Visas, travel costs spillovers, and international trade.

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Abstract

I study the relevance of business travel costs on international trade. I show that visa requirements are non-trivial and are significantly associated with lower trade. I also emphasize that non-business travel accounts for close to 80% of international travel and is therefore an important determinant of business travel cost. Motivated by these facts, I develop a model of international trade with heterogeneous firms where firms must undertake business travel to export. The model incorporates a travel sector that provides travel services to both tourists and business travelers, so the price of travel is determined in equilibrium. In the model, travel costs affect the extensive margin of firm participation to export. I calibrate the model to closely match international trade flows. I simulate two counterfactual scenarios: (i) reduced travel costs through improved airplane technology, and (ii) reduced fixed costs through relaxed visa policies. Preliminary findings indicate that a 25% reduction in travel costs between China and the EU due to lenient visa policies increases trade by 2.3%, while a 30% enhancement in airplane efficiency globally boosts trade by an average of 1.3%.

1 Introduction

The introduction of efficient long-range airplanes and wide-spread economic growth has resulted in a steady growth in demand for international travel, as witnessed in Figure 1. Traffic between countries has doubled on average, while the median country pair has seen an increase of about 50%. In addition to cheaper flights, countries have attempted to relax travel restrictions on incoming travelers. Recently, the Chinese government waived visa requirements for several countries[1], and the Gulf Cooperative Council (GCC) introduced the GCC permit for non-nationals in its member states[2] to enter and stay in any of the GCC members. The purpose of these policies is to encourage international travel by reducing barriers. Such changes in travel costs warrant an investigation in to their impact on business travel which is a small but essential component in facilitating international trade. So, in this paper, I ask what is the impact of travel costs on international trade flows?

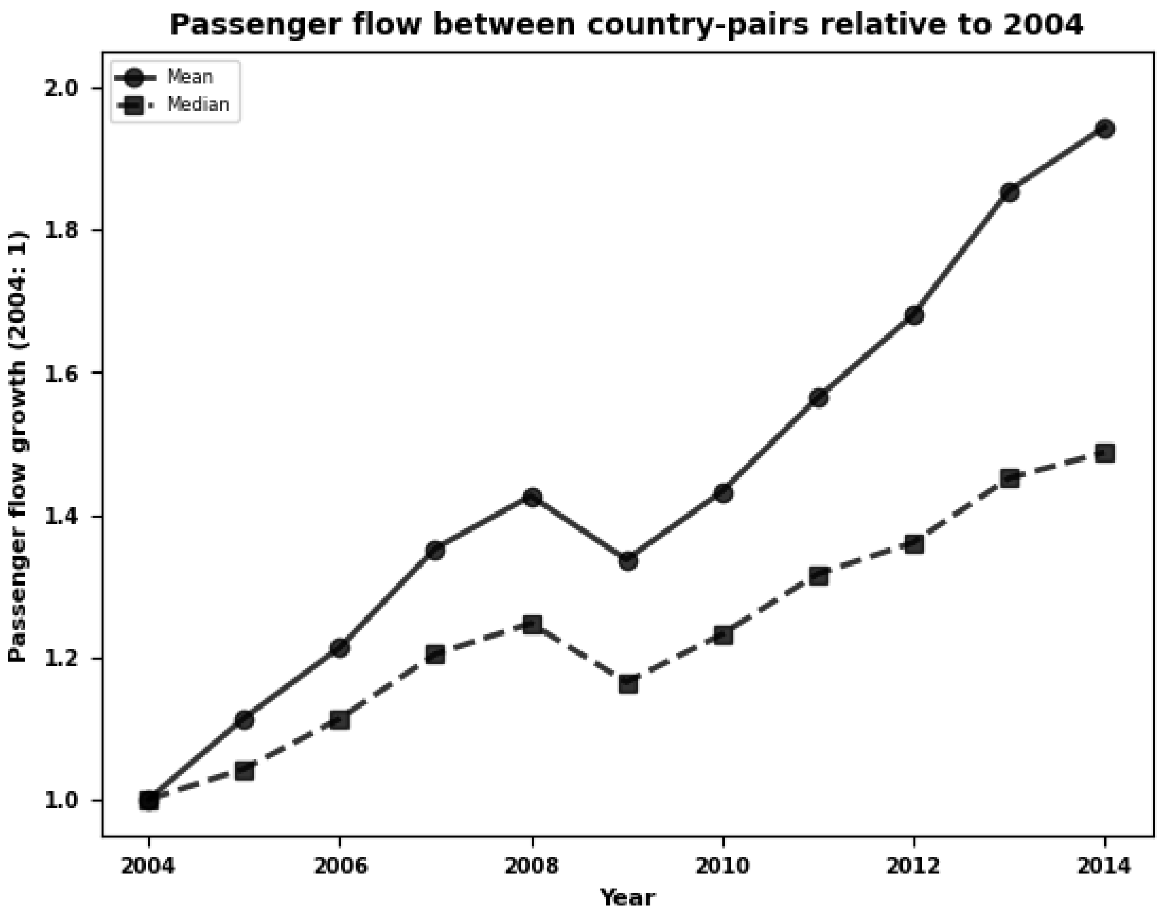

Figure 1: Mean and median growth in travelers between country-pairs relative to their 2004 levels. Only includes countries over 1000km apart to primarily factor air-travel.

[1]France, Germany, Italy, the Netherlands, Spain and Malaysia beginning December 2023, and for the US beginning January 2024

[2]Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates

Business managers engage in international travel to overcome informational and contractual frictions. Face-to-face interaction with business partners enables them to effectively transmit information and secure trust. However, travel is costly and requires careful planning, many months in advance of the actual trip. Travelers are responsible for searching and scheduling meets with relevant partners, reserving transport and lodging, arranging local currency, and securing immigration documents. These costs determine whether businesses undertake international travel, or how often they do. And so their choices regarding international travel affects international trade.

Furthermore, in addition to the direct costs, there is an entirely overlooked determinant of the cost of international business travel—tourists. International tourists and business travelers share the same travel infrastructure including airplanes, hotels, and immigration services. The combined demand for these services encourages their production and allows tourists and business travelers to benefit from each other's presence. But the two groups can overcrowd these resources, driving up the cost of travel for each other. The relative strength of these forces invariably influences the intensity of face-to-face interaction between business personnel across countries through business travel costs. Novel to this paper, I include this externality of tourism demand on business travel costs as a determinant of international trade flows.

I begin by showing that business travel constitutes a small portion of international travel ($\approx 20\%$) while tourism and other non-business related activities account for the majority of international travel. I then present evidence that visa costs are nontrivial, and are negatively associated with trade flows by showing that visa requirements to travel to a country are associated with lower exports to that country. On the basis of these facts, I develop a model of international trade with tourism and business travel, and a fixed cost to export. In the model, the price of tourism and business travel are jointly determined in equilibrium, thus linking changes in tourism demand to business travel costs. I calibrate the model to best fit existing trade flows and use it to study the simulate changes in visa policy and airplane technology and quantify their effect on trade flows.

There are two main challenges in quantifying the impact of travel costs on international trade. First, we lack data on travel costs. We do not observe the monetary price paid by travelers for flights or lodging. Additionally, travel costs are not constant between country pairs, even within a given period of time, and depend on the mode and route of transportation, as well as the time of reservation. So, we cannot directly observe the variation in travel costs and trade between countries and quantify their correlation. Second, travel and trade costs are largely determined by the same factors: geography, origin and destination factors, global economic fluctuations. So, co-variation in travel costs and international trade could be related to the variation in the common underlying determinants. So, even if we observed travel costs or used these observable measures to infer travel costs, relating their variation to trade could reflect direct changes in trade costs because of the common underlying factors, confounding the true relation between travel and trade.

I overcome these challenges by augmenting the canonical gravity framework for international trade flows with the presence of passport-affixed visa requirements between countries. Visas directly impact travel, not trade flows. They are imposed to restrict unwanted immigration and for the purposes of national security, and are therefore unrelated to the common determinants of travel and trade costs. By augmenting visa costs to the gravity framework, I am able to control for the common determinants of trade and travel: geography, origin and destination economy, as well as macroeconomic fluctuations, thereby leaving only variation in costs to travel associated with visas that can induce changes in trade through business travel.

Visa requirements vary widely between countries, and the process can be time-consuming and bureaucratic. Most countries require the passport of a traveler to be affixed with a paper visa prior to the international trip. According to the WTO, 47% of the world population still requires a traditional visa with a paper affixed to the passport. Visa processing delays and uncertainties can disrupt travel plans, and in turn disrupt international business transactions and collaborations.

A typical traveler obtains the paper visa in-person at a domestic office prior to the international trip. However this local office need not be close the site of production. For example, there are a total of 67 EU consulates and embassies in China that can grant a Schengen Visa (see section **??**). They are, however, all located in seven locations[3]. In 2023, the US embassy and consulates in India increased their staff to bring down the average wait time for an appointment from 1,000 days (32 months), to 250 days (8 months)! The average wait time across US consulates as of March 2024 is still more than 170 days, with some cities like Bogota experiencing wait times of 725 days. Furthermore, obtaining a visa is an uncertain process with rejection rates varying significantly across countries. The severity of visa enforcement can influence business travel decisions directly, or via reduced tourism which responds more elastically to travel costs.

The results from the gravity framework suggest that travel costs do impact

[3]Beijing, Shanghai, Guangzhou (Canton), Chengdu, Wuhan, Shenyang, Chongqing

international trade significantly. But without any further information on business travel, we are unable to comment on how changes in travel costs, as a consequence of better travel technology or laxer visa policies, can alter trade. This is partly due to the fact that we use the extensive margin of visa requirement in our gravity analysis, and so changes in visa policies that target the intensive margin can leave the extensive margin unchanged. Second, since we do not directly incorporate the price of travel, changes in technologies that are likely to lead to changes in travel prices are ignored by our gravity framework. We could have overcome this challenge by finding exogenous variation in travel prices. However, since travel costs and trade costs share their determinants, practically any exogenous variation in the former is almost always accompanied by exogenous variation in the latter and so cannot qualify as a credible instrument.[4].

In order to comment on counterfactual technological or policy scenarios, I extend a canonical model of international trade to feature tourism, business travel costs, and a travel sector. The model features a heterogeneous firm environment where firms incur a fixed cost to export. The fixed cost to export constitutes of travel costs that the firm incurs if it chooses to export to a specific destination. The presence of a fixed cost to export leads to a lower bound to firm productivity to export and determines trade flows conditional on this lower bound. On the household side, I augment the standard CES demand for tradable goods with demand for international tourism. Tourism consists of consuming public goods at the destination but incurs the cost of travel and accommodation. Separately, I model a travel production sector that produces a composite good for international travel and accommodation using labor from the destination country[5]. Thus the cost of travel is jointly determined by the demand for travel by firms and tourists. Finally, to capture the short-run dynamics of air-transport and hospitality sectors, travel sector is constrained by a fixed capacity with an upfront operation cost and must recuperate the cost of operating a route.

The are two key insights that the model delivers. First, the cost of travel effects international trade through the extensive margin of firm participation. Least productive firms cannot incur the cost of traveling and profitably export, and so they stay out of the international market. This is the standard mechanism of heterogeneous firms environment. Second, the capacity constraint on a route along with the cost of operating a given capacity leads to a non-monotonic

[4]Recent papers that makes some progress on this are Campante and Yanagizawa-Drott (2018), that incorporates the 9000km (12 hour threshold) for direct flights as an exogenous discontinuity in travel cost and Söderlund (2023) that exploits the freeing of the Soviet airspace as an exogenous reduction in travel time. I also attempted to use exogenous variation in travel costs for citizens from predominantly Muslim countries after 9/11 attacks (See Appendix).

[5]This can be extended to include labor from both origin and destination market.

relation between tourism and business travel costs. Low tourism can increase the cost of travel for businesses by forcing the travel sector to increase the price of travel while high tourism could crowd out business travel and increase cost for them. However, there exists a band in the middle for tourism demand where the price of business travel falls with an increase in tourism demand. This mechanism is unique to this paper.

I calibrate the model to match trade flows and then use the model to simulate changes in travel technology and visa policies. I use prices on flights and hotels from online sources to pin down the price of travel in the model. My preliminary results suggest that a 25% reduction in travel costs between China and the EU through lenient visa policy increases trade by 2.3%. Second, a 30% improvement in airplane efficiency enhances global trade by an average of 1.3%. The results are driven by an increase in lower productive being able to offer their products in international markets. So an increase in airline productivity could result in a decrease in the aggregate productivity measure.

The article contributes to three strands of literature: (i) determinants of trade costs, (ii) effects of tourism, and (ii) heterogeneous firms models in international trade featuring fixed costs to export.

It is well established that trade costs significantly shape trade flows around the world, and the sources of trade costs include transportation costs (Anderson and Van Wincoop (2004), Brancaccio et al. (2020)), informational, communication, and contracting frictions (Startz (2021), Poole (2009), Arkolakis (2010), Allen (2014), Guillouet et al. (2021)), and political costs (Fajgelbaum and Khandelwal (2022)). Using a regulatory discontinuity in flight operating costs around 9000 km distance between city-pairs, Campante and Yanagizawa-Drott (2018) show exogenous variation in business links determining economic outcomes. Söderlund (2023) estimates the impact of reduced air travel time on international trade using the liberalization of the Soviet airspace as a quasi-natural experiment that reduced travel time and encouraged business travel. Similarly, Blonigen and Cristea (2015) use the changes in air traffic induced by the 1978 Airline Deregulation Act in the US to link business travel to local economic growth. Umana-Dajud (2019) used the removal of Ecuador and Bolivio from the EU schengen waiver as an exogenous increase in travel costs and find a strong negative relation between exclusion from visa waiver and trade flows between them and the EU. Contrary to most of the findings, Neiman and Swagel (2009) used changes in the intensity of visa requirements in the US after 9/11 attacks for certain Latin American countries and find that visas do not hinder trade. In contrast to these papers, my study includes all the countries in the world, and proxies travel costs by augmenting the gravity framework with visa costs. My specification is able to include origin-year and destination-year fixed effects, thus delivering a highly robust relation between travel costs and trade.

The limited availability of data compels the use of structural tools to quantify the role of tourism on business travel. So the paper adds to a growing list of quantitative trade models featuring heterogeneous firms and fixed costs to export as in Melitz (2003) and Chaney (2008). In my model, firms incur fixed costs to export in a foreign country by sending managers to that country. The price of business travel depends on the capacity available on airplanes after tourism demand is met and thus is influenced by tourism demand. Thus the fixed costs are an equilibrium outcome in my model. Eaton et al. (2011) endogenize this fixed costs differently by relating them to marketing costs and allowing them to depend on the size of the destination market. Related to modeling tourism, Faber and Gaubert (2019) models demand for tourism in a spatial model of economic activity to quantify the local impact of tourism demand. So their model does not feature either business travel or the interdependence of tourism with business travel. Finally, related to modeling business travel, Antràs et al. (2023) model business travel in a canonical model of international trade and augment it with the epidemiological SIRD model to study the role of business travel in the spread of pandemics. Their model is also silent on the interplay between tourism and business travel.

Finally, this paper also contributed to a nascent but growing literature on the economic impact of tourism. Faber and Gaubert (2019) and Allen et al. (2020) study the impact of tourism on the local economy with the former focusing on Mexico while the latter on Barcelona. The focus of these articles on the effects of tourism on the local economy ignores the role of the shared infrastructure between tourists and business travelers. Therefore, the impact of tourism on the local economy could also happen by its impact on international trade via business travel. This is the first paper to make that connection and to model it in a quantitative framework.

The rest of the paper is organized as follows. In section 2, I describe the data used in this analysis. In section 3 the empirical evidence on the composition of international travel, and the impact of visa costs on international trade. Then in section 4 I develop the heterogeneous firm model of this paper. In section 5, I estimate the parameters of the model and simulate the counterfactual scenarios. Section 6 concludes.

2 Data

In order to test the relation between travel costs and trade, I compile data on international trade, travel flows, and travel restrictions from various sources[6].

2.1 International trade

I obtained the data on trade flows form the US International Trade Commission's *International Trade and Production Database for Estimation* (ITPD-E) database that contains industry-level trade flows between country-pairs from 2000 to 2016. It is administratively reported from several country sources and the is provided without any extrapolation of missing information using any model[7]. The unbalanced panel consists of 170 industries across agriculture, mining and energy, manufacturing, and service sectors from 243 countries. I aggregate over all industry-level exports from an exporter-importer pair to compute trade flows from an exporter to an importer. My sample consists of trade flows between 1234 country-pairs between 2000 and 2016. I exclude travel exports (industry code: 157) from my analysis and focus on the indirect affects of travel costs on trade.

2.2 Visa requirements

To know which origin-destination pair require a visa, I use the Determinants of International Migration (DEMIG) database provided by the International Migration Institute, University of Oxford. It records visa requirements between origin-destination pairs from 1973 to 2013. The source of this information is the Travel Information Manuals that are released monthly by the IATA (International Air Transport Association). The January manuals are used to populate the DEMIG database.

Since the period of trade data that I use is between 2000 and 2016, I restrict the DEMIG dataset to between 2000 and 2013. I supplement the remaining years (2014-2016) of visa restrictions from the Global Visa Costs (GVC) database constructed by Recchi et al. (2020). The GVC data is constructed manually and by web-scraping consulate/embassy/ministry websites, and contains information on visa processing fees associated with seven broad visa categories in 2019: (1) tourist, (2)student, (3) business, (4) work, (5) family reunification, (6) transit, and (7) other motives. Since the focus of my study is on short-

[6]All the data I use in this analysis is publicly available with the exception of the World Tourism Organization data. This data can be obtained by submitting a research proposal to the UN WTO. I will provide a link to each one of these in their respective sections.

[7]The data is sourced from FAOSTAT, COMTRADE, MISTAT, UNIDO, INDSTAT, WTO-UNCTAD-ITC, and UN TSD. Source: Borchert et al. (2021).

term immigration, I restrict myself to tourist and business visas, and check for origin-destination pairs where the fees for these visa categories is positive. I find that no country pair changed their visa requirements between 2013 and 2019 and thus I am able to extrapolate the visa requirements from 2013 to 2016 in the DEMIG database[8].

2.3 EU Visa (applications and rejection) rates

I obtain visa application and rejection rate at European consulates around the world between 2011 to 2016 from EU's home affairs website. I compute the aggregate number of applications and rejections by origin. The Schengen visa is primarily valid for the duration of the trip with a single entry-exit and a multi entry-exit option. The majority of the visas issued are single entry during the period of my sample with variation across countries.

2.4 International travel

I obtained inbound trips data from the UN World Tourism Organization that records temporary cross-border movement for personal or business purposes. The data is obtained from immigration offices and border controls, border surveys or a mix of them. The data measures the flows of international visitors to a country where each arrival is treated as a single trip. So if an individual travels to a country multiple times, the WTO records it separately. If an individual visits multiple countries in a single trip, each country is recorded as a separate trip. While the first mode of recording is appropriate for our context, the second recording methodology diverges from the model where each exporting choice is a separate decision. So the possibility of trade with countries close to existing trade partners, as highlighted in Chaney (2014) is excluded from my model. My choice of modeling is primarily driven by the need for simplicity and a more sophisticated modeling choice is left for future.

Another important point for this data is that border, seasonal and other short-term workers, long-term students are excluded and so the data prominently captures tourism or business travel. In addition to recording aggregate bilateral flows by country pairs, the data also records at country-level the total number of tourists, and business travelers separately. The period for the data is 1995 to 2020.

3 Empirical analysis

[8]According to GVC database there is a positive fees of travel between USA and EU but this is primarily incurred using an online portal and so the DEMIG database labels this arrangement as visa-free travel.

3.1 International travel is largely non-business

I first show that the evolution of the mean composition of travel across destinations. The data ranges from 1995 to 2019, and for each year, I take the average share of passengers that arrive for business purposes. In figure 2, I plot this share. We note that business travel accounts for a small fraction on most routes hovering around the 20% market and remaining stable over this long-horizon[9]. From the figure it is evident that non-business travel is an essential ingredient in determining the equilibrium price of travel and therefore can effect the cost faced by business travelers.

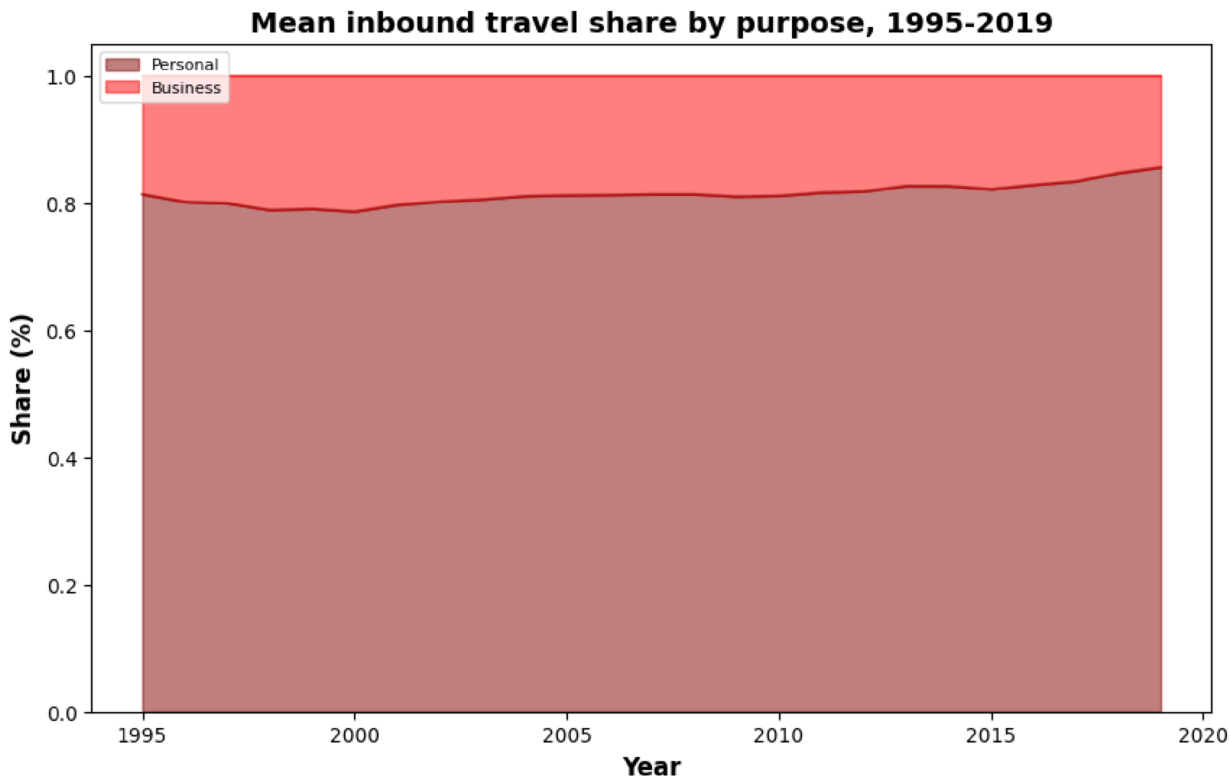

Figure 2: The figure plots the mean share of business travelers across countries in each year. Suppose b_{it} is the share of business travelers that arrive to country i in year t (so the share of leisure or non-business travelers is $(1 - b_{it})$), then for each year t, I compute $b_t = \frac{1}{N_t}\sum_i b_{it}$. Here N_t is the total number of countries for which the composition data is available.

In the model I combine this with the fact that business travel is less elastic, and more costly (Aryal et al. (2021)) to allow the price for tourism to be competitively set to the marginal cost of travel while allowing the travel sector to hold monopoly power over business travelers and charge them over the marginal cost. The setup however does not allow for business travel demand to influence the price of tourism.

[9]This is consistent with the estimates provided by the National Travel and Tourism Office from their Survey of International Air-travelers. The NTTO estimated that in 2018, 4.4m visitors, or 11% of the total visitors that arrived to the US came to visit customer or supplier or for sales/marketing or internal company meeting, and another 2.6m (6.5%) arrived for convention, conference or trade shows. In contrast, 30.8m (77.1%) visitors arrived for tourism or visiting family.

3.2 Nature of visa costs.

Visa regimes vary in their requirements, ranging from a valid passport to extensive documentation and physical presence. Most countries require a valid permit in addition to a valid passport to allow an international traveler to enter their borders. In some cases these permits can be obtained quickly through an online application or application on arrival at the destination and is usually the fastest way to enter a foreign destination. On the other hand, several countries require in-person verification of documentation at a local consulate, which need not be near the site of production.

For example, travel to twenty-seven European countries[10] is regulated by the Schengen visa requirement. A Schengen visa allows nationals from any country to travel to any of the Schengen countries and travel freely within them (as long as the visa is valid). Travelers are required to submit a completed visa application form, provide a valid passport, and offer proof of their travel itinerary, including round-trip travel reservations and accommodations. They are also required to show evidence of financial means sufficient to support themselves during their stay. Additionally, applicants must have travel medical insurance covering any expenses which might arise in connection with repatriation for medical reasons, urgent medical attention, and/or emergency hospital treatment. The insurance must have a minimum coverage of €30,000. Schengen visas are usually granted for short stays of up to 90 days within a 180-day period. However, the specific type and duration of the visa issued can vary based on the applicant's travel purpose, itinerary, and individual circumstances.[11].

The application process for both, the US and the EU, typically involves attending an interview and submitting bio-metric data at the embassy or consulate

[10] Austria, Belgium, Czech Republic, Croatia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Italy, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, and Switzerland.

[11] Similarly, to travel to the US, the primary category for short-term stay (less than six months) is called the B1/B2 visas and are valid for ten years. The holders of this visa can travel over this period to the US for either vacation, availing medical support or business during the period of validity. To obtain a B1/B2 visa, the applicant must demonstrate their intention to return to their home country after their temporary stay in the U.S. This involves providing evidence of strong ties to their home country, such as employment, family, property, or other commitments that indicate they will not overstay their visa. The application process includes filling out the DS-160 form online, paying the required visa application fee, and scheduling an interview with a U.S. consulate or embassy. During the interview, applicants are expected to present documentation supporting their application, such as proof of financial stability, an itinerary of their planned activities in the US, and any ties to their home country. The consular officer will evaluate the application to ensure that the applicant meets the visa requirements and is not inadmissible under U.S. immigration law. On the other hand, if citizens from EU member states intend to travel for a short duration (less than 90 days) to the US, then under a Visa Waiver Program (VWP) they can travel to the US for tourism or business purposes for stays of 90 days or less without obtaining a visa. They however, need to apply for authorization through the Electronic System for Travel Authorization (ESTA) before the trip. This is done online in minutes, and requires a fee of $14 to $21. The process for an American citizen to travel to the EU is simpler requiring only a valid passport for a 180-day trip.

of the country that is the main destination of the visit. In figure 3, I map the cities where an EU Schengen visa can be obtained. As can be seen from India, China and Brazil, there are large portions of land where there are no offices and a business manager must travel to the nearest consulate to obtain a Schengen Visa. We observe that even if the the travelers is able to obtain and present the document, they need to travel to one of only a handful of cities to present their case thereby adding substantial burden on the traveler.

Global presence of EU state consulates and embassies.

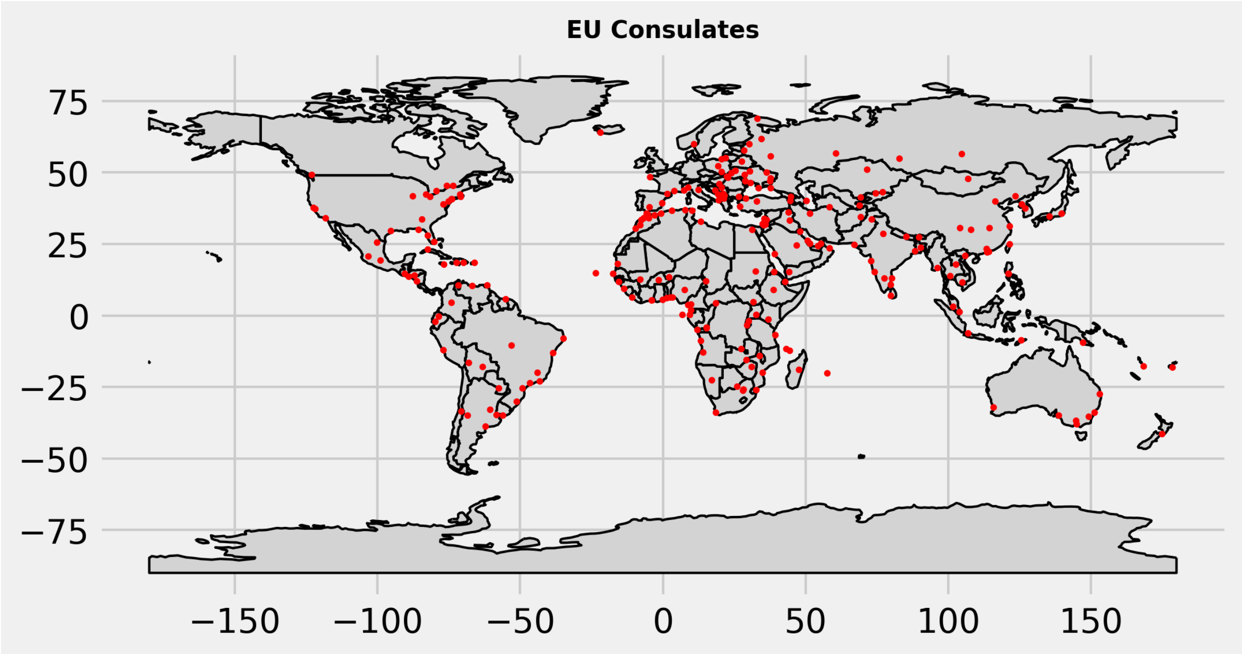

Figure 3: Each red dot represents a city where at least one of the EU states has a consulate or embassy. In most of these cities, there are multiple countries with their local office. Data source

In addition to the fixed cost of visiting a local consulate for verification, there remains an uncertainty around approval. During the interview, applicants should be prepared to answer questions about their travel plans, purpose of visit, and background. The visa requirements to these countries are stringent, and so there is a likelihood that a visa can be rejected. In each of the cases, the decision to grant or deny the visa is at the discretion of the consular officer based on the interview and the submitted documentation. In figure 4, I show the visa rejection rate for the EU around the world. As can be verified this is concentrated in developing countries, especially countries with a large Islamic population.

Visa requirements are, however, not restricted to entering advanced economies. For example, prior to 2024, travel to China, like the EU, required travelers to submit round-trip air tickets, proof of hotel reservations, itineraries or invitations to China to a local consulate or embassy in person[12]. So, US citizens

[12]This changed for US citizens from 01st January, 2024 (Source). This was in addition to a visa waiver

Schengen visa rejection rate by EU states.

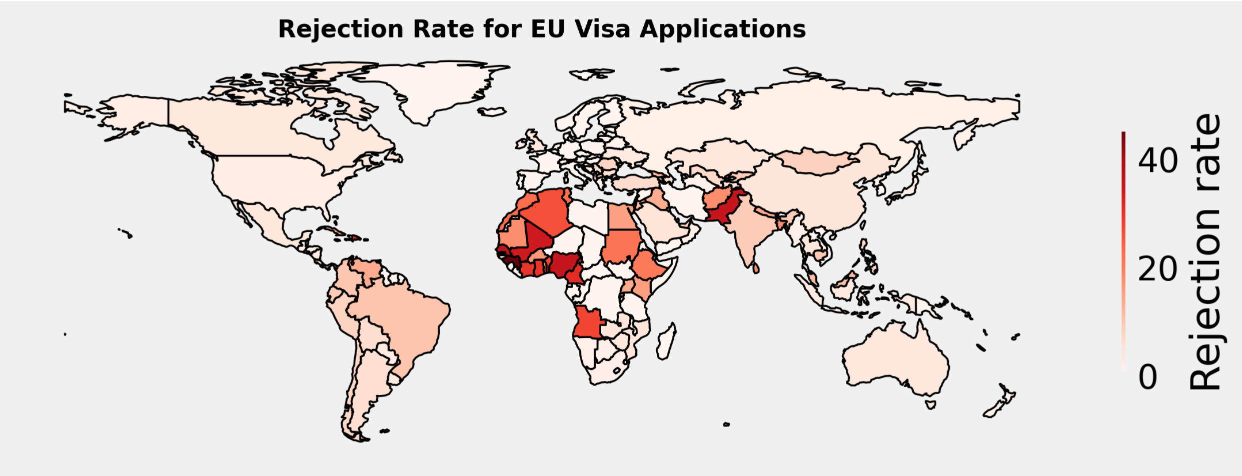

Figure 4: The rejection rates are computed as the average rejection rate between 2011 and 2016. Data source

traveling to China must present themselves at one the six Chinese consulates located in the US[13]. Thus visa restrictions are still a strong force in determining travel costs. In the next section we use this information to present evidence on the relevance of travel costs in determining international trade flows.

3.3 Visas hinder trade.

I employ the structural gravity framework to show that visa requirements are a part of international trade costs. The gravity framework is the workhorse empirical framework for international trade flows and is consistent with several trade theories. I augment it with information on whether short-term travel between country pairs is subject to visa requirement on both sides. I follow the recommendations set forth in Piermartini and Yotov (2016) for structural gravity estimations and estimate the model using the Poisson Pseudo Maximum Likelihood (PPML) estimator. My specification is:

$$X_{nit} = \exp\left[\beta_0 + \beta_v v_{ni} + \beta_d d_{ni} + \delta_l + \delta_b + \delta_c + \delta_{it} + \delta_{nt}\right] + \epsilon_{nit} \qquad (1)$$

X_{nit} is the total exports from exporter i to importer n in year t. d_{ni} is the log of distance (in km) between the country pair. δ_l is the coefficient on a language indicator that indicates if the pair share the same official language. δ_b is the coefficient on a border indicator that indicates if the pair share a border. δ_c is the coefficient on a colony indicator that indicates if the pair share a colonizer. δ_{it} and δ_{nt} are exporter-year and importer-year fixed effects that capture the multilateral resistance indexes.

from France, Germany, Italy, the Netherlands, Spain and Malaysia beginning 1st of December, 2023. (Source)

[13]Washington D.C, New York City, San Francisco, Los Angeles, Chicago, and Austin

v_{ni} is an indicator variable that indicates if citizens of i or n must present themselves in-person at a local office to obtain a visa to travel to the other country. Our coefficient of interest is β_v. This specification of gravity regression, including the extensive margin of visa requirement, has the advantage of simplicity of interpretation. β_v identifies the average impact of the presence of visas requiring approval from local authorities across channels discussed in section 3.2. It cannot tell us if the relation is driven by the fixed cost or the uncertainty of obtaining the visa, or the resulting change in extensive or intensive margin of firm participation. This remains open to further investigation.

In table 1, I present results for the model specified in equation 1. Both, the OLS and PPML methods yield insightful findings regarding the impacts of visa policies on international trade and migration flows. When augmented with visa requirements, OLS estimates that the presence of visa restriction is associated with 0.5% less exports. In contrast, the PPML estimates the same relation at 0.15% lower trade. The PPML estimates is our preferred estimates since it is robust to issues like heteroscedasticity and zero trade that is common in trade data. These findings can be informative to policymakers that are involved in the regulating travel. Tourism regulation overlooks business travel and related trade, and the regressions here shed light on these indirect associations.

Table 1: Estimates from Gravity regressions

	OLS			PPML		
	(1)	(2)	(3)	(4)	(5)	(6)
Visa required		**-0.435*****	**-0.023**		**-0.153***	**-0.077**
(Exporter to Importer)		(.031)	0.03		(.062)	0.07
Distance (km, log)	-1.548***	-1.442***		-0.746***	-0.659***	
	(.020)	(.023)		(.032)	(.038)	
Shared Border	0.774***	0.733***		0.310***	0.259**	
	(.113)	(.121)		(.069)	(.079)	
Shared Language	0.784***	0.650***		0.152*	0.223**	
	(.039)	(.042)		(.068)	(.070)	
Trade agreement	0.650***	0.770***		0.321***	0.539***	
	(.040)	(.062)		(.059)	(.084)	
Pair-FE	N	N	Y	N	N	Y
N	455,975	326,137	325,210	629,269	444,461	441,206
Adjusted-R2	0.729	0.722	0.827	0.946	0.948	0.982

4 Model

Motivated by the evidence presented in this section, I incorporate business travel and tourism in a model of international trade. The global economy consists of S countries indexed by i, j. Each country, i is endowed with labor

L_i which is the only factor of production. The countries are populated by a measure of firms N_i. Each firm produces a single good and holds monopoly power over that good. International trade is subject to iceberg trade costs, and fixed costs that firms must incur to sell in a market. Each country also produces tourism service that can be consumed internationally by undertaking travel. Travel is costly and incurs iceberg-like costs.

4.1 Household

Preferences in country i are given by:

$$U_i = \left(\int_{\Omega_i} q_i^T(\omega)^{\frac{\sigma-1}{\sigma}} d\omega \right)^{\left[\frac{\sigma}{\sigma-1}\right]\mu} \Pi_j (q_{ji}^V)^{\mu_j} \tag{2}$$

where $q_i^T(\omega)$ is the quantity of **T**raded variety ω consumed by the consumer and Ω_i is the set of varieties available to consumers in country i. q_{ji}^V is the quantity of tourism (or tra**V**el or **V**acation) services consumed by i from j. I assume that $\mu + \sum_{j=1}^{S} \mu_j = 1$, and $\sigma > 1$. μ represents the expenditure share in tradable goods and services. μ_j is the expenditure share on tourism from country j. σ is the elasticity of substitution within tradable varieties.

So, the expenditure share in i on the variety ω from j is given by:

$$\frac{p_{ij}^T(\omega) q_{ij}^T(\omega)}{Y_i} = \mu \left(\frac{p_{ij}^T(\omega)}{P_i^T} \right)^{1-\sigma} \tag{3}$$

where P_i^T denotes the price index for tradable varieties in country i.

And the expenditure share on tourism service from country j is given by:

$$\mu_j = \frac{p_{ji}^V q_{ji}^V}{Y_i} \tag{4}$$

where Y_i is the total income of the country. It is the sum of total wage income and dividends from profits discussed later.

4.2 Tradable varieties

Tradable goods are monopolistically produced by firms using only labor. Each firm draws a random unit labor productivity φ. The mass of firms that receive a productivity draw from the pareto distribution is equal to N_j. The cost of producing $q_{ij}^T(\omega)$ units of good ω and exporting it to i for a firm with productivity φ is given by:

$$c_{ij}(q_{ij}^T(\omega), \varphi) = \frac{w_j \tau_{ij}^T}{\varphi} q_{ij}^T(\omega) + f_{ij} \tag{5}$$

where w_j is the wage in i, τ_{ij}^T is the iceberg trade cost (**for exporting from j to i**), and f_{ij} is the fixed cost incurred to initiate trade for a firm in j to sell in i. Note that each firm produces a specific variety. I identify the variety by the productivity level of the firm that produces it.

So the price faced by a consumer in i for a variety with productivity φ from i is given by:

$$p_{ij}^T(\varphi) = \frac{\sigma}{\sigma - 1}\frac{w_j \tau_{ij}^T}{\varphi} \tag{6}$$

Firm productivity is drawn from a Pareto distribution with shape parameter, γ. Upon receiving their productivity draws firms decide whether to enter a market based on their profitability after paying the fixed costs. This results in a lower bound for productivity for firms in each country j to export to another country i.

Let $\bar{\varphi}_{ij}$ denote the lowest productivity firm from j exporting to i, then the price index P_i^T is given by:

$$P_i^T = \left(\sum_{j=1}^{S} N_j \int_{\bar{\varphi}_{ij}}^{\infty} \left(\frac{\sigma}{\sigma - 1}\frac{w_j \tau_{ij}^T}{\varphi} \right)^{1-\sigma} dF(\varphi) \right)^{\frac{1}{1-\sigma}} \tag{7}$$

where $F(\cdot)$ is the CDF of a Pareto distribution with shape parameter γ.

4.2.1 Firm's export choice

The profit for a firm in j exporting to i and productivity φ is given by:

$$\pi_{ij}(\varphi) = p_{ij}^T(\varphi) q_{ij}^T(\varphi) - c_{ij}(q_{ij}^T(\varphi), \varphi) = \frac{\sigma}{\sigma - 1}\frac{w_j \tau_{ij}^T}{\varphi} q_{ij}^T(\varphi) - \frac{w_j \tau_{ij}^T}{\varphi} q_{ij}^T(\varphi) - f_{ij} \tag{8}$$

Only firms with non-negative profits export to a given country which determines the productivity threshold, $\bar{\varphi}_{ij}$ where the firm is indifferent between exporting and not. So,

$$\bar{\varphi}_{ij} = \left(\frac{\sigma}{\mu} \right)^{\frac{1}{\sigma-1}} \left(\frac{\sigma}{\sigma - 1} \right) \frac{w_j \tau_{ij}^T}{P_i^T} \left(\frac{f_{ij}}{Y_i} \right)^{\frac{1}{\sigma-1}} \tag{9}$$

We can re-write the price index as follows:

$$P_i^T = \lambda Y_i^{\frac{1}{\gamma} - \frac{1}{\sigma-1}} \left[\sum_j N_j \left(w_j \tau_{ij}^T \right)^{-\gamma} \left(f_{ij} \right)^{\frac{\sigma-1-\gamma}{\sigma-1}} \right]^{-\frac{1}{\gamma}} \tag{10}$$

where $\lambda = \left(\frac{\sigma}{\sigma-1}\right)\left(\frac{\gamma}{\gamma+1-\sigma}\right)^{-\frac{1}{\gamma}}\left(\frac{\sigma}{\mu}\right)^{\frac{1}{\sigma-1}-\frac{1}{\gamma}}$.

$\left[\sum_j N_j \left(w_j \tau_{ij}^T\right)^{-\gamma} \left(f_{ij}\right)^{\frac{\sigma-1-\gamma}{\sigma-1}}\right]$ is the multilateral resistance, and is denoted by θ_i.

We are now ready to express the threshold productivity in-terms of the model parameters and equilibrium objects.

Proposition 1. *The productivity threshold for exporting by a firm in j to a country i , $\bar{\varphi}_{ij}$ is given by*

$$\bar{\varphi}_{ij} = \left(\frac{\sigma}{\mu}\right)^{\frac{1}{\gamma}} \left(\frac{\gamma}{\gamma+1-\sigma}\right)^{\frac{1}{\gamma}} \left(w_j \tau_{ij}^T\right) \theta_i^{\frac{1}{\gamma}} Y_i^{-\frac{1}{\gamma}} \left(f_{ij}\right)^{\frac{1}{\sigma-1}} \tag{11}$$

Proposition 1 highlights that the threshold of productivity is an increasing function of travel costs, i.e, as travel costs increases the productivity of the least productive firm that exports increases. This is the mechanism through with travel costs affect international trade. Higher travel costs prevent less productive firms from entering the international market.

4.2.2 Profits and dividends

The firms generate positive profits. These profits are accumulated in a global fund, and distributed as dividends across households in each country. Each household in country j owns w_j shares of the global fund as in Chaney (2008). So, if π is the dividend per share issued by the global fund, the total income of country j, Y_j is given by:

$$Y_j = w_j L_j + L_j(\pi w_j) \tag{12}$$

The total profits, Π are given by:

$$\Pi = \sum_i \sum_j N_j \int_{\bar{\varphi}_{ij}}^{\infty} \pi_{ij}(\varphi) dF(\varphi) \tag{13}$$

Since each household in country j holds w_j shares, and there are L_j households, the total outstanding shares of the global fund are $\sum_j w_j L_j$, and the dividend per share is:

$$\pi = \frac{\Pi}{\sum_j w_j L_j} = \frac{\frac{\sigma-1}{\sigma}\frac{\mu}{\gamma}}{1 - \frac{\sigma-1}{\sigma}\frac{\mu}{\gamma}} \tag{14}$$

4.3 Business travel

I interpret the fixed cost incurred to export, f_{ij} as travel costs. The firm in j must send managers to i to initiate an export transaction and so incur an upfront business travel cost. I assume that it depends on the number of people/trips needed to initiate trade, ϕ, the price paid per person which is denoted by P^B_{ij}, and whether there is a visa requirement between countries or not. So,

$$f_{ij} = \phi p^B_{ij} + \psi \tag{15}$$

p^B_{ij} is the price charged by the travel industry to business travelers from j to i, and is determined in equilibrium. ϕ captures the degree of contractual or information frictions present and can vary along several dimensions including industry, as well as origin and destination country. ψ represents visa costs (and can be extended to be pair specific).

Using the fixed cost structure, and the fact that the total demand for business travel is the firm aggregated demand for international travel, we can compute the demand curve for business travel.

Proposition 2. *The total demand for business travel from j to i to initiate exports from j at price p^B_{ij} is:*

$$q^B_{ij} = \kappa Y_i \frac{N_j\left(w_j \tau^T_{ij}\right)^{-\gamma}\left(\phi p^B_{ij} + \psi_{ij}\right)^{-\frac{\gamma}{\sigma-1}}}{\sum_k N_k\left(w_k \tau^T_{ik}\right)^{-\gamma}\left(\phi p^B_{ij} + \psi_{ij}\right)^{1-\frac{\gamma}{\sigma-1}}} \tag{16}$$

Proof:

$$\begin{aligned}
q^B_{ij} &= \int_{\bar{\varphi}_{ij}}^{\infty} N_j \phi dF(\varphi) = N_j \phi (1 - F(\bar{\varphi}_{ij})) = N_j \phi \bar{\varphi}_{ij}^{-\gamma} \\
&= \phi \underbrace{\frac{\mu}{\sigma} \frac{\gamma + 1 - \sigma}{\gamma}}_{\kappa} \frac{Y_i}{f_{ij}} \frac{N_j\left(w_j \tau^T_{ij}\right)^{-\gamma}\left(f_{ij}\right)^{\frac{\sigma-1-\gamma}{\sigma-1}}}{\theta_i} \\
&= \kappa Y_i \frac{N_j\left(w_j \tau^T_{ij}\right)^{-\gamma}\left(\phi p^B_{ij} + \psi_{ij}\right)^{-\frac{\gamma}{\sigma-1}}}{\sum_k N_k\left(w_k \tau^T_{ik}\right)^{-\gamma}\left(\phi p^B_{ij} + \psi_{ij}\right)^{1-\frac{\gamma}{\sigma-1}}}
\end{aligned}$$

This is the demand curve for business travel. A rather strange point to note is that if visa costs did not exist, that is if $\psi = 0$, the curve is independent of ϕ, the number of travelers the firm sends to initiate trade (which is a measure of contracting / informational frictions). This is because an increase in contracting frictions decreases the number of firm exporting, but since those firms have to send more managers to export, the total demand for business travel remains unchanged.

4.4 Travel services

Tourists travel to consume tourism and business travelers travel to conduct business. In this model, I treat tourism and air-travel jointly as a single good produced by a representative firm in each country. I do this to circumvent the problem of modeling two separate sectors that are complementary.

The firm operating from a destination i produces travel services to bring people to i using a linear production technology with only local labor:

$$Q_i = z_i^V L_i^V \tag{17}$$

where z_i^V is a country specific productivity parameter.

Each destination (i) and origin (j) pair is endowed with an exogenous capacity of *seats*, F_{ij}. Furthermore, the firm pays an upfront fixed cost f per unit of capacity. So the total fixed cost of operating a route is fF_{ij}. For a route to be feasible, the firm must recover at least the total fixed cost of operation by selling at most F_{ij} seats to tourists and business travelers combined. So the firm faces two constraints:

$$q_{ij}^V + q_{ij}^B \leq F_{ij} \tag{18}$$

and

$$p_{ij}^V q_{ij}^V + p_{ij}^B q_{ij}^B \geq fF_{ij} \tag{19}$$

The firm sells tickets to tourists competitively at marginal cost but tourist incur an ice-berg like cost, τ_{ij}^V as in Faber and Gaubert (2019). The price of ticket faced by tourist in j to travel to i is given by:

$$p_{ij}^V = \frac{\tau_{ij}^V . w_i}{z_i^V} \tag{20}$$

I make two assumptions based on evidence (Aryal et al. (2021)) to make business travel different from tourists: business travelers purchase their tickets after tourists, and the travel service firm has monopoly power in serving business travel demand. So the firm maximizes profits by taking business travel demand in proposition 2 as given and sets p_{ij}^B subject to constraints in 18 and 19. Thus the firm's business travel pricing problem becomes:

$$\begin{aligned} \max_{p^B_{ij}} \; p^B_{ij} q^B_{ij} - \frac{w_i \tau^V_{ij}}{z^V_i} q^B_{ij} \quad & \text{Subject to} \\ q^B_{ij} \leq F_{ij} - \mu_i Y_j \frac{z^V_i}{\tau^V_{ij} w_i} \quad & \text{and} \\ p^B_{ij} q^B_{ij} \geq f F_{ij} - \mu_i Y_j & \end{aligned} \tag{21}$$

where q^B_{ij} is given by 16. In the above optimization problem, $p^V_{ij} q^V_{ij}$ has been replaced by $\mu_i Y_j$ in 19, and $p^V_{ij} = \frac{\tau^V_{ij}.w_i}{z^V_i}$ in 18.

This setup resembles the monopoly pricing with demand uncertainty and price rigidities that is described in Stole (2007). I differ from Stole (2007) in the fact that demand is not uncertain in my setup but heterogeneous where the heterogeneity in the consumers is reflective of the two states that the producers face in that setup. Second, my model features a temporal dimension where the households are served first, and the business travelers are served after the household demand is satisfied.

Depending on the parameters of the model, three solution possibilities emerge: two for corner, and one interior solution.

1. **Case 1 (Interior solution):** In this case, neither of the constraints bind and we can safely ignore them in maximizing the objective function. So the price satisfies the following first order condition:

$$q^B_{ij} = \left(\frac{w_i \tau^V_{ij}}{z^V_i} - p^B_{ij} \right) \frac{\mathrm{d}q^B_{ij}}{\mathrm{d}p^B_{ij}} \tag{22}$$

2. **Case 2 (Low tourism demand):** In this case the capacity constraint 18 is not binding, but the monopoly price is so high that it generates demand such that the total revenue fails to clear the 19. So the firm sets price such that 19 binds (and 16 is satisfied), that is:

$$p^B_{ij} q^B_{ij} = f F_{ij} - \mu_i Y_j \tag{23}$$

3. **Case 3 (High tourism demand):** Finally, when the combined demand is so high that $q^V_{ij} + q^B_{ij} > F_{ij}$ at the monopoly price, the firm charges business travelers a price higher than monopoly price to reduce business travel demand upto the point where the capacity constraint, 18 binds:

$$q^B_{ij} = F_{ij} - q^V_{ij} \tag{24}$$

and the firm recovers the price, p^B_{ij} from 4.3.

Any profits from the tourism/travel sector from business travelers are treated as dead-weight losses. The primary purpose of this assumption is to simplify the total income of the country and not have to compute profits from this problem to add to equation 11.

4.5 International trade flows

To compute the aggregate trade flow between countries, we integrate the revenues of all exporting firms. So, the total exports from country j to country i is given by:

$$\begin{aligned} X_{ij} = N_j \int_{\bar{\varphi}_{ij}}^{\infty} p_{ij}(\varphi) q_{ij}(\varphi) dF(\varphi) &= \mu Y_i \left[\frac{N_j \left(w_j \tau_{ij}^T\right)^{-\gamma} \left(f_{ij}\right)^{\frac{\sigma-1-\gamma}{\sigma-1}}}{\sum_k N_k \left(w_k \tau_{ik}^T\right)^{-\gamma} \left(f_{ik}\right)^{\frac{\sigma-1-\gamma}{\sigma-1}}} \right] \\ &= \mu Y_i \left[\frac{N_j \left(w_j \tau_{ij}^T\right)^{-\gamma} \left(\phi p_{ij}^B + \psi\right)^{\frac{\sigma-1-\gamma}{\sigma-1}}}{\sum_k N_k \left(w_k \tau_{ik}^T\right)^{-\gamma} \left(\phi p_{ij}^B + \psi\right)^{\frac{\sigma-1-\gamma}{\sigma-1}}} \right] \end{aligned} \tag{25}$$

An important outcome of this characterization emerges from the fact that by combining equation 16 and 25, we find that $p_{ij}^B q_{ij}^B = \frac{\kappa}{\mu} X_{ij}$, i.e, business travel expenditure is a constant share of trade (exports from j to i). This information helps us with the calibration of the model.

4.6 Equilibrium Characterization

Here I collect all the equilibrium governing equations of this economy

1. Demand:

$$\mu_j = \frac{p_{ji}^V q_{ji}^V}{Y_i}$$

$$X_{ij} = \mu Y_i \left[\frac{N_j \left(w_j \tau_{ij}^T\right)^{-\gamma} \left(\phi p_{ij}^B + \psi\right)^{\frac{\sigma-1-\gamma}{\sigma-1}}}{\sum_k N_k \left(w_k \tau_{ik}^T\right)^{-\gamma} \left(\phi p_{ij}^B + \psi\right)^{\frac{\sigma-1-\gamma}{\sigma-1}}} \right]$$

2. Total Income:

$$Y_i = w_i L_i + L_i(\pi w_i) \quad \text{where} \quad \pi = \frac{\frac{\sigma-1}{\sigma}\frac{\mu}{\gamma}}{1 - \frac{\sigma-1}{\sigma}\frac{\mu}{\gamma}}$$

3. Tourism and business travel:

$$p_{ij}^V = \frac{\tau_{ij}^V . w_i}{z_i^V}$$

$$q_{ij}^B = \frac{\mu}{\sigma}\frac{\gamma+1-\sigma}{\gamma}Y_i\frac{N_j\left(w_j\tau_{ij}^T\right)^{-\gamma}\left(\phi p_{ij}^B+\psi\right)^{-\frac{\gamma}{\sigma-1}}}{\sum_k N_k\left(w_k\tau_{ik}^T\right)^{-\gamma}\left(\phi p_{ij}^B+\psi\right)^{1-\frac{\gamma}{\sigma-1}}}$$

and

$$q_{ij}^B = \left(\frac{w_i\tau_{ij}^V}{z_i^V} - p_{ij}^B\right)\frac{\mathrm{d}q_{ij}^B}{\mathrm{d}p_{ij}^B} \quad \textbf{or} \quad p_{ij}^B q_{ij}^B = fF_{ij} - \mu_i Y_j \quad \textbf{or} \quad q_{ij}^B = F_{ij} - q_{ij}^V$$

4.7 Key takeaways

The first key takeway of the model is that it generates changes in international trade, X_{ij} in response to changes in travel costs, f_{ij} by affecting the export threshold for productivity, $\bar{\varphi}_{ij}$. $\bar{\varphi}_{ij} = \Phi\phi^{\frac{1}{\gamma}}$, rises with contracting/informational frictions, ϕ, and visa costs, ψ[14].

The second key takeaway of the model is that in the absence of visa costs, ϕ, $q_{ij}^B = N_j\phi\bar{\varphi}_{ij}^{-\gamma} = N_j\Phi^{-\gamma}$, where the first equality comes from line 1 of equation 16. So an increase in contracting frictions decreases the number of firm exporting, but since those firms have to send more managers to export, the total demand for business travel remains unchanged.

The third key takeaway from the model is that $p_{ij}^B q_{ij}^B = \frac{\kappa}{\mu}X_{ij}$. That is business travel expenditure is a constant share of trade flows between countries.

Finally, to see the key mechanism of the paper, it is best to compare two countries that are identical in every respect except their total income, Y. The travel service sector ideally chooses the monopoly price if neither 18 nor 19 binds for either countries, in which case, the price does not depend on tourism demand. However, 18 could bind for higher income country, while 19 is likely to bind for the lower income country, i.e, the monopoly price is too low or too high respectively. In case of the former (rich country), the travel service sector continues to increase the price until the demand for business travel just satisfies equation 24. To do this, replace q_{ij}^B with $F_{ij} - q_{ij}^V$ in equation 18. In the later case (poor country), the travel service sector continues to decrease the price until the expenditure for business travel just satisfies equation 23. To do this, replace q_{ij}^B with $\frac{fF_{ij}-\mu_i Y_j}{p_{ij}^B}$ in equation 19.

5 Calibration

I calibrate the model using the following parameter values from either data or the literature. In the below table, I list out the parameters and my calibration

[14] Here $\Phi = \frac{\kappa^{\frac{1}{\gamma}}(w_j\tau_{ij}^T)Y_i^{-\frac{1}{\gamma}}(p_{ij}^B)^{\frac{1}{\sigma-1}}}{\left[\sum_k N_k(w_k\tau_{ik}^T)^{-\gamma}(p_{ij}^B)^{\frac{\sigma-1-\gamma}{\sigma-1}}\right]^{-\frac{1}{\gamma}}}$

method for each of them.

	Standard Parameters	
Parameter	**Description**	**Calibration technique**
σ	Elasticity of substitution between tradable varieties	Broda and Weinstein (2006) estimate 4. I use 2 (as $\gamma + 1 > \sigma$).
μ	Expenditure share of tradeable varieties	Data on expenditure share
μ_i	Expenditure share on tourism services from i	Data on expenditure share
L_i	Total labor supply in i	Data on equipped labor
γ	Shape parameter of productivity distribution	Chaney (2018) estimates this at 1.0041
τ_{ij}^T	Iceberg trade cost from j to i	Parametrize $\tau_{ij}^T = 1 + \delta_d d_{ij} + \delta_l l_{ij} + \delta_b b_{ij}$, where d_{ij} is the distance between countries, l_{ij} and b_{ij} is an indicator for shared language and border respectively. Find $\{\delta_d^N, \delta_l^N, \delta_b^N\}$ that best fit the model to the data.
N_i	Mass of firms in i	Select to match trade flow data
	(Novel) Travel Parameters	
z_i^V, τ_{ij}^V	Travel services productivity/Iceberg travel cost	Obtain the average price of trips between countries p^V from flight and hotel data from google or another online price platform
ϕ	Number of trips/person per trade transaction	Select to match trade flow data. Alternatively, compute from Eaton et al. (2011) and SIAT at 1.68 (mean, and median of 1)
F_{ij}	Total seat capacity from j to i	Flight data or WTO data on travel flows
f	Unit cost of capacity	Select to match trade flow data

Since I jointly proxy (z_i^V, τ_{ij}^V) using data on flight and hotel prices (for a week) from online sources that I collect manually, I restrict my attention to 34 countries including the EU, US, China, Japan, India, Brazil, UK, South Korea and Taiwan[15].

To complete the calibration of the model, I need to compute: $\{N, w, \delta_d, \delta_b, \delta_l, \phi, f, \psi\}$. Here I follow Fieler (2011)'s strategy to estimate these in MATLAB using NLLS by simulating the model to match X_{ij} as closely as possible.

[15] The full list is: AUT, BEL, BGR, BRA, CHN, CYP, CZE, DEU, DNK, ESP, EST, FIN, FRA, GBR, GRC, HRV, HUN, IND, IRL, ITA, JPN, KOR, LTU, LUX, LVA, MLT, NLD, POL, PRT, SVK, SVN, SWE, TWN, and USA

5.1 Calibration algorithm

Unlike Fieler (2011) I do not normalize the trade data and use the raw export values for 2014. Given the parameters $\{\sigma, \mu, \mu_i, L_i, \gamma, (z_i^V, \tau_{ij}^V)\}$, equation 4, the total income equation, and equation 20 pin down the relation between the demand for tourism and the income. I proxy wages with w with GDP per capita as is the norm and back out the demand for tourism between country pairs, q^V.

Then, for each guess of the parameters, $\{N, \delta_d, \delta_b, \delta_l, \phi, f, \psi\}$, I solve for q_{ij}^B and p_{ij}^B using equations 16 and 22 constrained by equations 18 and 19. Finally using the expression $p_{ij}^B q_{ij}^B = \frac{\kappa}{\mu} X_{ij}$, I compute trade flows, and compute the squared error. I adjust my guess for $\{N, \delta_d, \delta_b, \delta_l, \phi, f, \psi\}$ and repeat the process. Note that the first half of the algorithm is solved entirely outside the optimization loop, and only determines the constraints through it's influence on q^V.

The values of parameters I thus obtained are[16]:

δ_d	δ_b	δ_l	ϕ	f	ψ
0.0765	-0.0083	-0.0128	0.0783	0.0236	1.2165

It is re-assuring to note that the signs of these parameters are in-line with our expectations. We expect shared border and language to be negatively associated with trade costs as found, and we expect contracting frictions, unit cost of flight operation, and visa costs to all be positive as found.

5.2 Counterfactual Analysis

The counterfactual analysis was performed by changing the value of a single parameter and simulating the model again to produce international trade flows under the changed circumstance.

5.2.1 Efficient airplane technology

I begin my counterfactual analysis by reducing my estimated travel iceberg costs, τ^V by 30% for all country pairs. I then compute the changes in international trade flows under the new scenario, $X_{ij}^{\text{Efficient CF}}$ for each bilateral pair. The I compute the change in trade flows under the new counterfactual scenario as for each pair.

$$\Delta X_{ij} = \frac{X_{ij}^{\text{Efficient CF}} - X_{ij}}{X_{ij}}$$

[16] I exclude the vector of N from the table to preserve space. Future variation of the paper will include a detailed appendix section including the values of N, (z_i^V, τ_{ij}^V), F, L, μ and μ_i

Finally, I compute the mean change in international trade between country pairs, ΔX to obtain the mean impact of improved airplane technology on international trade as:

$$\Delta X = \frac{1}{S(S-1)} \sum_{i \neq j} \Delta X_{ij} = 1.3$$

5.2.2 Relaxed visa constraints between EU and China.

The second counterfactual I pursue reduces the value of ϕ for exporters from China to the EU by 25% while keeping the visa costs the same for the rest of the world. I then simulate the model again under the new parameterization. I then compute the change in trade flows between China and EU states as before.

$$\Delta X_{\text{EUChina}} = \frac{\sum_{i \in \text{EU}} X^{\text{Visa}}_{i\text{China}} - \sum_{i \in \text{EU}} X_{i\text{China}}}{\sum_{i \in \text{EU}} X_{i\text{China}}}$$

where i belongs to an EU state.

I find that $\Delta X_{\text{EUChina}} = 2.3\%$

6 Conclusion

This research emphasizes the interaction between international travel and trade, revealing the critical role that travel costs and visa policies play in shaping face-to-face interaction via busines travel. By demonstrating that international travel, particularly non-business travel, constitutes a significant component of overall trade costs, this study highlights the importance of considering travel-related factors in trade analyses. The findings suggest that reducing visa costs can lead to tangible increases in trade volumes, emphasizing the potential economic benefits of more lenient visa policies. My paper is a first step in fully endogenizing travel costs into a model of international trade by including by including tourism demand.

The counterfactual analysis provide valuable insights into the potential changes in technology as well as impacts of policy interventions aimed at reducing travel costs. Improved airplane technology and relaxed visa policies offer compelling evidence of the substantial trade-enhancing effects of such measures. The simulations reveal that large but feasible reductions in travel costs can lead to significant increases in trade volumes, driven primarily by the increased participation of previously excluded low-productivity firms in international markets.

Overall, this research contributes to a deeper understanding of the complex relationship between international travel and trade, highlighting the economic significance of travel costs and visa policies. By integrating these factors into a comprehensive model of international trade, this study offers insights for policymakers who regulate immigration. The findings underscore the potential benefits of policies aimed at reducing travel costs and improving travel accessibility, ultimately contributing to more efficient and inclusive global trade systems.

References

Allen, T. (2014). Information frictions in trade. *Econometrica*, 82(6):2041–2083.

Allen, T., Fuchs, S., Ganapati, S., Graziano, A., Madera, R., and Montoriol-Garriga, J. (2020). Is tourism good for locals? evidence from barcelona. *Dartmouth College, mimeograph.*

Anderson, J. E. and Van Wincoop, E. (2004). Trade costs. *Journal of Economic literature*, 42(3):691–751.

Antràs, P., Redding, S. J., and Rossi-Hansberg, E. (2023). Globalization and pandemics. *American Economic Review*, 113(4):939–981.

Arkolakis, C. (2010). Market penetration costs and the new consumers margin in international trade. *Journal of political economy*, 118(6):1151–1199.

Aryal, G., Murry, C., and Williams, J. W. (2021). Price discrimination in international airline markets. *arXiv preprint arXiv:2102.05751.*

Blonigen, B. A. and Cristea, A. D. (2015). Air service and urban growth: Evidence from a quasi-natural policy experiment. *Journal of Urban Economics*, 86:128–146.

Borchert, I., Larch, M., Shikher, S., and Yotov, Y. V. (2021). The international trade and production database for estimation (itpd-e). *International Economics*, 166:140–166.

Brancaccio, G., Kalouptsidi, M., and Papageorgiou, T. (2020). Geography, transportation, and endogenous trade costs. *Econometrica*, 88(2):657–691.

Broda, C. and Weinstein, D. E. (2006). Globalization and the gains from variety. *The Quarterly journal of economics*, 121(2):541–585.

Campante, F. and Yanagizawa-Drott, D. (2018). Long-range growth: economic development in the global network of air links. *The Quarterly Journal of Economics*, 133(3):1395–1458.

Chaney, T. (2008). Distorted gravity: the intensive and extensive margins of international trade. *American Economic Review*, 98(4):1707–1721.

Chaney, T. (2014). The network structure of international trade. *American Economic Review*, 104(11):3600–3634.

Chaney, T. (2018). The gravity equation in international trade: An explanation. *Journal of Political Economy*, 126(1):150–177.

Eaton, J., Kortum, S., and Kramarz, F. (2011). An anatomy of international trade: Evidence from french firms. *Econometrica*, 79(5):1453–1498.

Faber, B. and Gaubert, C. (2019). Tourism and economic development: Evidence from mexico's coastline. *American Economic Review*, 109(6):2245–2293.

Fajgelbaum, P. D. and Khandelwal, A. K. (2022). The economic impacts of the us–china trade war. *Annual Review of Economics*, 14:205–228.

Fieler, A. C. (2011). Nonhomotheticity and bilateral trade: Evidence and a quantitative explanation. *Econometrica*, 79(4):1069–1101.

Guillouet, L., Khandelwal, A., Macchiavello, R., and Teachout, M. (2021). Language barriers in multinationals and knowledge transfers. Technical report, National Bureau of Economic Research.

Melitz, M. J. (2003). The impact of trade on intra-industry reallocations and aggregate industry productivity. *Econometrica*, 71(6):1695–1725.

Neiman, B. and Swagel, P. (2009). The impact of post-9/11 visa policies on travel to the united states. *Journal of International Economics*, 78(1):86–99.

Piermartini, R. and Yotov, Y. V. (2016). Estimating trade policy effects with structural gravity.

Poole, J. (2009). Business travel as an input to international trade.

Recchi, E., Deutschmann, E., Gabrielli, L., and Kholmatova, N. (2020). Assessing visa costs on a global scale. *Robert Schuman Centre for Advanced Studies Research Paper No. RSCAS*, 18.

Söderlund, B. (2023). The importance of business travel for trade: Evidence from the liberalization of the soviet airspace. *Journal of International Economics*, page 103812.

Startz, M. (2021). The value of face-to-face: Search and contracting problems in nigerian trade. *Available at SSRN 3096685*.

Stole, L. A. (2007). Price discrimination and competition. *Handbook of industrial organization*, 3:2221–2299.

Umana-Dajud, C. (2019). Do visas hinder international trade in goods? *Journal of Development Economics*, 140:106–126.

Appendix

A Rejection rate as Instrument

A.1 US Visa (granted and rejection) rates

The cross country variation in travel that is unrelated to geographic factors or economic fundamentals is captured by visa requirements that countries impose on nationals of other countries. I combine (publicly available) data on visa applications, granted and rejected, from US Department of State[17] that provides details on the number of visas applications granted across all non-permanent immigrant categories by the nationality of the traveler. There are 84 categories of visas, with two categories accounting for 81% of the total visas issue during fiscal year 2014: B-1,2/BCC (75.3%) and F-1 (6.0%). Other major categories in 2014 were J-1 (3.3%), C-1/D (2.7%), H-1B (1.6%), B-2 (1.3%), H-4 (1.1%), and A-2 (1.0%). Combined these visa categories accounted for 9.1 million of the 9.9 million visas that were granted by the US to various countries in 2014. I have the visas issued across categories between 1997 and 2022.

In addition to the visa granted, the department of state also releases the rejection rate for B1 and B2 visas across countries from 2006. Using the number of granted visas and the rejection rate, I back out the total number of B1/B2 visa applications to construct the excess annual rejection that I use as my instrument for travel flows.

In 5 I plot the mean rejection rate for the US. we can see that in some cases, this is over 50%.

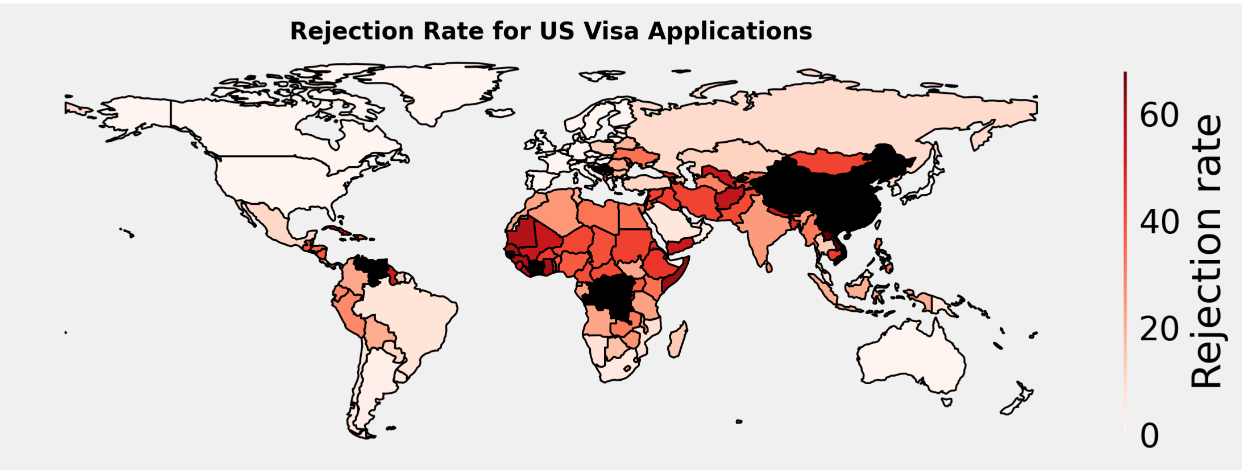

Figure 5: Mean rejection rate for the US. Black is for missing data.

[17] Source

A.2 Questions in Visa interviews

Here I list out standard visa interview questions that are asked. Candidates are expected to answer all or a subset of these questions to be considered eligible for approval.

- Purpose of Travel
- Where in the US will you go?
- How long will you stay?
- Will you be traveling alone?
- Do you have family in the US?
- Do you know someone in the US?
- Who will pay for your trip?
- What other countries have you been to?
- What is your occupation?
- How long have you been in this line of work?
- Are you single or married?
- Do you have any kids?

A.3 Temporal variation in enforcement of visa policy.

Since we do not observe the decomposition of business and tourist flows, we cannot comment on the presence and strength of either of these forces directly and rely on indirect methods. I exploit the temporal variation in visa rejection intensity that is an outcome of consulate efficiency and internal quotas. It is a common belief that tourist visas are among the lowest priority visas and tourists are subjected to the most intense scrutiny for international travel. While on the other hand, businesses that are capable of trading internationally can easily obtain visas if they choose to apply and so are unaffected by temporal variation in visa enforcement. I present two exercises that exploit temporal variation in visa rejection rate to identify the nature of relation between tourism and trade. The variation in the rate of rejection could be an outcome of internal decisions or fluctuations in the productivity of the consulates and is likely to be independent of trade fundamentals thereby having no direct impact on the business travel[18].

[18]During the trade advising group it was mentioned that tourist visas are low priority and I am maintaining this assumption, i.e, if business travelers applies for a visa, they obtain it.

First, I consider only pairs where there is a visa requirement to travel from the exporting country and importing country. I then estimate the gravity model again, but using the z-score for visa rejection rate instead of the indicator for visa requirement. The z-score is measured as the deviation of the rejection rate each year from its mean in units of the standard deviation of the rejection rate. Formally, let r_t^i be the percentage of visa applications that are rejected from country i in year t. For the US, there are rejection rate for B1/B2 visa applications, and for the EU, these are the Schengen C-class visas. Let $\bar{r}^i$ and σ_{r^i} be the mean and standard deviation of the rejection rate faced by the country i computed as the sample average. The I instrument for V_{it} in the specification from the above section as:

$$\Delta r_t^i = \frac{r_t^i - \bar{r}^i}{\sigma_{r^i}}$$

By considering only country pairs with visa requirements, I effectively control for the confounding impact of visa policies on business travel and focus helps in isolating the influence of tourism-related travel. Using the z-score provides a normalized measure of how strict or lenient a country's visa policy is in a given year relative to its average. While the approach helps to control for visa policies' impact on business travel, it does not completely separate tourist from business travel. Some portion of the travel facilitated by more lenient visa policies might still be business-related. Visa policies and rejection rates can be influenced by broader political or economic factors unrelated to tourism or trade per se, such as security concerns or diplomatic relations. These should be considered as potential confounders.

Second, I instrument for unexpected fluctuations in tourism intensity using the excess rejection that tourists from a country face in a given year[19]. To do so, I again restrict my attention to country pairs with visa requirements and since we only look at country pairs with visa requirements, we control for the direct impact of visa requirements on business travel and consequently, on trade. So, a higher rejection rate for a country in a year could decrease the number of tourists from that country to the US and influence business travelers by either increasing or decreasing the cost of travel to the US. So I instrument for travel between countries using the excess rejection that is recorded each year as measured by

$$\Delta Q_t^i = (r_t^i - \bar{r}^i) * Q_t^i(A)$$

[19]Due to the differences in time horizon for visa expiration, the total pool of travelers in any given year is determined by the number of valid visas in circulation in any given year. In appendix ?? I present the the various visa categories along with the shortest duration for which the visas are valid.

where ΔQ_t^i is the excess rejection rate that travelers from exporter i experience in t while traveling to US or EU. $Q_t^i(A)$ is the total number of applications.

A.4 Result

Table 1: Gravity regressions with Visa requirement and international travel

	Visa barrier			Travel intensity		
	OLS	**Proxy (US)**	**Proxy (EU)**	**OLS**	**IV (US)**	**IV (EU)**
Visa requirement	-0.334***					
	(.025)					
Visa intensity proxy		-(.138)	-0.332***			
		(.090)	(.053)			
Trips (Exporter to Importer)				0.205***	1.155***	2.394**
				(.010)	(.083)	(.878)
N	211,698	1,450	2,897	98,110	805	571
Adjusted-R2	0.706	0.087	0.034	0.783	0.689	0.563

Note: Distance > 1000 km. Origin- and destination-year fixed included; bilateral travel is the sum arrival and departures between countries; standard errors in parentheses and clustered by origin-destination pairs; *** denotes significance at the 1 percent level; ** denotes significance at the 5 percent level; * denotes significance at the 10 percent level.

B 9/11 as exogenous variation in travel costs

I also attempt to introduce exogenous variation in travel costs using the September 11 attacks. I augment naive gravity specification with trips undertaken from importer to exporter country. Since this specification suffers from simultaneity bias, I instrument for the travel with the religious composition of the origin country with NATO alliance of the destination country. The gravity specification that I use for this analysis is:

$$\log X_{nit} = \beta_0 + \beta_q q_{nit} + \beta_d d_{ni} + \delta_{ni} + \delta_{it} + \delta_{nt} + \epsilon_{nit} \tag{26}$$

Here the specification is close the one used in the main section, with the exception that I use pair-fixed effects, δ_{ni} instead of border, language and colonizing indicators. Furthermore, I include q_{nit}, the number of trips from n to i in year t.

To over come the simultaneous causality bias, I instrument for q_{nit} using 9/11 as a quasi-natural experiment for exogenous variation in travel costs, across country-pairs and time. I construct the instrument from a combination of indicator variables identifying: (i) the period of observation as before or after 9/11, (ii) the destination/exporter in the trips was an ally of the US (or NATO), and (iii) the origin/importer was a predominantly Muslim country. I classify country-pairs into four groups (g) based on religious composition at importer n, and political closeness to US of the exporter i. I Identify countries with $>$ 50% population of Islamic faith as Muslim(M)[20]. I identify countries in then EU[21] as political allies[22].

So the country-pair groups look like

- India to Japan (Non-Muslim origin to non-NATO ally)
- India to Italy (Non-Muslim origin to NATO ally)
- Iran to Japan (Muslim to non-NATO ally)
- Iran to Italy (Muslim to NATO ally)

The instrument is based on differences in travel growth across the country-pair groups as inferred from figure 6. Travel flow growth to EU($\diamond$) slower than ex-EU($\cdot$) after 9/11. The difference is larger for pairs with origin in Muslim Countries than ex-Muslim countries. No clear indication of pre-9/11 trends that explain the divergence.

[20] Alternatively use a 20% threshold.

[21] EU as of 2001: BEL, DEU, LUX, DNK, GRC, PRT, FIN, GBR, FRA, ITA, NLD, IRL, ESP, AUT,

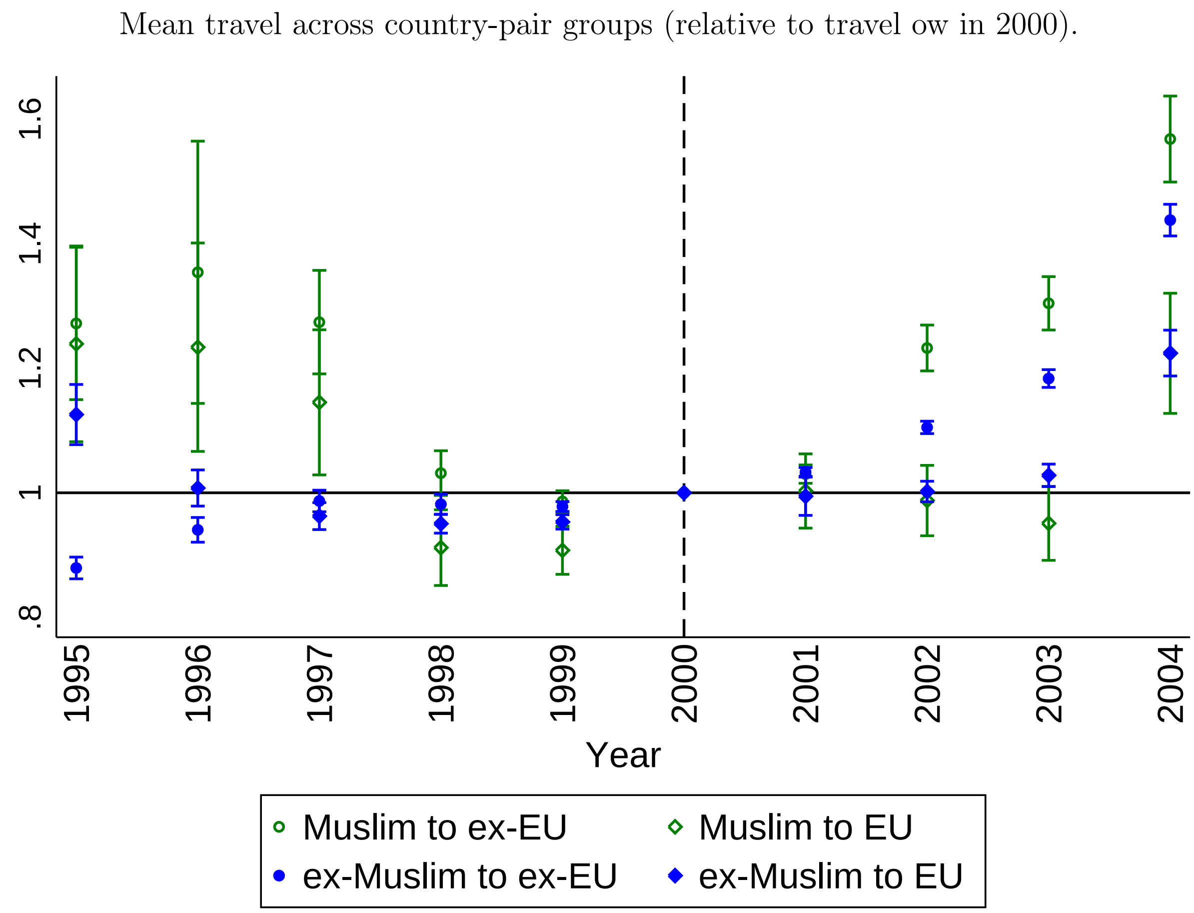

Figure 6: Each dot is the mean travel between country pairs relative to 2000, the year prior to the attacks. The bands are standard deviation within groups. Blue and green represent travel from ex-Muslim and Muslim countries respectively, and circle and diamond represent travel to ex-EU and EU countries respectively.

For the purpose of this analysis, I assume that 9/11 did not effect trade flows directly, either in the form of costlier transportation of inputs or an negative sentiment towards products originated in Muslim countries or policy uncertainty from major economic players.

Formally, I the instrument for the q_{nit} is:

$$\mathbb{I}_{t>2000}+\mathbb{I}_{n\in M}+\mathbb{I}_{i\in EU}+\mathbb{I}_{t>2000}\mathbb{I}_{i\in EU}+\mathbb{I}_{t>2000}\mathbb{I}_{n\in M}+\mathbb{I}_{n\in M}\mathbb{I}_{i\in EU}+\mathbb{I}_{t>2000}\mathbb{I}_{n\in M}\mathbb{I}_{i\in EU}$$

where M, and EU represents the set of Muslim and EU countries. $\mathbb{I}_{t>2000}$ captures the global increase in airport security measures (and hence travel costs) after 9/11. $\mathbb{I}_{i\in EU}$ captures the average resistance faced to travel to EU. $\mathbb{I}_{n\in M}$ captures the average resistance faced to travel from a Muslim country.

There is concern over the lack of significance in the main interaction term. Year-specific income shocks in 2002 and 2003 could drive the trips variation

and SWE.

[22]NATO and OECD are potential alternatives to EU.

independent of 9/11.

I first present the first stage:

First stage: the affect of 9/11 on trips, q_{nit}.

	log(*trips*)	
	(1)	(2)
EU	0.572***	0.933***
	(0.0745)	(0.105)
Muslim	-0.349***	0.0286
	(0.0732)	(0.0812)
Muslim × EU	-1.045***	-1.281***
	(0.182)	(0.218)
post-911	-0.0663***	-0.0377*
	(0.0161)	(0.0182)
post-911 × EU	-0.0870**	-0.0899*
	(0.0310)	(0.0391)
post-911 × Muslim	0.0267	0.0283
	(0.0444)	(0.0467)
post-911 × Muslim × EU	-0.0422	0.0774
	(0.0801)	(0.0929)
log(distance)	-0.854***	-0.405***
	(0.0278)	(0.0332)
Obs	27753	27753
R-squared	0.505	0.306

Column 1 controls for GDP, and columns 2 for GDP per capita at the origin and destination.

Includes controls for shared border, language, colonizer.

Standard errors in parentheses

*, **, *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

The results from the IV regression show that trade exhibits a significant and substantial correlation with trips, both in the OLS, and the IV specifications.

IV estimates of the effect of trips, q_{nit}, on international trade.

	log(trade, $mn)					
	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	OLS	Instrument	OLS	OLS	Instrument
log(trips)		0.402***	1.089***		0.760***	1.416***
		(0.0168)	(0.106)		(0.0175)	(0.110)
log(distance)	-0.814***	-0.452***	0.166	-0.0976*	0.252***	0.553***
	(0.0290)	(0.0293)	(0.0998)	(0.0429)	(0.0297)	(0.0599)
exporter-GDP	0.902***	0.724***	0.421***			
	(0.0148)	(0.0151)	(0.0491)			
importer-GDP	0.747***	0.516***	0.121			
	(0.0168)	(0.0183)	(0.0624)			
exporter-GDP pc				0.765***	0.517***	0.303***
				(0.0342)	(0.0274)	(0.0469)
importer-GDP pc				0.348***	0.0251	-0.253***
				(0.0333)	(0.0281)	(0.0542)
N	27753	27753	27753	27753	27753	27753
r2	0.601	0.657	0.492	0.208	0.490	0.280

Includes controls for shared border, language, colonizer.

Standard errors in parentheses

*, **, *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

B.1 Plausible alternate classifications of country-pairs.

I had also considered alternative classification. I present travel growth patterns between country pairs using alternative classifications.

- On 9/12/01, NATO invoked article 5 which enshrines the principle of collective defense and requires member states to come to the aid an attacked member. So it acts as an alternative to EU for increased risk of terrorist attacks.
- I choose Latin America and Asia to check differential patterns unrelated to religious composition at the origin.
- In figure ??, my results are puzzling here. Both Latin America and Asia experienced weaker travel growth to EU than Muslim countries. However, the growth was low even for non-EU countries possibly reflecting: (i) increased security costs between pairs not directly involved in the attacks, or (ii) group specific shock independent of the affects of 9/11 that affected travel from these country groups.

B.2 Alternate events that potentially changed travel costs.

Finally, to overcome the criticism that 9/11 was a global shock not merely to travel but to other economic variables such as sentiment, policy, and transport, I consider two alternative events that could have affected travel without affecting trade. First, in 2010 several volcanic events occurred between April and June 2010 in Eyjafjallajokull, Iceland. Ask covered large areas of Northern Europe in April and disrupted air travel in April and May. ≈ 10m passengers were affected. Second, I consider the 2011 Japanese nuclear accidents. Tsunami

Alternate classications considered for the 9/11 analysis.

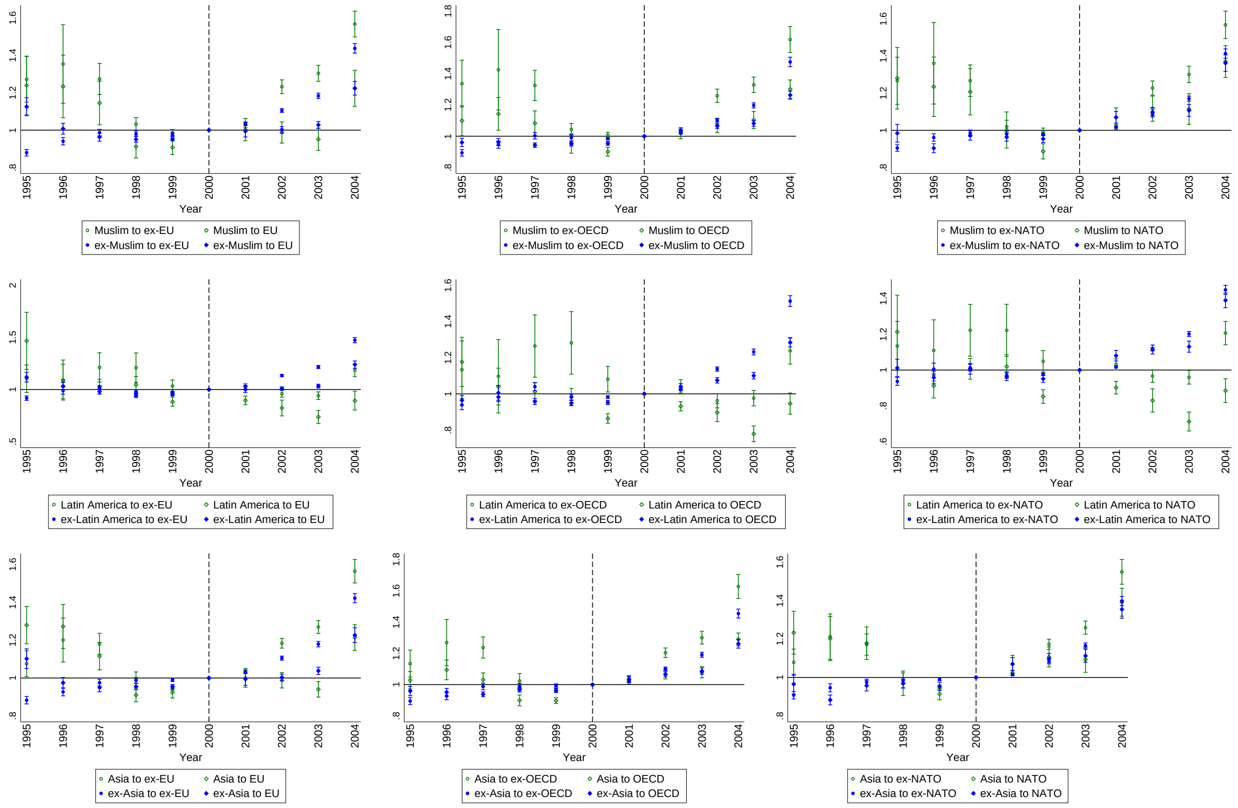

Figure 7: Growth rates between country rates relative to 2000 by various groupings.

from earthquake in the Toohoku region (east- Japan) resulted in damage to the Fukushima Daiichi Nuclear Power Plant in Japan. It was the most severe nuclear accident since the Chernobyl. Rated 7 on the International Nuclear Event Scale (INES), highest on the scale of 0 to 7. It led to three nuclear meltdowns (worst-case scenario), three hydrogen explosions, and the release of radioactive contamination. The evacuation zone was set at a 20 km radius. As shown in figure ??, neither events appear to have impacted the travel growth significantly for those involved to warrant a valid instrument, and so I did not pursue this any further.