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Abstract

Effects of direct flights on trade costs are investigated using micro price data at the city level. After controlling for local retail/distribution costs, traded input prices are obtained to be further used in the measurement of trade costs across cities through arbitrage conditions. The existence of a direct flight enters trade costs regressions negatively and significantly. The results are shown to be robust to the consideration of many control variables, nonlinearities in the effects of distance on trade costs, possible endogeneity of having direct flights between cities and alternative definitions of the data. The direct flights that are shown to be determined by bilateral air services agreements are further shown to reduce trade costs through an endogeneity analysis; the main policy implications are twofold: (i) international trade policies through aviation services, such as Open Skies Agreements of the U.S., are alternative trade policy tools to reduce international trade barriers; (ii) direct flights facilitate the integration of internal markets as in the case of European Union.

JEL Classification: F15, F31, L93, L98

Key Words: Market Integration; Trade Costs; Direct Flights; Border Effects

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1 Introduction

The increase in air transportation/travel due to the technological development in jet aircraft engines has led to the improvement of global market integration significantly since World War II. This improvement has been partly achieved by the increase in air shipment due to lower air transportation costs,[1] and partly due to the face-to-face business meetings that overcome informational asymmetries in international trade, because, as indicated by Rauch (2001), the reduction in informal trade barriers through business and social networks is one of the key factors facilitating trade. Therefore, there is no doubt that air transportation/travel has significantly contributed to welfare-improving globalization.

Within this picture, direct flights have gained more importance, because, compared to the inconvenience of transferring flights and the additional flying time, direct flights provide the cheapest/fastest air travel and air transportation. Regarding the role of direct flights in air travel, a direct flight facilitates a business travel by considerably reducing the journey costs, including the opportunity cost of time. By reducing the travel time, direct flights also allow business people to have face-to-face meetings, expand the knowledge of alternative markets, augment their reciprocal

[1] Hummels (2007) shows that by the year of 2000, air shipments were representing a third of the value of U.S. imports and more than half of U.S. exports with countries outside North America. Similarly, again in 2000, excluding land neighbors, the air share of import value was more than 30 percent for Argentina, Brazil, Colombia, Mexico, Paraguay, and Uruguay.

trust and thus increase the likelihood of trade.[2] For example, Alderighi and Gaggero (2012) have found that the elasticity of exports to direct flights is about 10%, which is mostly attributed to the increasing role of business traveling in maintaining and reinforcing commercial relations; Cristea (2011) and Poole (2013) have shown that business travel helps to overcome informational asymmetries in international trade by generating international sales in the form of new export relationships.

Regarding the role of direct flights in air transportation, Micco and Serebrisky (2006) have shown that *Open Skies Agreements* (OSAs) between the U.S. and other countries, which allow airlines to operate direct flights internationally, reduce air transport costs by 9% and increase by 7% the share of imports arriving by air. Similarly, Winston and Yan (2015) investigate OSAs from a welfare perspective and show that they have generated at least $4 billion in annual gains to travelers. As regards the importance of time spent in transportation, Hummels and Schaur (2013) estimate that each day in transit is equivalent to an ad-valorem tariff of 0.6% to 2.3%, where due to having a direct flight, the travel time between, for example, Taipei and Shanghai is cut from more than 5 hours to around one and a half hours (see Chang et al., 2011). Moreover, studies such as by Bel and Fageda (2008) have found that the availability of direct flights has a large influence on the location of large firms' headquarters, which is another factor facilitating trade. Finally, studies such as by Cristie, Hillberry and Mattoo (2014) have discussed the importance of direct flights

[2] See Frankel (1998), Rauch (1999), Kulendran and Wilson (2000), Frankel and Rose (2002).

(through plurilateral air services agreements) in passenger traffic, which is another factor in the removal of informational trade barriers.

Considering the discussion so far, this paper attempts to measure the effects of direct flights on trade costs between cities by introducing and using a micro price data set on 22 traded goods at the retail level across 433 cities covering 114 countries.[3] Such a rich data set allows us to consider the effects of direct flights on trade costs for both international and intranational city pairs. Trade costs are defined as the *arbitrage costs* measured by the maximum price difference between traded input prices across cities in order to control for local retail/distribution costs. We also work with time-averaged (long-run) data to eliminate the transitory variations in prices, such as those due to exchange rates. The results show that the existence of direct flights between cities negatively and significantly reduces trade costs. This result is robust to the consideration of many control variables and nonlinearities in the effects of distance on trade costs.

We also consider the possible endogeneity of having direct flights between cities by investigating potential international policies. It is shown that the existence of direct flights are positively affected by air services agreements signed between countries. One example is the policy of the U.S. through OSAs, the first of which has been signed between the U.S. and Netherlands in 1992. According to the U.S. Department of State, as of 2015, the U.S. currently has OSAs with more than 100 countries, and over

[3] The data have been downloaded from http://www.numbeo.com/ which is the world's largest database of user contributed data about cities. See the data section below for more details.

70 percent of international departures from the United States now fly to OSA partners. Other examples include *Multilateral Agreement on the Establishment of a European Common Aviation Area* signed by many European countries among themselves, *A Common Aviation Area Agreement* and *Euro-Mediterranean Aviation Agreement* of the E.U. with countries outside of Europe. Since direct flights affected by such policies are further shown to reduce trade costs through a two-stage endogeneity analysis, it is implied that international air services agreements are significant policy tools for reducing trade costs.

The rest of the paper is organized as follows. The next section uses a retail model to measure trade costs. Section 3 depicts the details of the estimation methodology and the data. Section 4 reveals the empirical results together with many robustness checks. Section 5 concludes by providing policy suggestions.

2 The Measurement of Trade Costs

Data for trade costs are either non-existing, excluding informal barriers to trade, or not covering the globe.[4] Accordingly, many existing studies in the literature have considered disaggregate price information across countries to measure trade costs. The

[4]Even the most detailed data sets, such as the one on the U.S. international trade (that can be obtained from http://dataweb.usitc.gov/), exclude information on informal barriers to trade and can at most provide data for the calculated duties and the cost of all freight, insurance, and other charges incurred; they do not cover, for instance, trade costs due to search frictions or time to ship.

common strategy based on international/intranational studies considers the arbitrage condition for retail prices; i.e., consumers search for the minimum retail price and order/purchase the product from the low-price location after taking trade costs into account. Since the largest observed price difference between locations provides information about the limit that the arbitrage condition imposes, the recent literature has estimated trade costs using inequality moments. Examples of this strategy include the intercity price analysis study by Borraz et al. (2014) using the price data obtained by the Billion Prices Project at MIT, together with international trade studies by Eaton and Kortum (2002), Simonovska and Waugh (2014), among many others, in the literature.[5] One problem with this strategy is that retail prices of traded goods consist of both traded and non-traded input prices, where the latter mostly refers to local distribution costs. Accordingly, studies such as by Crucini and Yilmazkuday (2014) have considered arbitrage opportunities only for the traded-input prices; this can be achieved by controlling the retail prices for the local distribution costs (as we do in this paper). In order to be consistent with the exiting literature, we directly follow these studies while measuring trade costs, below.

[5] The estimation of inequality moments has also been achieved by Andrews, Berry and Jia (2004), Andrews and Guggenberger (2009), Andrews and Soares (2010), Andrews and Shi (2014), Ponomareva and Tamer (2011), and Rosen (2008).

2.1 Arbitrage Condition for Traded-Input Prices

When traded inputs of the same retail good across two locations are perfect substitutes (e.g., 1kg of rice in a New York City *wholesaler* versus 1kg of rice in an Istanbul rice *wholesaler*), one has to control the observed retail prices for local retail/distribution costs. Accordingly, as in Crucini and Yilmazkuday (2014), we define retail prices as follows:

$$P_i^g = Z_i \left(Q_i^g\right)^{\alpha^g} \left(W_i\right)^{1-\alpha^g} \tag{1}$$

where P_i^g is the retail price of good g in location i, Z_i is the inverse retail productivity in location i, W_i is the local wage in location i, Q_i^g is the traded-input (e.g., wholesale) price of good g in location i, and α^g is the traded input share of good g that is common across all locations. Log relative prices between locations i and j are implied as follows:

$$p_{ij}^g = z_{ij} + \alpha^g q_{ij}^g + \left(1 - \alpha^g\right) w_{ij} \tag{2}$$

where $p_{ij}^g = \log\left(P_i^g / P_j^g\right)$, $q_{ij}^g = \log\left(Q_i^g / Q_j^g\right)$, $z_{ij} = \log\left(Z_i / Z_j\right)$ and $w_{ij} = \log\left(W_i / W_j\right)$. Following Crucini and Yilmazkuday (2014), for the identification of q_{ij}^g's, we follow a two-stage approach to control for retail costs.

The first stage utilizes geometric mean regression (to control for any measurement errors) on the available data for relative prices and relative wages to estimate the following expression:

$$\underbrace{p_{ij}^g}_{\text{Relative Price Data}} = \left(1 - \alpha^g\right) \underbrace{w_{ij}}_{\text{Wage Data}} + \underbrace{p_{ij}^{\prime g}}_{\text{Relative Prices Controlled for Local Wages}}$$

where, according to Equation 2, residuals of $p'^g_{ij} = z_{ij} + \alpha^g q^g_{ij}$ represent relative prices controlled for local wages; we also obtain an estimated value for α^g by this estimation.[6] In this first stage, we assume that wages are orthogonal to retail productivities and traded-input prices. It is implied that z_{ij}'s measure the part of the local retail costs that cannot be measured by wages, such as infrastructure or location-specific markups.

The second stage uses the relative prices controlled for local wages to estimate the following expression:

$$\underbrace{p'^g_{ij}}_{\text{Relative Prices Controlled for Local Wages}} = \underbrace{z_{ij}}_{\text{Fixed Effects}} + \alpha^g \underbrace{q^g_{ij}}_{\text{Relative Traded-Input Prices}}$$

where fixed effects (i.e., z_{ij}'s) are orthogonal to relative traded-input prices (i.e., q^g_{ij}'s) by construction. Once $\alpha^g q^g_{ij}$'s are obtained as residuals, using α^g's estimated in the first stage, we identify the traded input prices q^g_{ij}'s.

The traded input prices q^g_{ij}'s are subject to arbitrage after controlling for trade costs. More specifically, the arbitrage condition for traded input prices of good g between locations i and j is given by :

$$q^g_{ij} = q^g_i - q^g_j \leq \log \tau_{ij} \tag{3}$$

where τ_{ji} represents the gross multiplicative trade/arbitrage costs from location j to location i. According to this arbitrage condition, it must be the case that the traded-input prices in location i is lower than the traded-input prices in location j

[6] The estimated values of α^g's at the good level are provided in Online Appendix tables.

plus trade costs; otherwise, the product would have been imported from location j until this condition would hold with inequality one more time. The interesting point is that this condition is bilateral, because the story holds for the potential imports of location j from location i; hence, we can also write:

$$q_{ji}^{g} = q_{j}^{g} - q_{i}^{g} \leq \log \tau_{ij} \tag{4}$$

where we have considered symmetric trade costs due to $\tau_{ij} = \tau_{ji}$. The last two arbitrage conditions can be combined as follows:

$$\left| q_{i}^{g} - q_{j}^{g} \right| \leq \log \tau_{ij} \tag{5}$$

where $|\cdot|$ is the absolute value operator. When the maximum (i.e., the upper bound) of the left hand side is considered as the maximum traded-input price difference across goods between locations i and j, the last inequality turns into an equality as follows:

$$\log \tau_{ij} = \max_{g} \left\{ \left| q_{i}^{g} - q_{j}^{g} \right| \right\} \tag{6}$$

which we use as our measure of trade/arbitrage costs.

It is important to emphasize that our trade cost definition is broad enough to capture any transportation costs and international border related costs as well as any information frictions. Since we control for local retail/distribution costs, our definition of trade costs is slightly different from studies such as by Anderson and van Wincoop (2004) who have a broader definition of trade costs as capturing even distribution costs. Other related studies such as by Allen (2014) have distinguished between transportation costs and information frictions; in the absence of an international border, while the case of complete information in Allen (2014) implies that τ_{ij} in this paper corresponds to transportation costs (i.e., no information frictions), the case of incomplete information implies that τ_{ij} captures both transportation costs and information frictions. Since we are interested in investigating the effects of direct flights on informational trade barriers, our analysis corresponds to the case of incomplete information by keeping information frictions as a part of the trade costs.

3 Empirical Methodology and Data

Once trade costs are obtained (as described in the previous subsection), we are interested in finding the effects of having direct flights between cities. Accordingly, we consider the following regression investigating the trade costs between cities i and j:

$$\log \tau_{ij} = \beta_0 + \beta_1 f_{ij} + \beta_2 \log d_{ij} + \beta_3 b_{ij} + \sum_k \beta_{3+k} x_{ij}^k \tag{7}$$

where f_{ij} is a dummy variable taking a value of 1 if there is any direct flight between cities i and j, d_{ij} is the great circle distance in miles between cities i and j, b_{ij} is a dummy variable taking a value of 1 when there is an international border between cities i and j, and finally x_{ij}^k's represent a set of control variables including city fixed effects (capturing any city characteristics such as its size, geographical location, being on a coast, etc.) as well as variables at the bilateral country level (i.e., control variables that are common across city pairs located in two specific countries) that are standard in international studies, including having a common land border, language, colony or regional trade agreement (RTA).[7]

Micro price data include observations of 22 traded goods at the retail level obtained from 433 cities (covering 114 countries) for the years between 2010 and 2014.[8] The complete lists of goods and cities are given in Online Appendix tables, while the coverage of cities are depicted on the world map in Figure 1, where we have multiple cities from many countries. The data also include "Average Monthly Disposable Salary (After Tax)" which we accept as our wage data. The data have been downloaded from http://www.numbeo.com/ which is the world's largest database of user contributed data about cities. Users of Numbeo can enter the micro prices that they observe either at the good level or by using the price collection sheet provided by the web page. Since the price data are user contributed, Numbeo uses alternative methodologies to filter out noise data. First, the user provided data are checked for outliers manually.[9] Second, one quarter of lowest and highest inputs are discarded as

[7]While a common land border refers to city pairs that are located in neighbor countries (through a land border), an international border refers to city pairs located in different countries that do not necessarily share a land border. All of the country-level control variables are set equal to 1 for intranational city pairs. It is important to emphasize that such a strategy does not affect anything in the regression results, because the effects of having an international border is already controlled by b_{ij}.

[8]Although the original data set includes 49 retail goods, we ignored the goods that are non-traded in our investigation, since such goods may not be subject to arbitrage opportunities due to trade.

[9]For example, for a particular price in a city, when values contributed are 5, 6, 20, and 4 in a reasonable time span, the value of 20 is discarded as a noise.

borderline cases. Third, Numbeo uses heuristic technology that discards data which most likely are incorrect statistically.

Using the model-implied traded-input prices, we calculate log trade costs according to the following version of Equation 6 in the long run:

$$\log \tau_{ij} = \max_{g} \left\{ \left| q_i^g - q_j^g \right| \right\} = \max_{g} \left(\frac{\sum_t \left| q_{i,t}^g - q_{j,t}^g \right|}{T} \right) \tag{8}$$

where, as indicated in Table 1, the number of city pairs is 90,743 ($= 10,676 + 80,067$), and number of international city pairs are much higher than the number of intranational city pairs. The use of time-averaged data is designed to eliminate the transitory variations in prices, such as the ones due to exchange rates. As is evident in Table 1, on average, trade costs between international city pairs (i.e., city pairs having an international border) are about 50% higher compared to intranational city pairs (i.e., city pairs within a country). Compared to the existing literature based on international trade costs, the magnitude of trade costs in this paper are relatively lower. In particular, based on earlier and different data sets, Anderson and van Wincoop (2004) have estimated international trade costs about 170% (ad-valorem tax equivalent), while the implied international trade costs in Eaton and Kortum (2002) are about %190; nevertheless, it is important to emphasize that these values in the literature are not fully comparable to the values in this paper, since they are at the country level, and they have not been controlled for local retail/distribution costs. The results in this paper regarding the size of intranational trade costs are in line with studies such as by Allen (2014) who, by using a smaller set of goods within Philippines, has recently estimated ad-valorem tax equivalent trade costs as ranging between 47% and 101%, where the former represents pure transportation costs, while the latter represents the summation of transportation costs and information frictions.

The data for direct flights have been obtained from Airline Route Mapper for the year 2013. The data include information on 63,149 direct flights from around the world where the name of the airlines and airports are also provided. Considering the provided airport codes and names, we determined the exact location of the airports (in terms of their latitudes and longitudes) and the countries in which they are located by using Google Maps.

By using Google Maps, we also calculated the exact location of cities in our price data (in terms of their latitudes and longitudes). Considering these locations, we calculated the great circle distance between them in miles to be used in the regression analysis (see Table 1). Furthermore, in order to determine whether there is a direct flight between any two cities in our price data, we searched for the airports within 50 miles of the city centers by using the airport location data we have. We found that for some cities, there are no airports within 50 miles, while for some others, there are more than one airport; summary statistics are provided in Table 1 where the number of city pairs with direct flights is 10,676 (out of 90,743). For a given city pair for which prices are compared, we produced the binary variable of having direct flights (using the direct flight data that we have) by taking into account all airports within 50 miles of the analyzed cities.

As shown in Table 1, when all city pairs in the sample are considered, the average trade costs are about %111.5 for city pairs with at least one direct flight, while they are about %136.6 for city pairs without any direct flights. Therefore, without any other controls, trade costs are about 25% lower for city pairs with at least one direct flight. Similar comparisons can be made for international and intranational city pairs as well, where city pairs with at least one direct flight have lower trade costs in both cases. Regarding the distribution of trade costs, the Kernel density estimates are given in Figure 2, where the city pairs that have direct flights between each other have lower trade costs, independent of being international or intranational. Therefore, direct flights seem to have a reducing effect on trade costs between cities; nevertheless, proving this claim requires a formal investigation, the results of which are depicted in the next section.

We estimate Equation 7 with alternative combinations of the right hand side variables using OLS as the benchmark case. However, existence of a direct flight between any two cities may be endogenously determined by trade costs. Accordingly, besides the benchmark case, we also consider an IV estimation (of Two-Stage Least Squares, TSLS) to control for endogeneity. In the first stage, the existence of a direct flight is regressed on policy-based instruments by a linear probability model, and the fitted values of the first stage are used to estimate Equation 7 in the second stage.[10] Using policy-based instruments is the key here in order to make sure that

[10] Needless to say, exogenous variables in Equation 7 (e.g., distance, border, language, colony, RTA, city fixed effects) are included in both stages. We also consider two-way clustered standard errors

the corresponding policy suggestions will be relevant for governments regarding their international policies.

We consider four different sets of instruments in the first stage estimation that are depicted in Table 2. The instrument sets consist of five policy variables at the country level that are borrowed from Piermartini and Rousova (2013) who use a large data set of approximately 2,300 air services agreements that were in force in 2005 among 184 countries. The timing of this data set perfectly matches the purpose of this paper, since these instruments represent the initial conditions of countries, about five years before the collection of data on trade costs. The first policy instrument is the Air Liberalization Index (ALI) constructed by the WTO Secretariat (WTO 2006). It is an expert-based index that measures how liberal the aviation agreements are between countries; it considers the main features of air services agreements between countries by assigning a weight to each provision included in the agreement, such as grant of rights, capacity clause, pricing, withholding, designation, statistics and cooperative arrangements. ALI ranges between 0 and 50, where 0 is associated with the most restrictive agreement and 50 denotes the most liberal agreement across countries. Factor Analysis Index (FAI) is another instrument introduced by Piermartini and Rousova (2013) that has been obtained by means of factor analysis using the same similar indicators with alternative weights; FAI ranges between zero and one, and it increases with the degree of liberalization of the aviation market. Log Effective

at the city level that have been modified to control for biases due to having a two-stage estimator.

Years (LEY) represent the number of years since the first air services agreements have entered into force, capturing the historical links between two countries in terms of cooperation in aviation matters. Incident Investigation Procedures (IIP) in air services agreements is a dummy variable for incident investigation that equals 1 if investigation procedures in the event of an accident or forced landing by an aircraft of one party in the territory of the other are covered by an air services agreement. Security Cooperation Provision (SCP) in air services agreements is another dummy variable for security cooperation taking a value of 1 if a provision is made for cooperation in situations involving aviation security, including actions taken to prevent, suppress, or terminate threats or acts of unlawful interference. The reader is referred to Piermartini and Rousova (2013) for further details of these policy instruments. Since ALI and FAI are substitute indices for each other, we use alternative combination of these four variables to construct our set of instruments as depicted in Table 2.

4 Empirical Results

4.1 Benchmark Case

The benchmark case results based on OLS are given in Table 3, where the effects of direct flights on trade costs are negative and significant (at the 0.1% level), independent of including the control variables.[11] As is evident in column 5, which is the case with all control variables includes to avoid any omitted variable bias, the existence of a direct flight reduces trade costs by about 1.32% across cities. This is much lower compared to Micco and Serebrisky (2006) who have shown that Open Skies Agreements between countries reduce air transport costs by 9%; however, note that we only focus on the effect of direct flights, while they focus on both direct and indirect flights potentially taking effect due the international agreements.

The effect of distance on trade costs is positive, as expected, where the coefficient estimate takes a value of about 0.05. This estimate corresponds to about 36% of trade costs when the distance between cities is about 1000 miles; it is also consistent with existing studies in the literature such as by Crucini and Yilmazkuday (2014). Nevertheless, there may be nonlinearities in the effect of distance on trade costs; we will consider such possibilities during the robustness checks, below.

Having an international border between cities also contributes to trade costs with an additional effect of about %15 percent. Therefore, direct flights have an additional reduction impact on international trade costs compared to intranational trade costs. Regarding other international effects, having a common border (between the countries where cities are located) reduces trade costs by about 11%, while having a common language (between the countries where cities are located) reduces trade costs by about

[11] Since trade costs are at the city-pair level, cluster-robust standard errors are calculated at the city level; such a strategy has been used to control for within-city-pair cross-city correlation in the regression analyis.

13%. Having a colonial relationship (between the countries where cities are located) also reduces trade costs between cities by about 4%, and finally having an RTA reduces trade costs by about 13%. Having a high explanatory power further supports these results.

4.2 Robustness Checks

As the first robustness check, we consider nonlinearities in the effect of distance on trade costs; the results are given in Table 4. While the first column replicates the last column of Table 3 for comparison purposes, the second column considers log distance squared, and the remaining columns investigate the effects of distance considering five distance intervals defined as the first to fifth 20th percentile of the distance data. As is evident, both log distance and log distance squared are significant in the second column; hence, there is evidence for nonlinearity in the effects of distance on trade costs. This is also supported by the effects of log distance intervals in columns (3)-(6). The existence of a direct flight, which is the main focus of this paper, still has negative effects on trade costs in all columns, and its coefficient is significant in all columns except for column (2). Therefore, there is still strong evidence for the negative effects of having direct flights on trade costs between cities, even after considering for nonlinearities in distance measures.

As the second robustness check, we consider the potential endogeneity of having direct flights between cities. As discussed in details above, this consists of a two-stage estimation, where the existence of a direct flight is investigated in the first stage through a linear probability model, and the fitted values of this first stage are further used in the second stage to determine the effects of direct flights on trade costs. The results of the first stage are given in Table 5, where we have (for sure) included the exogenous variables of the second stage analysis as well, including nonlinearities in distance. Each column represents a different set of instruments as defined in Table 2. Before moving to the details of the results, it is important to emphasize that the considered instruments are relevant according to the F-test results in Table 5 showing the significance level of the instrument-relevance test results based on the joint null hypothesis of the coefficients of instruments being equal to zero.

Regarding the results, both Air Liberalization Index (ALI) and Factor Analysis Index (FAI) affect the existence of a direct flight positively. Therefore, if two cities are located in two countries having an aviation agreement, it is more likely for these cities to have a direct flight between each other. Log Effective Years (LEY) also enter positively and significantly to the first stage estimation, meaning that as the number of years for having an aviation agreement increases, the chances for the cities located in these countries to have a direct flight also increases. Similarly, both Incident Investigation Procedures (IIP) and Security Cooperation Provision (SCP) in air services agreements have positive effects on the existence of a direct flight; i.e., if two countries have such details in their agreement, there is a bigger chance that there will be a direct flight between the cities located in these countries.

When we investigate the effects of standard gravity variables on the existence of a direct flight in Table 5, it is evident that log distance enters the linear probability regression positively and significantly, while its squared value enters negatively and significantly. Therefore, direct flights are more available between cities that are remote from each other, but as distance increases between cities, there are fewer direct flights. This is potentially because of having longer flights as the distance increases between cities, which makes it economically less profitable due to having fewer demand between such cities; instead, indirect flights through connection hubs may be more preferable in such cases. Having an international border between cities also decreases the chances of having a direct flight between cities, meaning that direct flights are more common across intranational city pairs. Having a common/land border across countries where two cities are located also reduces the likelihood of having a direct flight, potentially due to having easy access to other modes of transportation through that border (e.g., European countries that have a common border). Having a common language also increases the possibility of having direct flights. Finally, having a common language, a colonial relationship or a regional trade agreement also enter positively and significantly in most cases. High explanatory power in the regressions support these results.

The fitted values of the first stage regressions, which represent direct flights determined by policy instruments based on air services agreements, are further used to investigate the effects of direct flights on trade costs. The results are given in Table

6, where the null hypothesis of the existence of a direct flight being exogenous is rejected at the 10% level for Instrument Set #1 and at the 1% level for other set of instruments. As is evident, the effects of direct flights are negative and significant in all IV (TSLS) results, independent of the set of instruments used, although the magnitude of the negative effect changes across instrument sets.

4.3 Further Robustness

Information frictions have been shown to be higher internationally compared to intranationally (e.g., see Hau, 2001). Accordingly, we would like to know whether the existence of a direct flight affects trade costs differently when we consider international versus intranational city pairs. The corresponding results are given in Table 7, where the results based on the interaction of the direct flight and an international border are shown. As is evident, international direct flights correspond to lower trade costs independent of the instruments used; however, the corresponding evidence on the effect of intranational direct flights are mixed. It is implied that our results of direct flights corresponding to lower trade costs are mostly derived by international rather than intranational direct flights. Therefore, the results are in line with the existing literature based on higher international information barriers.

Although we consider city fixed effects in almost all of our regressions in order to capture city-specific characteristics such as size and geographical location, for robustness, we also consider an alternative city-pair dummy variable which takes a value of

1 when both cities are coastal cities.[12] We are particularly interested in the interaction of this dummy variable with the existence of a direct flight in order to test the hypothesis of whether direct flights have a different impact for coastal city pairs, since such city pairs may have lower trade costs between each other. As is evident in Table 7, the corresponding results are mixed (i.e., they depend on the set of instruments used), suggesting that direct flights do not necessarily affect coastal city pairs in a different way, after controlling for city fixed effects.

Finally, as mentioned by Eaton and Kortum (2002) and Borraz et al. (2014), the maximum price difference across goods is sensitive to the possibility of measurement errors in the price data. For example, prices may be misreported or posted outside the no-arbitrage range. Accordingly, Eaton and Kortum (2002) have considered the second maximum price difference across goods, while Borraz et al. (2014) have considered alternative percentiles (e.g., 80th, 90th, etc.). Following these studies, besides Equation 6, for robustness, we also considered the second maximum, together with the 80th and 90th percentiles, of traded-input price differences across goods between cities as the measure of trade costs. Furthermore, we also considered alternative airport locations such as within 100 and 200 miles of city centers. All of these investigations resulted in virtually the same result: having direct flights affects trade costs

[12] Coastal cities are defined as cities that are at most 50 miles away from the closest shoreline. Such calculations are achieved in Matlab using the exact location of cities (in terms of their latitudes and longitudes) and the global self-consistent hierarchical high-resolution shoreline data of gshhs_f.b.gz.

negatively and significantly.[13]

5 Concluding Remarks and Policy Implications

The effects of direct flights on trade costs are shown to be negative and significant across cities around the world. This result is supported by many robustness checks, including the consideration of control variables, nonlinearities in the effects of distance on trade costs, potential endogeneity of having direct flights between cities, and alternative definitions of the data. Since air services agreements signed between countries are shown to be effective on the existence of direct flights, there is strong evidence in favor of such policies that facilitate direct flights and thus reduce trade costs.

In terms of the development of trade costs over time, the literature on economic history has shown that the technological developments in ocean transportation were important determinants of growing trade in the first era of globalization during the latter half of the nineteenth century. Hummels (2007) has argued that the technological development in air transportation (due to the declining cost of rapid transportation) has been a critical input into a second era of globalization during the latter half of the twentieth century. Therefore, the existing literature has restricted the reasons for globalization to the analysis of technology, which is not directly connected to international government policies. In contrast, this paper suggests that globalization

[13] The results of these robustness checks are available upon request.

(measured by the reduction in trade costs) can also be achieved through air services liberalization across countries that has direct connections to international government policies. Hence, one policy implication of this paper is that tariff rates and/or duties are not the only trade policy tools that can be used to lower trade costs in order to facilitate welfare increasing economic interaction between countries; other international trade policies through aviation services, such as *Open Skies Agreements* of the U.S. or *A Common Aviation Area Agreement* and *Euro-Mediterranean Aviation Agreement* of the E.U., are also effective in reducing international trade costs.

Another policy implication is that direct flights facilitate the integration of internal markets. This is in line with studies such as by Engel and Rogers (2004) who discuss trade costs among the types of friction providing significant barriers to the integration of product markets, which has been the major conclusion of many researchers in the literature investigating the price differences across locations for several decades. This paper has contributed to that literature by showing that trade costs can be reduced through direct flights even within the same internal market; e.g., *Multilateral Agreement on the Establishment of a European Common Aviation Area* signed by many European countries among themselves to facilitate the integration of their internal markets is a perfect example to this case.

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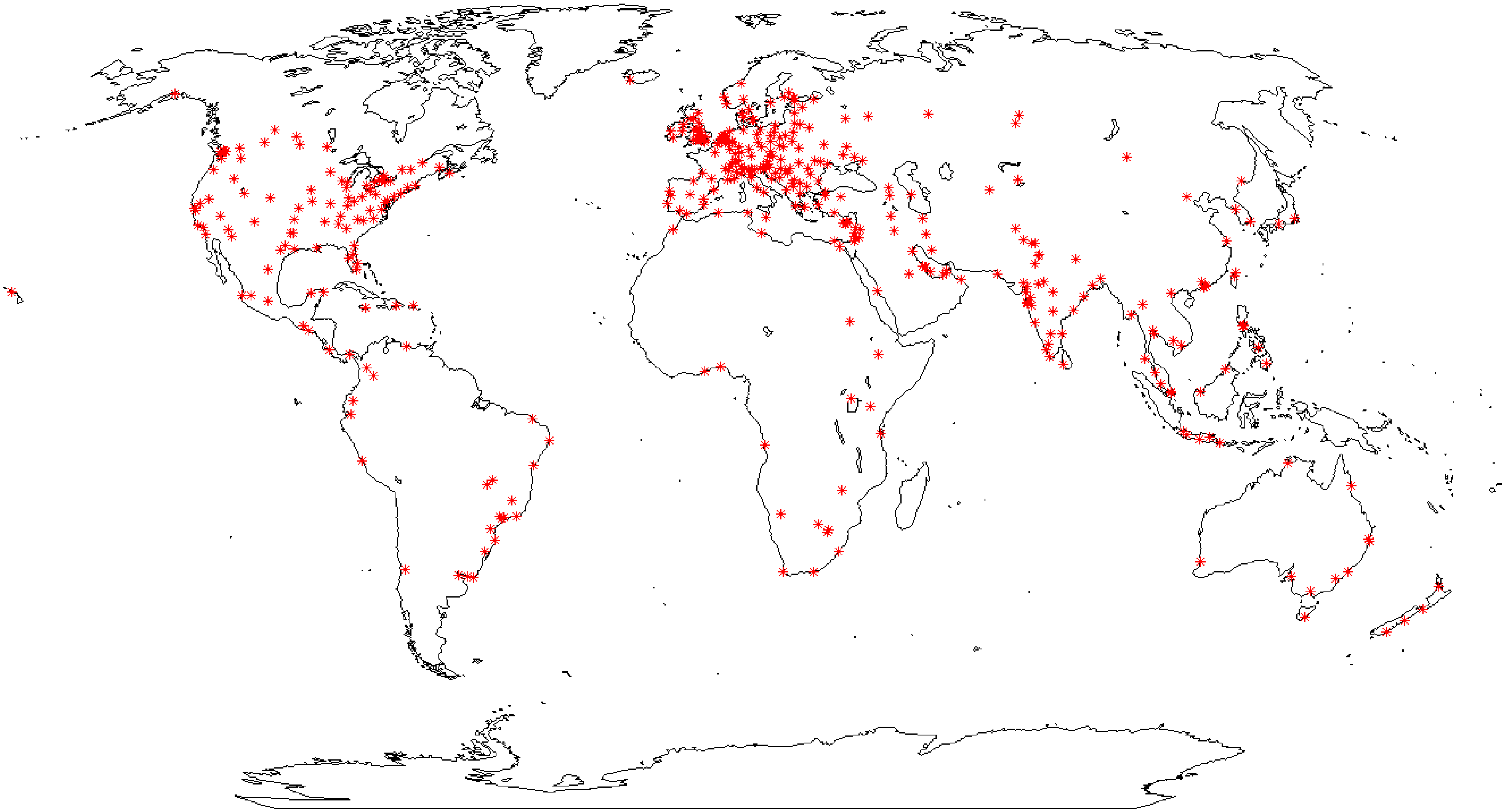
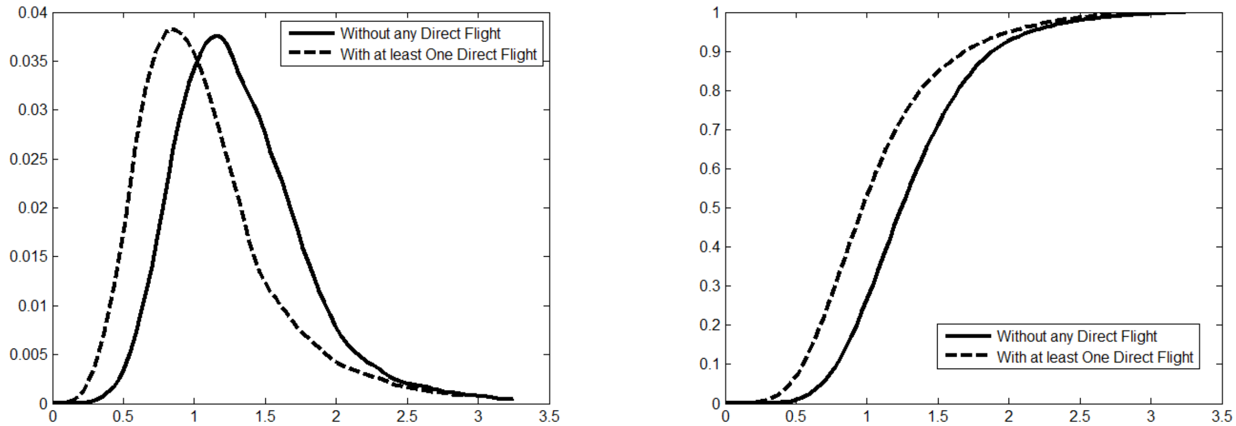
Figure 1 - Cities in the Micro Price Data



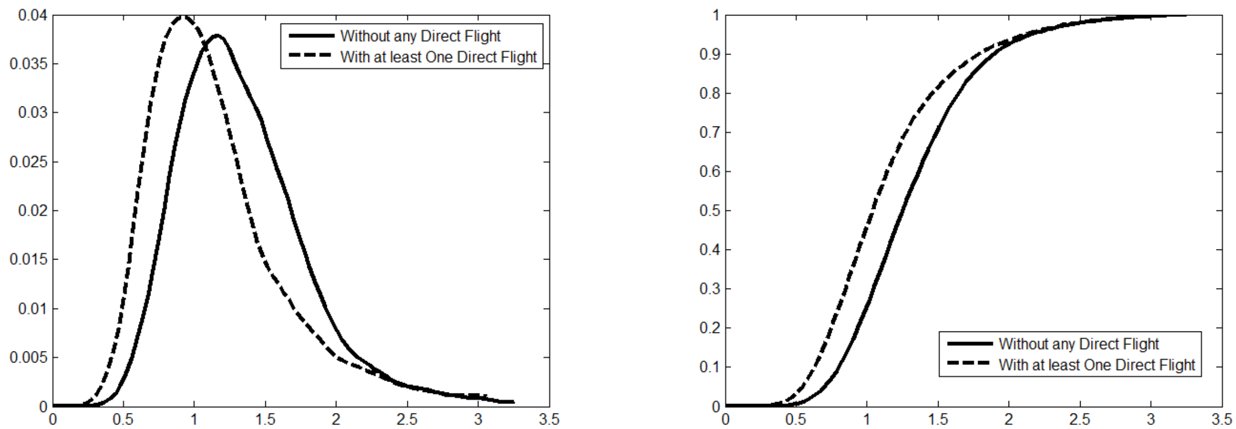
Notes: Each star represents a city in the micro price data. There are 433 cities in the sample.

Figure 2 - Kernel Density of Trade Costs across Cities

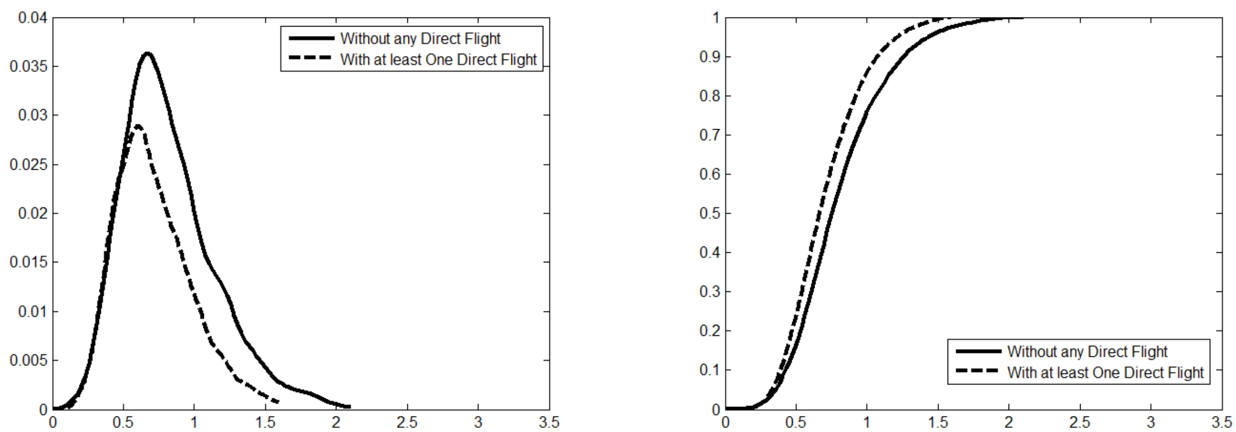
All City Pairs



International City Pairs



Intranational City Pairs



Notes: For any given city pair, the trade costs are measured by the maximum of the absolute log price difference across goods. City pairs with direct flights are defined as the pairs that have direct flights between each other through an airport within 50 miles of the center city. The left panel shows the kernel estimation of the probability density function (pdf), while the right panel shows the kernel estimation of the cumulative density function (cdf). The sample size is 90,743.

Table 1 - Descriptive Statistics

	All City Pairs	International City Pairs	Intranational City Pairs
Average Estimated Trade Costs between City Pairs ***with*** Direct Flights	1.115	1.198	0.724
Average Estimated Trade Costs between City Pairs ***without*** Direct Flights	1.366	1.376	0.833
Number of City Pairs ***with*** Direct Flights	10,676	8,818	1,858
Number of City Pairs ***without*** Direct Flights	80,067	78,489	1,578
Average Distance in Miles between City Pairs ***with*** Direct Flights	1,913	2,138	845
Average Distance in Miles between City Pairs ***without*** Direct Flights	4,897	4,973	1,134

Source: International city pairs are defined as the pairs that have an international border between them. Intranational city pairs are defined as the pairs that are located in the same country. The availability of the price data has been determined by considering the long-run relative prices between 2010-2014. The availability of the direct flights has been determined according to the data for 2013. Average Estimated Trade Costs represent the mean values of the estimated distributions given in Figure 2.

Table 2 - Policy Instruments for Direct Flights

	Instrument Set #1	Instrument Set #2	Instrument Set #3	Instrument Set #4
Air Liberalization Index (ALI)	YES	NO	YES	NO
Factor Analysis Index (FAI)	NO	YES	NO	YES
Log Effective Years (LEY) of an Air Services Agreements	NO	NO	YES	YES
Incident Investigation Procedures (IIP) in Air Services Agreements	NO	NO	YES	YES
Security Cooperation Provision (SCP) in Air Services Agreements	NO	NO	YES	YES

Notes: ALI ranges between 0 and 50, where 0 is associated with the most restrictive agreement and 50 denotes the most liberal agreement. FAI ranges between 0 and 1; it increases with the degree of liberalization of the aviation market. IIP is a dummy variable for incident investigation that equals 1 if investigation procedures in the event of an accident or forced landing by an aircraft of one party in the territory of the other are covered by an air services agreement. SCP is another dummy variable for security cooperation taking a value of 1 if a provision is made for cooperation in situations involving aviation security, including actions taken to prevent, suppress, or terminate threats or acts of unlawful interference. See Piermartini and Rousova (2013) for further details.

Table 3 - Benchmark Estimation Results for Trade Costs

	Dependent Variable: Log Trade Costs				
	(1)	(2)	(3)	(4)	(5)
	OLS	OLS	OLS	OLS	OLS
Direct Flight	-0.250***	-0.254***	-0.0720***	-0.0416***	-0.0132***
	(0.00626)	(0.00412)	(0.00694)	(0.00406)	(0.00395)
Log Distance			0.105***	0.126***	0.0514***
			(0.00251)	(0.00173)	(0.00255)
International Border			0.366***	0.326***	0.151***
			(0.00776)	(0.00708)	(0.00817)
Common Border					-0.108***
					(0.00606)
Common Language					-0.133***
					(0.00431)
Colony					-0.0417***
					(0.00475)
RTA					-0.134***
					(0.00436)
City Fixed Effects	NO	YES	NO	YES	YES
Adjusted R-squared	0.016	0.744	0.058	0.782	0.795
Sample Size	90,743	90,743	90,743	90,743	57,963

Notes: ***, ** and * represent significance at the 0.1%, 1%, and 5% levels. The estimation is by OLS in all columns. Cluster-robust standard errors calculated at the city level are in parentheses.

Table 4 - Estimation Results for Trade Costs: Nonlinearities in Distance Measures

	Dependent Variable: Log Trade Costs					
	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	OLS	OLS	OLS	OLS	OLS
Direct Flight	-0.0132***	-0.00587	-0.0629***	-0.0332***	-0.0462***	-0.00810*
	(0.00395)	(0.00390)	(0.00686)	(0.00400)	(0.00680)	(0.00394)
Log Distance	0.0514***	-0.0900***				
	(0.00255)	(0.0144)				
Log Distance Squared		0.00997***				
		(0.00100)				
Log Distance Interval #1			0.0745***	0.0862***	0.0369***	0.0203***
			(0.00680)	(0.00377)	(0.00738)	(0.00380)
Log Distance Interval #2			0.109***	0.0999***	0.0592***	0.0273***
			(0.00556)	(0.00327)	(0.00604)	(0.00336)
Log Distance Interval #3			0.0864***	0.1000***	0.0351***	0.0273***
			(0.00529)	(0.00304)	(0.00582)	(0.00323)
Log Distance Interval #4			0.0930***	0.103***	0.0460***	0.0354***
			(0.00515)	(0.00296)	(0.00565)	(0.00313)
Log Distance Interval #5			0.0847***	0.0924***	0.0554***	0.0272***
			(0.00493)	(0.00289)	(0.00546)	(0.00308)
International Border	0.151***	0.161***	0.357***	0.343***	0.0103	0.166***
	(0.00817)	(0.00805)	(0.00785)	(0.00708)	(0.0115)	(0.00818)
Common Border	-0.108***	-0.105***			-0.0234**	-0.120***
	(0.00606)	(0.00601)			(0.00880)	(0.00611)
Common Language	-0.133***	-0.142***			-0.220***	-0.128***
	(0.00431)	(0.00441)			(0.00578)	(0.00463)
Colony	-0.0417***	-0.0364***			-0.0439***	-0.0413***
	(0.00475)	(0.00468)			(0.00928)	(0.00492)
RTA	-0.134***	-0.124***			-0.230***	-0.123***
	(0.00436)	(0.00443)			(0.00800)	(0.00458)
City Fixed Effects	YES	YES	NO	YES	NO	YES
Adjusted R-squared	0.795	0.795	0.076	0.788	0.155	0.795
Sample Size	57,963	57,963	90,743	90,743	57,963	57,963

Notes: ***, ** and * represent significance at the 0.1%, 1%, and 5% levels. Log Distance Intervals #1-5 correspond to the first-fifth 20th percentile of the distance measures in order to consider possible nonlinearities. The estimation is by OLS in all columns. Cluster-robust standard errors calculated at the city level are in parentheses.

Table 5 - Estimation Results for the Existence of a Direct Flight

	Dependent Variable: Existence of a Direct Flight			
	(1) LPR Instrument Set #1	(2) LPR Instrument Set #2	(3) LPR Instrument Set #3	(4) LPR Instrument Set #4
ALI	0.00242***		0.00169***	
	(0.000157)		(0.000175)	
FAI		0.0731***		0.0447***
		(0.00680)		(0.00749)
LEY			0.0157***	0.0149***
			(0.00202)	(0.00203)
IIP			0.0553***	0.0683***
			(0.00586)	(0.00569)
SCP			0.0291***	0.0336***
			(0.00396)	(0.00397)
Log Distance	0.465***	0.453***	0.473***	0.466***
	(0.0234)	(0.0233)	(0.0233)	(0.0232)
Log Distance Squared	-0.0412***	-0.0405***	-0.0414***	-0.0409***
	(0.00155)	(0.00154)	(0.00154)	(0.00153)
International Border	-0.155***	-0.178***	-0.165***	-0.173***
	(0.0115)	(0.0113)	(0.0127)	(0.0126)
Common Border	-0.0711***	-0.0766***	-0.0547***	-0.0554***
	(0.00771)	(0.00770)	(0.00781)	(0.00782)
Common Language	0.0486***	0.0476***	0.0369***	0.0349***
	(0.00501)	(0.00506)	(0.00514)	(0.00516)
Colony	0.00694	0.00305	0.0112+	0.00924
	(0.00618)	(0.00618)	(0.00620)	(0.00620)
RTA	0.0152***	0.0297***	-0.000912	0.00497
	(0.00456)	(0.00445)	(0.00471)	(0.00467)
City Fixed Effects	YES	YES	YES	YES
Adjusted R-squared	0.427	0.426	0.429	0.429
F-test (Relevance)	240.894	116.942	91.109	80.614
	[0.000]	[0.000]	[0.000]	[0.000]
Sample Size	57,963	57,963	57,963	57,963

Notes: ***, ** and * represent significance at the 0.1%, 1%, and 5% levels. The estimation is by linear probability regression (LPR) in all columns; instruments are defined in Table 2. Cluster-robust standard errors calculated at the city level are in parentheses. F-test (Relevance) shows the instrument-relevance test results based on the joint null hypothesis of the coefficients of instruments being equal to zero; the corresponding p-values are given in brackets.

Table 6 - Two-Step Estimation Results for Trade Costs

	Dependent Variable: Log Trade Costs			
	(1) IV Instrument Set #1	(2) IV Instrument Set #2	(3) IV Instrument Set #3	(4) IV Instrument Set #4
Direct Flight	-0.117+	-0.523***	-0.415***	-0.518***
	(0.0611)	(0.103)	(0.0505)	(0.0567)
Log Distance	-0.0420	0.133**	0.0866**	0.131***
	(0.0299)	(0.0475)	(0.0265)	(0.0291)
Log Distance Squared	0.00559*	-0.0104*	-0.00612**	-0.0102***
	(0.00261)	(0.00423)	(0.00224)	(0.00247)
International Border	0.138***	0.0556*	0.0776***	0.0567***
	(0.0145)	(0.0225)	(0.0135)	(0.0148)
Common Border	-0.114***	-0.145***	-0.137***	-0.145***
	(0.00776)	(0.0109)	(0.00792)	(0.00850)
Common Language	-0.138***	-0.121***	-0.125***	-0.121***
	(0.00506)	(0.00654)	(0.00530)	(0.00562)
Colony	-0.0364***	-0.0365***	-0.0365***	-0.0365***
	(0.00470)	(0.00556)	(0.00523)	(0.00555)
RTA	-0.119***	-0.102***	-0.107***	-0.102***
	(0.00508)	(0.00645)	(0.00525)	(0.00552)
City Fixed Effects	YES	YES	YES	YES
Adjusted R-squared	0. 792	0. 730	0. 754	0.731
F-test (Endogeneity)	3.370	32.545	79.625	108.688
	[0.066]	[0.000]	[0.000]	[0.000]
Sample Size	57,963	57,963	57,963	57,963

Notes: ***, ** and * represent significance at the 0.1%, 1%, and 5% levels. The estimation is by IV (TSLS). Instrument Set #1-4 correspond to instrumenting the existence of Direct Flights with policy instruments defined in Table 2. Cluster-robust standard errors calculated at the city level are in parentheses. F-test (Endogeneity) shows the regression-based endogeneity test results based on the null hypothesis of the existence of a direct flight being exogenous; the corresponding p-values are given in brackets.

Table 7 - Two-Step Estimation Results for Trade Costs: Additional Variables

	Dependent Variable: Log Trade Costs					
	(1)	(2)	(3)	(4)	(5)	(6)
	IV	IV	IV	IV	IV	IV
	Instrument Set #3	Instrument Set #4	Instrument Set #3	Instrument Set #4	Instrument Set #3	Instrument Set #4
Direct Flight			-0.887***	-0.601***		
			(0.131)	(0.110)		
International Direct Flight	-0.782***	-0.550***			-1.031***	-0.599***
	(0.120)	(0.0931)			(0.147)	(0.113)
Intranational Direct Flight	1.239**	-0.377			0.291	-0.646
	(0.462)	(0.312)			(0.554)	(0.477)
CoastalPair*DirectFlight			1.649***	0.332	1.313**	0.359
			(0.388)	(0.375)	(0.411)	(0.469)
Log Distance	-0.0335	0.121***	0.237***	0.156***	0.128+	0.161**
	(0.0500)	(0.0354)	(0.0504)	(0.0405)	(0.0703)	(0.0622)
Log Distance Squared	-0.000119	-0.00969***	-0.0163***	-0.0117***	-0.0103*	-0.0120**
	(0.00347)	(0.00266)	(0.00386)	(0.00305)	(0.00469)	(0.00396)
International Border	1.113***	0.145	0.00666	0.0448*	0.698*	0.0201
	(0.285)	(0.194)	(0.0257)	(0.0202)	(0.317)	(0.259)
Common Border	-0.136***	-0.145***	-0.122***	-0.141***	-0.124***	-0.140***
	(0.0105)	(0.00860)	(0.0122)	(0.00976)	(0.0121)	(0.0103)
Common Language	-0.117***	-0.121***	-0.108***	-0.118***	-0.106***	-0.118***
	(0.00769)	(0.00608)	(0.00867)	(0.00670)	(0.00871)	(0.00669)
Colony	-0.0385***	-0.0367***	-0.0320***	-0.0356***	-0.0343***	-0.0355***
	(0.00691)	(0.00565)	(0.00800)	(0.00567)	(0.00793)	(0.00585)
RTA	-0.0655***	-0.0989***	-0.121***	-0.106***	-0.0910***	-0.107***
	(0.0128)	(0.00975)	(0.00746)	(0.00657)	(0.0152)	(0.0143)
City Fixed Effects	YES	YES	YES	YES	YES	YES
Adjusted R-squared	0.584	0.728	0.536	0.727	0.556	0.726
F-test (Endogeneity)	52.409	54.247	56.960	54.589	41.285	36.335
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Sample Size	57,963	57,963	57,963	57,963	57,963	57,963

Notes: ***, ** and * represent significance at the 0.1%, 1%, and 5% levels. The estimation is by IV (TSLS). Instrument Set #3-4 correspond to instrumenting the existence of Direct Flights with policy instruments defined in Table 2. Cluster-robust standard errors calculated at the city level are in parentheses. F-test (Endogeneity) shows the regression-based endogeneity test results based on the null hypothesis of the existence of a direct flight being exogenous; the corresponding p-values are given in brackets.

Online Appendix (Not For Publication)

Table A.1 - Traded Goods in the Micro Price Data

Good Code	Traded Goods	Traded-Input Share
1	Imported Beer (0.33 liter bottle)	0.45
2	Coke/Pepsi (0.33 liter bottle)	0.26
3	Water (0.33 liter bottle)	0.14
4	Milk (regular), (1 liter)	0.61
5	Eggs (12)	0.49
6	Water (1.5 liter bottle)	0.33
7	Bottle of Wine (Mid-Range)	0.42
8	Imported Beer (0.33 liter bottle)	0.50
9	Pack of Cigarettes (Marlboro)	0.20
10	Chicken Breasts (Boneless, Skinless), (1kg)	0.43
11	Gasoline (1 liter)	0.40
12	Volkswagen Golf 1.4 90 KW Trendline (Or Equivalent New Car)	0.49
13	1 Pair of Jeans (Levis 501 Or Similar)	0.46
14	1 Summer Dress in a Chain Store (Zara, H&M, ...)	0.62
15	1 Pair of Nike Shoes	0.64
16	1 Pair of Men Leather Shoes	0.51
17	Apples (1kg)	0.52
18	Oranges (1kg)	0.45
19	Potato (1kg)	0.30
20	Lettuce (1 head)	0.41
21	Rice (white), (1kg)	0.44
22	Tomato (1kg)	0.27

Notes: Traded-input shares represent the estimated values.

Online Appendix (Not For Publication)
Table A.2 - Cities in the Micro Price Data

City	City	City	City	City	City	City	City	City
Aachen, Germany	Bhopal, India	Cologne, Germany	Grenoble, France	Kota Kinabalu, Malaysia	Milton Keynes, United Kingdom	Phnom Penh, Cambodia	Sao Jose dos Campos, Brazil	Tunis, Tunisia
Aalborg, Denmark	Bhubenswar, India	Colombo, Sri Lanka	Groningen, Netherlands	Kowloon, Hong Kong	Milwaukee, WI, United States	Phoenix, AZ, United States	Sao Paulo, Brazil	Turin, Italy
Abbotsford, Canada	Bialystok, Poland	Columbus, OH, United States	Guadalajara, Mexico	Krakow (Cracow), Poland	Minneapolis, MN, United States	Phuket, Thailand	Sarajevo, Bosnia And Herzegovina	Turku, Finland
Aberdeen, United Kingdom	Bilbao, Spain	Copenhagen, Denmark	Guangzhou, China	Kuala Lumpur, Malaysia	Minsk, Belarus	Pittsburgh, PA, United States	Saskatoon, Canada	Ulaanbaatar, Mongolia
Abu Dhabi, United Arab Emirates	Birmingham, United Kingdom	Cork, Ireland	Guatemala City, Guatemala	Kuching, Malaysia	Mississauga, Canada	Plovdiv, Bulgaria	Seattle, WA, United States	Utrecht, Netherlands
Accra, Ghana	Bogota, Colombia	Coventry, United Kingdom	Guildford, United Kingdom	Kuwait City, Kuwait	Monterrey, Mexico	Port Elizabeth, South Africa	Seoul, South Korea	Vadodara, India
Ad Dammam, Saudi Arabia	Boise, ID, United States	Cuenca, Ecuador	Gurgaon, India	Lagos, Nigeria	Montevideo, Uruguay	Portland, OR, United States	Sevilla, Spain	Valencia, Spain
Addis Ababa, Ethiopia	Bologna, Italy	Curitiba, Brazil	Haifa, Israel	Lahore, Pakistan	Montreal, Canada	Porto Alegre, Brazil	Shanghai, China	Vancouver, Canada
Adelaide, Australia	Bordeaux, France	Dallas, TX, United States	Halifax, Canada	Larnaca, Cyprus	Moscow, Russia	Porto, Portugal	Sharjah, United Arab Emirates	Varna, Bulgaria
Ahmedabad, India	Boston, MA, United States	Damascus, Syria	Hamburg, Germany	Las Vegas, NV, United States	Mumbai, India	Poznan, Poland	Shenzhen, China	Venice, Italy
Akron, OH, United States	Brampton, Canada	Dar Es Salaam, Tanzania	Hamilton, Canada	Lausanne, Switzerland	Munich, Germany	Prague, Czech Republic	Shiraz, Iran	Verona, Italy
Albuquerque, NM, United States	Brasilia, Brazil	Darwin, Australia	Hanoi, Vietnam	Leeds, United Kingdom	Muscat, Oman	Pretoria, South Africa	Singapore, Singapore	Vicenza, Italy
Alexandria, Egypt	Brasov, Romania	Davao, Philippines	Harare, Zimbabwe	Leicester, United Kingdom	Nagpur, India	Pristina, Serbia	Skopje, Macedonia	Victoria, Canada
Algiers, Algeria	Bratislava, Slovakia	Delhi, India	Hartford, CT, United States	Leiden, Netherlands	Nairobi, Kenya	Puerto Vallarta, Mexico	Sliema, Malta	Vienna, Austria
Alicante, Spain	Brighton, United Kingdom	Denver, CO, United States	Helsinki, Finland	Lille, France	Nanaimo, BC, Canada	Pune, India	Sofia, Bulgaria	Vilnius, Lithuania
Almaty, Kazakhstan	Brisbane, Australia	Detroit, MI, United States	Ho Chi Minh City, Vietnam	Lima, Peru	Naples, Italy	Punta del Este, Uruguay	Split, Croatia	Visakhapatnam, India
Amman, Jordan	Bristol, United Kingdom	Dhaka, Bangladesh	Hobart, Australia	Limassol, Cyprus	Nashville, TN, United States	Quebec City, Canada	Spokane, WA, United States	Vladivostok, Russia
Amsterdam, Netherlands	Brno, Czech Republic	Dnipropetrovsk, Ukraine	Hong Kong, Hong Kong	Lisbon, Portugal	Nasik, India	Quezon City, Philippines	Stavanger, Norway	Warsaw, Poland
Anchorage, AK, United States	Brussels, Belgium	Doha, Qatar	Honolulu, HI, United States	Liverpool, United Kingdom	Navi Mumbai, India	Quito, Ecuador	Stockholm, Sweden	Washington, DC, United States
Ankara, Turkey	Bucharest, Romania	Donetsk, Ukraine	Houston, TX, United States	Ljubljana, Slovenia	New Orleans, LA, United States	Raleigh, NC, United States	Strasbourg, France	Waterloo, Canada
Antalya, Turkey	Budapest, Hungary	Dresden, Germany	Huntsville, AL, United States	Lodz, Poland	New York, NY, United States	Reading, United Kingdom	Stuttgart, Germany	Wellington, New Zealand
Antwerp, Belgium	Buenos Aires, Argentina	Dubai, United Arab Emirates	Hyderabad, India	London, Canada	Newcastle Upon Tyne, United Kingdom	Recife, Brazil	Surabaya, Indonesia	West Palm Beach, FL, United States
Arhus, Denmark	Buffalo, NY, United States	Dublin, Ireland	Iasi, Romania	London, United Kingdom	Nice, France	Regina, Canada	Surat, India	Wichita, KS, United States
Asheville, NC, United States	Bursa, Turkey	Dunedin, New Zealand	Indianapolis, IN, United States	Los Angeles, CA, United States	Nicosia, Cyprus	Reno, NV, United States	Surrey, Canada	Windhoek, Namibia
Athens, Greece	Busan, South Korea	Durban, South Africa	Indore, India	Louisville, KY, United States	Nis, Serbia	Reykjavik, Iceland	Sydney, Australia	Windsor, Canada
Atlanta, GA, United States	Bydgoszcz, Poland	Dusseldorf, Germany	Irbil, Iraq	Luanda, Angola	Nizhniy Novgorod, Russia	Richmond, VA, United States	Szczecin, Poland	Winnipeg, Canada
Auckland, New Zealand	Cairns, Australia	Edinburgh, United Kingdom	Islamabad, Pakistan	Lublin, Poland	Noida, India	Riga, Latvia	Taichung, Taiwan	Wroclaw, Poland
Austin, TX, United States	Cairo, Egypt	Edmonton, Canada	Istanbul, Turkey	Ludhiana, India	Nottingham, United Kingdom	Rijeka, Croatia	Taipei, Taiwan	Yangon, Myanmar
Baghdad, Iraq	Calgary, Canada	Eindhoven, Netherlands	Izmir, Turkey	Lugano, Switzerland	Novi Sad, Serbia	Rio De Janeiro, Brazil	Tallinn, Estonia	Yekaterinburg, Russia
Bahrain, Bahrain	Cambridge, United Kingdom	Esfahan, Iran	Jacksonville, FL, United States	Luxembourg, Luxembourg	Novosibirsk, Russia	Riyadh, Saudi Arabia	Tampa, FL, United States	Yerevan, Armenia
Baku, Azerbaijan	Campinas, Brazil	Espoo, Finland	Jaipur, India	Lviv, Ukraine	Nuremberg, Germany	Roanoke, VA, United States	Tampere, Finland	Yogyakarta, Indonesia
Bali, Indonesia	Canberra, Australia	Florence, Italy	Jakarta, Indonesia	Lyon, France	Odesa, Ukraine	Rochester, NY, United States	Tartu, Estonia	Zagreb, Croatia
Baltimore, MD, United States	Cancun, Mexico	Florianopolis, Brazil	Jeddah (Jiddah), Saudi Arabia	Macao, Macao	Oklahoma City, OK, United States	Rome, Italy	Tashkent, Uzbekistan	Zurich, Switzerland
Bandung, Indonesia	Cape Town, South Africa	Fort Lauderdale, FL, United States	Jerusalem, Israel	Madison, WI, United States	Omaha, NE, United States	Rostov-na-donu, Russia	Tbilisi, Georgia	
Bangalore, India	Caracas, Venezuela	Fort Worth, TX, United States	Johannesburg, South Africa	Madrid, Spain	Orlando, FL, United States	Rotterdam, Netherlands	Tehran, Iran	
Bangkok, Thailand	Cardiff, United Kingdom	Fortaleza, Brazil	Johor Baharu, Malaysia	Makati, Philippines	Osaka, Japan	Sacramento, CA, United States	Tel Aviv-Yafo, Israel	
Banja Luka, Bosnia And Herzegovina	Casablanca, Morocco	Frankfurt, Germany	Kampala, Uganda	Malaga, Spain	Osijek, Croatia	Saint Louis, MO, United States	Thane, India	
Barcelona, Spain	Cebu, Philippines	Fredericton, Canada	Kansas City, MO, United States	Malmo, Sweden	Oslo, Norway	Saint Petersburg, Russia	The Hague, Netherlands	
Barrie, Canada	Chandigarh, India	Gaborone, Botswana	Karachi, Pakistan	Manama, Bahrain	Ottawa, Canada	Salt Lake City, UT, United States	Thessaloniki, Greece	
Basel, Switzerland	Charlotte, NC, United States	Galway, Ireland	Kathmandu, Nepal	Manchester, United Kingdom	Oxford, United Kingdom	Salvador, Brazil	Thiruvananthapuram, India	
Beersheba, Israel	Chennai, India	Gdansk, Poland	Katowice, Poland	Manila, Philippines	Padova, Italy	San Antonio, TX, United States	Timisoara, Romania	
Beijing, China	Chiang Mai, Thailand	Geneva, Switzerland	Kaunas, Lithuania	Maribor, Slovenia	Panama City, Panama	San Diego, CA, United States	Tirana, Albania	
Beirut, Lebanon	Chicago, IL, United States	Genoa, Italy	Kelowna, Canada	Marseille, France	Paphos, Cyprus	San Francisco, CA, United States	Tokyo, Japan	
Belfast, United Kingdom	Chisinau, Moldova	Gent, Belgium	Kharkiv, Ukraine	Medellin, Colombia	Paris, France	San Jose, CA, United States	Tomsk, Russia	
Belgrade, Serbia	Christchurch, New Zealand	Glasgow, United Kingdom	Khartoum, Sudan	Melbourne, Australia	Patras, Greece	San Jose, Costa Rica	Toronto, Canada	
Belo Horizonte, Brazil	Cincinnati, OH, United States	Goa, India	Kiev, Ukraine	Memphis, TN, United States	Pattaya, Thailand	San Juan, Puerto Rico	Toulouse, France	
Bergamo, Italy	Cleveland, OH, United States	Goiania, Brazil	Kingston, Jamaica	Merida, Mexico	Penang, Malaysia	San Salvador, El Salvador	Trieste, Italy	
Bergen, Norway	Cluj-napoca, Romania	Gold Coast, Australia	Kitchener, Canada	Mexico City, Mexico	Perth, Australia	Santa Barbara, CA, United States	Tripoli, Libya	
Berlin, Germany	Coimbatore, India	Gothenburg, Sweden	Kochi, India	Miami, FL, United States	Petaling Jaya, Malaysia	Santiago, Chile	Trondheim, Norway	
Bern, Switzerland	Coimbra, Portugal	Graz, Austria	Kolkata, India	Milan, Italy	Philadelphia, PA, United States	Santo Domingo, Dominican Republic	Tucson, AZ, United States	