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The Importance of Business Travel for Trade: Evidence from the Liberalization of the Soviet Airspace

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Abstract

The strong negative relationship between geographical distance and trade is not well understood. I use the liberalization of the Soviet airspace to estimate the causal impact of business travel cost on trade. The liberalization radically reduced travel time between Europe and East Asia and was associated with a significant increase in trade. I find that the cost of business travel can account for most of the trade frictions (85.3%) that cause trade to sharply decline with distance. A plausible explanation for these results is that face-to-face interaction through business travel is important for trade, and that transporting people is costly.

Keywords: trade costs, air travel, face-to-face communication
JEL: F14, F15, R4

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1 Introduction

While the world becomes more globalized, geographical distance still has a remarkably strong negative impact on trade. Trade frictions generated by distance are also not well understood, despite being a key component of most empirical trade models. In a review of the literature, Head and Mayer (2013) conclude that the distance elasticity of trade is large, not declining, and largely unaccounted for by conventional explanations such as transport costs and tariffs. This conclusion stands in stark contrast to much of the popular writing on the current wave of globalization usually describing a shift to a global economy where physical distance does not matter.[1]

One hypothesis to explain the distance elasticity is that physical interaction is still important for trade and that transporting personnel comes at a significant cost (Baldwin, 2016). If travel costs are significant and increase with distance, it could provide an answer for why countries that are far apart trade very little compared to those that are close.[2] While the face-to-face explanation is plausible, it is hard to disentangle from other channels that also correlate with distance. For instance, unfamiliarity with remote business partners, differences in preferences, or uncertainty about foreign legal systems. Another issue is reverse causality, as trade creates an incentive to provide better transportation which may bring down the cost of face-to-face communication.

The purpose of this paper is twofold. The first goal is to estimate the causal relationship between business travel cost and trade. The second objective is to estimate what fraction business travel costs can account for the total trade frictions that causes bilateral trade to decline with geographical distance. I identify the causal impact of business travel cost on trade using the liberalization of the Soviet airspace in 1985 as a natural experiment. Before the liberalization almost no airline had permission to overfly the Soviet Union. This added significant flight time to a large number of international routes, primarily between Europe and East Asia. Nearly

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[1] The book *The World is Flat* by Thomas Friedman (2005) is perhaps the most notable example popularizing the notion of a borderless global economy.

[2] Similar ideas have been put forward by several scholars, see for instance Leamer and Storper (2001), and Storper and Venables (2004).

every flight from Europe to East Asia was routed either through Anchorage, Alaska, or the Middle East. After the liberalization, Soviet leaders started to permit non-Soviet airlines to make non-stop overflights over its territory. For instance, a flight from London to Tokyo, which would typically take 18 hours, could be done non-stop in less than 12 hours when routed over Soviet airspace. The liberalization partly had to do with a general reorientation of Soviet policy towards the West at the end of the Cold War. Another important motivation for granting overflight rights was that the air traffic control fees that the Soviets could charge airlines became a vital source of foreign currency. Between 1985 and 1995 the number of non-stop passengers, non-stop routes and airlines that received overflight rights increased rapidly.

To operationalize this quasi experiment, I gather novel non-digitized timetable data from the British Library along with detailed passenger traffic data from ICAO to map flight patterns during the 1980s. I compute changes in flight routes and travel times due to the opening of the Soviet airspace using the geoprocessing software ArcGIS. Using bilateral trade data from the COMTRADE database, I then estimate a theoretical gravity model to analyze the causal impact of shorter travel time on trade. I find that shorter flight times between Europe and East Asia had a substantial positive impact on trade volumes. I estimate that business travel cost can account for 85.3% of the total trade frictions generated by geographical distance. The effect of travel time on trade holds up when restricting the analysis to trade in goods that are not typically transported by air. Hence, the impact on trade is not driven by lower transportation costs for goods shipped by air.[3] The results are also robust to a number of alternative specifications of the gravity model and alternative compositions of the sample. Moreover, using a product classification of technological advancement from Lall (2000), I show that trade in products that rely on more advanced technologies increased more as a consequence of shorter flight routes, compared to goods relying on simple technologies. I argue that products that rely on advanced technologies require more physical presence through business travel when

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[3] The empirical literature suggests that transport costs generally account for a small share of total trade costs. For instance, Glaeser and Kohlhase (2003) find that for 80% of all shipments by value, transport costs make up less than 4% of the value of the good.

traded. The fact that goods that arguably require more face-to-face interaction when traded also responded the most to the reduction in travel time substantiates the claim that it is the lower cost of meeting in person that is driving the results.

If travel cost of people is a major impediment for trade it has wide ranging implications for policy. First, it suggests that infrastructure investments that affect the mobility of people can have substantial effects on trade. It also creates a stronger incentive for policy makers to improve international flight routes through better air traffic control coordination.[4] The findings of this study may also improve our understanding of the economic consequences of the COVID-19 pandemic. The reduced mobility of people, due to the travel restrictions implemented by many countries, is likely to have severe negative consequences for trade beyond the breakdown of supply chains.

My paper is perhaps most closely related to the work of Startz (2016). Startz (2016) makes a key contribution in establishing a causal relationship between face-to-face communication and trade. She uses a structural estimation approach in a developing country context based on transaction-level data from Nigerian traders. The results show that higher costs of travel to meet foreign suppliers lowers both trade and welfare by making it more difficult to gather information about supply and overcoming problems of moral hazard. While the paper establishes causality and disentangle various channels at play, the modeling approach prevents the author from estimating the elasticity of business travel cost on trade. Hence, the paper is not able to say to what extent business travel costs can explain the fact that countries that are close trade much more than countries far apart. The context of my study is also more general compared to Startz (2016), as my sample contains almost all types of goods and countries that vary greatly in terms of per capita income. Moreover, the affected countries accounted for approximately half of world GDP at the time.

Other than Startz (2016), causal evidence on the impact of travel cost on trade is surprisingly limited. One reason might be that shocks to infrastructure, such

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[4] In Europe for instance, air traffic management is based on national borders which makes international flights experience frequent handovers between controllers. This fragmentation together with inefficient placement of beacons makes the average flight 49 kilometers longer than necessary (Mills, 2017).

as new flight connections, change travel costs between cities, while trade data is usually recorded between countries. Instead, a number of studies have focused on correlations, rather than establishing a pure causal relationship. Studies that find a positive link between travel and trade include for instance Kulendran and Wilson (2000), Shan and Wilson (2001), Cristea (2011), Alderighi and Gaggero (2017), and Yilmazkuday and Yilmazkuday (2017). A number of papers, not explicitly studying trade, have used exogenous travel cost shocks to better isolate the impact of face-to-face communication.[5]

My paper is also related to a broader literature that tries to explain the negative impact of distance on trade and other forms of economic exchange. While no consensus about the main causes of the persistent negative impact of distance on trade has been established, several hypotheses have been put forward. One competing hypothesis to the face-to-face explanation is that locally biased preferences, rather than actual trade barriers, might be an important factor for the negative distance effect (Trefler, 1995; Head and Mayer, 2013; Atkin, 2013; Bronnenberg et al., 2012; Ferreira and Waldfogel, 2013; and Blum and Goldfarb, 2006). Another hypothesis is that unfamiliarity with foreign countries and institutions increases with distance creating trade frictions (Coeurdacier and Martin, 2009; Peri, 2005; Griffith et al., 2011; Hortaçsu et al., 2009; Chaney, 2014; Lendle et al., 2016, Huang, 2007; Dixit, 2003; Anderson and Marcouiller, 2002, Ranjan and Lee, 2007; and Turrini and van Ypersele, 2010). As unfamiliarity at least partly can be overcome by business travel, the unfamiliarity hypothesis can be seen as both a complementary and a competing explanation to the face-to-face hypothesis. A third hypothesis is that changes in the composition of trade have been biased towards goods that are more sensitive to

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[5] For instance, Bernard et al. (2015) use an expansion of high-speed railway in Japan as a source of exogenous variation to study firm-to-firm linkages, Giroud (2013) uses the introduction of new flight routes between headquarters and plants in the United States to study plant investments, Bernstein et al. (2016) use a similar identification strategy to study venture capitalists' involvement with portfolio companies in the United States, Campante and Yanagizawa-Drott (2018) use a discontinuity in flight staffing requirements to examine air links on spatial allocation of economic activity, and Catalini et al. (2016) use the introduction of new low fare air routes to study the impact on scientific collaboration within the United States. In contrast, Hovhannisyan and Keller (2015) use an instrumental variable approach to examine the impact of business travel on patenting.

distance (Duranton and Storper, 2008; Hummels and Schaur, 2013; and Evans and Harrigan, 2005).[6] Methodologically, this paper is also related to a large literature that uses shocks in travel and transport costs to study various economic outcomes (e.g., Pascali, 2016; Donaldson, 2010; Donaldson and Hornbeck, 2016; Feyrer, 2009; and Feyrer, 2019).

2 Data

To map changes in flight patterns due to the liberalization of the Soviet airspace, I obtain city-to-city flight data from the International Civil Aviation Organization (ICAO) between 1982 and 2000. A limitation of the ICAO data is that, before 1989, it only records the city of departure and destination for direct flights. A direct flight is a flight where the same flight number is maintained. A direct flight can either be a non-stop flight from city A to city B or a flight that departs from city A, makes a stopover in city X, and then continues to city B. Regardless of which route the flight might take, ICAO data prior to 1989 only record city A as the city of departure and B as the city of destination and leave out any information on stopovers. Consequently, before 1989, I am not able to distinguish non-stop flights between Europe and East Asia taking the shorter route over Soviet airspace from longer direct flights that avoided Soviet airspace and made stopovers in cities such as Anchorage. The Soviet Union started to liberalize its airspace in 1985, four years prior to when more detailed data is available. Flight data before 1989 is obtained from ICAO's On-Flight Origin and Destination data set (OFOD). The OFOD data contain all scheduled international direct flights reported to the ICAO. The data

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[6] The degree to which the composition hypothesis is a competing or complementary explanation to the face-to-face hypothesis depends on how one explains the cause of the sensitivity to distance. Hummels and Schaur (2013), and Evans and Harrigan (2005) focus on the idea that the share of goods where time to market is more important has been increasing. Increased importance of time to market is a competing explanation to the face-to-face hypothesis, as it has to do with the time cost of transporting goods rather than people. In contrast to this, Baldwin (2016) argues that the composition of trade has been biased towards goods where face-to-face interaction is vital. Baldwin's argument suggests that the negative impact of the cost of meeting face-to-face has been magnified over time by the changing composition of world trade.

include city of departure, city of arrival, airline, and number of passengers carried.

To separate non-stop flights from flights taking a detour around the Soviet Union before 1989, I gather supplementary flight timetable data from the British Library. The archival data is novel as it is based on a vast set of non-digitized flight timetables called the *ABC World Airways Guide*.[7] Using the timetables, I obtain information on the frequency of non-stop flights and estimate the number of non-stop passengers on all routes between Europe and East Asia from 1980 to 1988.[8]

From 1989, ICAO records non-stop flight data.[9] For instance, the London-Anchorage-Tokyo flight is recorded as two separate legs, one from London to Anchorage and one from Anchorage to Tokyo. Thus, from 1989 I am able to distinguish flights that made detours around Soviet airspace from those that flew non-stop over Soviet airspace without using additional timetable data.[10] In sum, data from the ICAO and the *ABC World Airways Guide* allow me to identify all air traffic between Europe and East Asia that were routed over Soviet airspace between 1980 to 2000.[11]

I obtain the trade data from the UN COMTRADE database which include variables that identify the exporting and importing country, commodity on the 4-digit level based on the first revision of Standard International Classification codes (SITC),

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[7] The *ABC World Airways Guide* was published monthly from 1950 until 1996. Timetables are typically updated in April and November, so I study every April issue from 1980 to 1989. While there exist no direct flight data from ICAO before 1982, it is evident from the timetable data alone that there existed no non-stop flights between Europe and East Asia prior to 1983.

[8] To be able to estimate the number of non-stop passengers flying between Europe and East Asia, I also gather information on airline and airplane types from the flight timetables. Using the archival timetable data, together with the ICAO non-stop flight data, I compute an estimated figure for the annual number of passengers flying non-stop between Europe and East Asia. See Section A.2 in the Appendix for a more detailed description of the procedure of estimating the number non-stop passengers.

[9] I obtain non-stop flight data between 1989 and 2000 from ICAO's Traffic by Flight Stage dataset (TFS). The TFS data contain information on city of departure and destination, airplane model, number of departures, passenger load factor, average distance over the number of passengers carried, and the number of seats available.

[10] Two non-stop routes avoided Soviet airspace. Section 3 describes the non-stop flights that avoided Soviet airspace in close detail.

[11] As the number of non-stop flights between 1980 to 1988 is based on different data compared to the period between 1989 and 2000, I also collect direct flight data from 1989. I then identify the non-stop flights from the direct flight data using the timetables from 1989 and compare it with the non-stop flight data from ICAO's TFS dataset for the same year.

and the value of trade. The data comprise of 136 countries and cover years from 1976 to 1995. As many countries do not report trade data for the period around the liberalization of the Soviet airspace, I combine both export and import data to reduce the amount of missing trade flows. Trade from country i to country j in a given year is computed as the average of exports reported by i to j and imports reported by j from i. In cases where i does not report export data, trade from i to j will solely be based on imports reported by j. In cases where j does not report imports from i, trade from i to j will solely be based on exports reported by i. I supplement the COMTRADE data with customs data from Eurostat of all goods traded between the EU and East Asia by product and mode of shipment. I use this dataset to analyze the impact of the Soviet airspace liberalization on goods not typically transported by air.

I also obtained a number of control variables commonly used in gravity regression from the CEPII Gravity Dataset (Mayer and Zignago, 2011). The CEPII data include information on country pair-year-level and contains variables related to geographical distance between country pairs, shared borders, common language, common colonizer, and free trade agreements. I obtain product-level data on the technological advancement of goods from Lall (2000) and U.S. consumer price index data from the World Bank to deflate trade values. Finally, I use the CEPII Trade and Production Data developed by de Sousa et al. (2012) to estimate the general equilibrium effect of the liberalization of the Soviet airspace.

3 Historical Background

The emergence of non-stop air traffic between Europe and East Asia traversing Soviet airspace was an intricate process affected by international flight regulation, Cold War politics, geography, and technology.

Rights to fly over foreign countries are negotiated bilaterally and typically regulated in accordance with the Chicago Convention, first signed in 1944. Article 5 of the Convention stipulates that a signatory country allows other members to fly over its territory. The Soviet Union never signed the Chicago Convention and could restrict other countries from flying over its airspace. With very few exceptions, the Soviet Union did not allow non-Soviet airlines to fly over its territory during most of the Cold War era. A few airlines received rights to enter Soviet airspace beginning in early 1970s. However, all flights between Europe and East Asia that entered Soviet airspace were required to make a mandatory stop in Moscow. The number of such flights was limited and the share of passengers who flew between Europe and East Asia via Moscow was small. For instance, of all passengers flying directly from London to Tokyo, just above 10% made a stopover in Moscow prior to liberalization of the Soviet airspace, (see Figure A.1 in the Appendix).[12]

Instead of flying via Moscow, most air traffic was either rerouted north via Anchorage, Alaska, or south over the Middle East, which added significant flight time (Jaffe, 2016). The London-Anchorage-Tokyo route is shown in Figure 1.[13]

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[12] The share of passengers that flew via Moscow from London to Tokyo would be considerably smaller if one also would count the number of passengers that made a transfer and thereby switched flight number on this route. Due to the structure of the *ABC World Airways Guide* timetables it is hard to gather all flight traffic between Europe and East Asia via Moscow. The route between London and Tokyo is, however, likely to have been the direct flight that carried most passengers via Moscow.

[13] There were two exceptions where airlines operated non-stop flights between Europe and East Asia prior to 1985 that did not enter Soviet airspace. The first exception is Finnair, which introduced a weekly non-stop route between Helsinki and Tokyo in 1983 (*Aviation Week and Space Technology*, 1983). Due to Helsinki's proximity to Tokyo and the willingness of airplane manufactures to accommodate Finnair's need to increase its maximum operating distance, the non-stop flight to Tokyo was routed over the North Pole to avoid Soviet airspace (Wegg, 1983). While Helsinki-Tokyo was the only non-stop flight between Europe and East Asia at the time, it represented a negligible share of the total passenger traffic between Japan and Europe. The second exception was Cathay Pacific that introduced a weekly non-stop route avoiding Soviet airspace between London and Hong Kong in 1984. Initially, Cathay Pacific only flew non-stop from London to Hong Kong, but added a weekly non-stop flight in the other direction in 1985. This service accounted for a very small share of passengers flying between Hong Kong and Europe.

Figure 1: The London-Anchorage-Tokyo Route

The Soviet Union lifted the strict restrictions on their airspace in 1985 when Japanese Airlines was granted rights to fly non-stop between London and Tokyo (*Aviation Week and Space Technology*, 1985). Shortly after, the Soviet Union granted Japanese Airlines and Air France rights to fly between Paris and Tokyo. A second route over Soviet airspace became available in 1986 when a number of airlines were granted rights to fly non-stop between Europe and Hong Kong. Due to the strained relationship between the Soviet Union and China, however, airlines were not allowed to cross the border between the two countries. All airplanes had to pass through a neutral country first, which in practice meant that non-stop flights to Hong Kong still had to be routed south of the Himalayas instead of over central China (*Flight International*, 1986). Still, being able to traverse Soviet airspace on the way to Hong Kong represented a major reduction in flight distance.[14]

The sudden opening up of the Soviet airspace came after years of fruitless negotiations between Soviet leaders and various airlines.[15] The motivation for Soviet leaders to liberalize its airspace had partly to do with a general reorientation of policy

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[14] At least for Cathay Pacific, the route south of the Himalayas represented the shortest route between Europe and Hong Kong until 1996 (*Flight International*, 1996).

[15] For instance, Wegg (1983) describes how Finnair failed to reach a deal for non-stop flights to Tokyo after negotiations that started in the mid-1970s, partly due to the large fees demanded by Soviet air traffic control.

towards the West at the end of the Cold War. Another important factor for granting overflight rights was that the air traffic control fees that the Soviets could charge airlines became a vital source of foreign currency. The influx of foreign currency was important as the economic situation deteriorated further during the 1980s (Gaidar, 2007).

The number of non-stop passengers flying over Soviet airspace expanded quickly after 1985, as shown in Figure 2. Figure 2 also validates the estimated non-stop passenger traffic based on the timetable data, as the estimated numbers of non-stop passengers almost exactly equals the number of observed non-stop passengers in the overlapping year in 1989. Cities that obtained non-stop connections early include Amsterdam, Copenhagen, Frankfurt, Helsinki, Milan, and Paris in Europe and Tokyo and Hong Kong in East Asia. The possibility of flying over Soviet airspace represented a significant reduction in flight distance for all routes between Western Europe and East Asia. As non-stop flights between Europe and East Asia were initially limited, these flights were typically targeted at frequent business travelers while the transpolar service was targeted at the vacation traveler and the remaining business community (*Aviation Week and Space Technology*, 1986). As the number of permitted overflights increased rapidly, polar traffic via Anchorage declined and ended by 1993. Hong Kong and Japan came to dominate the non-stop traffic from Europe until the early 2000s when China surpassed Hong Kong in terms of non-stop passengers.[16]

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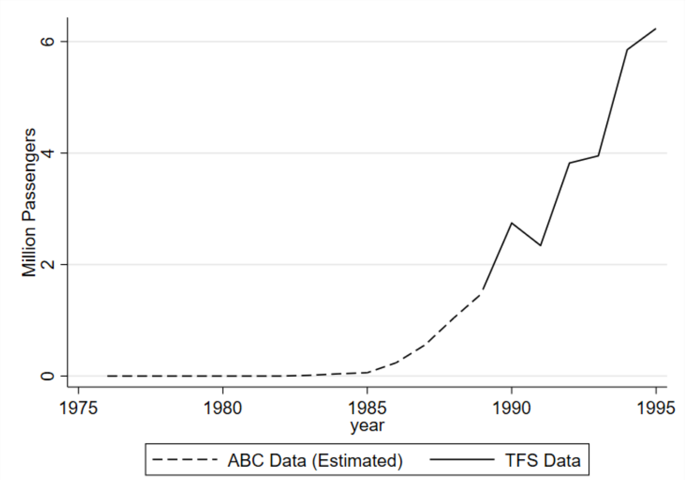
[16] The signing of the Sino-British Joint Declaration in 1984 helped to establish Hong Kong as a key hub for intercontinental air traffic. The declaration stipulated that Hong Kong would return to Chinese rule in 1997 when Britain's lease of the territory ended. The declaration also contained administrative arrangements about how Hong Kong would be governed, including a section on civil aviation. The Chinese leaders decided that civil aviation in Hong Kong would not see any major changes after 1997, removing significant uncertainty about future operations for airlines in the region (Davies, 1997).

Figure 2: Non-Stop Passenger Traffic between Western Europe and East Asia



Notes: The number of non-stop passengers prior to 1989 is estimated based on data from the *ABC World Airways Guide* along with non-stop flight data from ICAO's TFS dataset. See Section A.2 in the Appendix for details on how the number of passengers is estimated. Data from 1989 to 1995 is based on actual non-stop traffic data from the TFS dataset.

4 Impact of the Liberalization on the Cost of Travel

The liberalization of the Soviet airspace reduced the cost of business travel by primarily reducing the time cost of travel. As firms need to pay their workers while travelling, having personnel flying long distances for business is costly. The overflight fees charged by the Soviet Union, on the other hand, did generally not have an impact as it did not affect ticket prices. At the time of the Soviet airspace liberalization, ticket prices were negotiated between the airlines and the International Air Transport Association (IATA) and were typically based on the city of departure and arrival (Doganis, 1991). Thus, a trip from London to Tokyo was priced the same, regardless if it was routed via Anchorage or non-stop over the Soviet Union.

4.1 Identifying Treated Country Pairs

The first step to estimate the impact of travel time on trade is to exactly identify which country pairs were affected by the liberalization of the Soviet airspace. I do this by mapping routes that pass through or close to Soviet airspace in the geoprocessing software ArcGIS. I then compare these routes to current flight routes using flight tracking imagery from uk.flightaware.com.[17] This method leaves me with a group of country pairs where I can safely verify a reduction in flight distance, between Western Europe and East Asia. The countries belonging to Western Europe and East Asia are listed in Section A.3 in the Appendix. In total, 252 origin-destination country pairs were affected.[18]

There are a few uncertain cases where it is hard to determine if some country pairs might have experienced some marginal impact of the liberalization of the Soviet airspace. I address this by running robustness checks where I exclude country pairs that are connected by routes that are close to Soviet airspace.[19] The remaining country pairs of the world, excluding the Eastern Bloc, constitute the control group.[20]

4.2 Computing the Change in Travel Time

The second step to estimate the impact of travel time on trade is to measure the reduction in travel time for the affected country pairs due to the liberalization of the

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[17] This is arguably the most reliable way of verifying the impact of the Soviet airspace liberalization as I do not have access to a large enough set of flight maps from airlines that operated in or close to the Soviet airspace during the 1980s.

[18] Figure A.2 in the Appendix depicts an overview of how countries are divided into larger regions.

[19] Details about the excluded routes can be found in Section A.9 in the Appendix. There are also a number of routes where I lack enough information to determine if minor changes of routes potentially could have occurred as a consequence of the liberalization of the Soviet airspace. One example is the route Cairo-Tokyo which today passes over Chinese airspace. I have very limited information on routes over China and how these routes changed during the period of interest. Another example is Copenhagen-Istanbul which today is routed over Poland and Romania. I do not know how flights between Denmark and Turkey were routed during the 1980s and I do not know if they changed around the time of the Soviet airspace. Neither Poland or Romania were part of the Soviet Union, but it is plausible that Soviet satellite states were influenced by the decision of Soviet leaders also in terms of airspace policy. Common to all routes where I lack information is that they run close to the Soviet airspace and are excluded when running robustness checks.

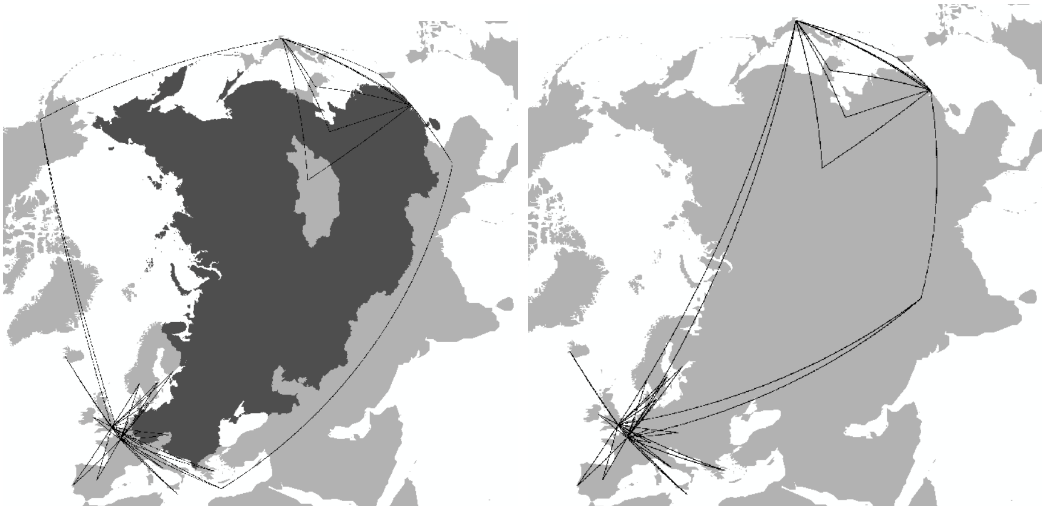
[20] The reason for excluding the Eastern Bloc is that it is hard to evaluate to what extent this region was affected by the liberalization of the Soviet airspace. The liberalization did not shorten any flight routes but it is possible that air traffic between the Eastern Bloc and the rest of the world may have changed in other ways as a consequence of the policy change. Including the Eastern Bloc does not change the baseline results much. I define the Eastern Bloc as the Soviet Union, Albania, Bulgaria, Czechoslovakia, Hungary, Poland, Romania, Yugoslavia, and North Korea.

Soviet airspace. Using the change in travel time based on time table data from before and after the liberalization is likely to be correlated with changes in trade and hence endogenous. The reason for this is that country pairs that had greater potential to increase trade are likely to also have received better non-stop connections. Instead, I use ArcGIS to map the shortest routes between Western Europe and East Asia and then compute the change in travel time.

To compute the shortest routes between Western Europe and East Asia, I create two networks of routes that connect these regions. The first network captures the period before the liberalization and contains routes that avoid Soviet airspace. The second network reflects the period after the liberalization and contains routes that cross Soviet airspace. All routes after the liberalization avoid the parts of the Chinese airspace that was still restricted. Both networks consist of points that represent the city in each country with the most departing passengers in 1985.

The networks also reflect the fact that some cities have better flight connections than others and that only few countries obtained a non-stop connection during the years after the Soviet airspace opened up. I categorize every point as either a hub or a spoke. I assume that hubs are the only points in the network that have intercontinental connection. Thus, to reach East Asia when flying from a spoke in Western Europe, the flight has to be routed through a European hub. If the destination is an East Asian spoke, the flight also needs to be routed through an East Asian hub. Using actual hubs that connected Western Europe and East Asia may be a function of country pairs trading relationship and therefore also endogenous. Instead, I choose the two cities with the most departing passengers in each region in 1985 to be hubs and the remaining points to be spokes. The busiest cities turned out to be London, Paris, Tokyo, and Hong Kong. Based on the set of hubs, spokes and the available airspace Figure 3 depicts the flight route network that connects Western Europe and East Asia before and after the liberalization of the Soviet airspace.

Figure 3: Flight Route Networks Before and After the Liberalization



Notes: The left map depicts the flight network that connected Western Europe and East Asia before the liberalization of the Soviet airspace. The dark area depicts the Soviet Union and China. The right map depicts the network after the liberalization. Routes to and via Hong Kong were still somewhat restricted after the liberalization as airplanes were not allowed to cross directly between Chinese and Soviet airspace due to the poor relationship between the countries.

Using the constructed networks, I simulate the shortest distance between all affected country pairs before and after the liberalization. To translate distances into travel time, I assume an average flight speed of 850 km/h and that flying through a hub adds 1.5 hours of travel time.[21] The average computed reduction in flight time among the 252 affected origin-destination country pairs was 3.9 hours or 19 percent. To illustrate how the intensity of treatment varies across countries, I present the average percentage travel time reduction for every affected country in Figure 4. We see that Northwestern and Central Europe along with Japan and South Korea experienced the largest average reduction in in travel time.[22]

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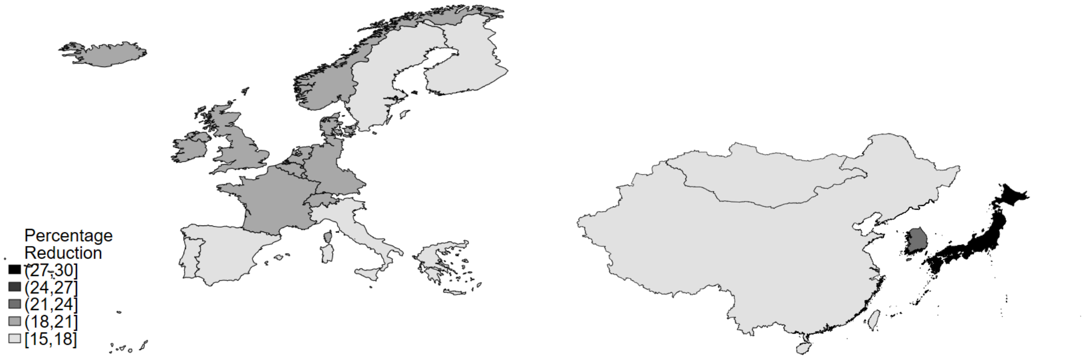
[21] The flight speed is based on the cruising speed of the typical wide-body aircraft that were operating routes between Western Europe and East Asia during the 1980s. The results of the main analysis are not very sensitive to assumptions regarding stop-over time and average flight speed. See Section A.5 in the Appendix for a more comprehensive description on how the travel time is computed using ArcGIS.

[22] The distribution of the reduction in distance among the affected country pairs is shown in Figure A.7 in the Appendix.

Figure 4: Average Percentage Reduction in Distance Across Treated Countries



Notes: This map depicts the average percentage reduction in flight time for all affected routes by country. For instance, the average value for France is the average reduction in travel time between France and all countries in East Asia. Hong Kong and Macao are hard to see due to their small size. The average reduction for Hong Kong is 17% and the average reduction for Macao is 16%.

4.3 Changes in Flight Patterns

The flight data show substantial differences in flight patterns among the treated country pairs compared to the control group. Figure 5 compares passenger traffic among treated country pairs and controls. Values are normalized and the base year is set to 1990. As I do not observe non-stop flights before 1989 for the control group, I also display the normalized number of direct flight passengers flying between the country pairs in the control group. We see that the control group experienced a gradual increase of passengers. The treatment group, on the other hand, goes from practically having no passengers before 1985 to several millions just a few years after the liberalization.[23]

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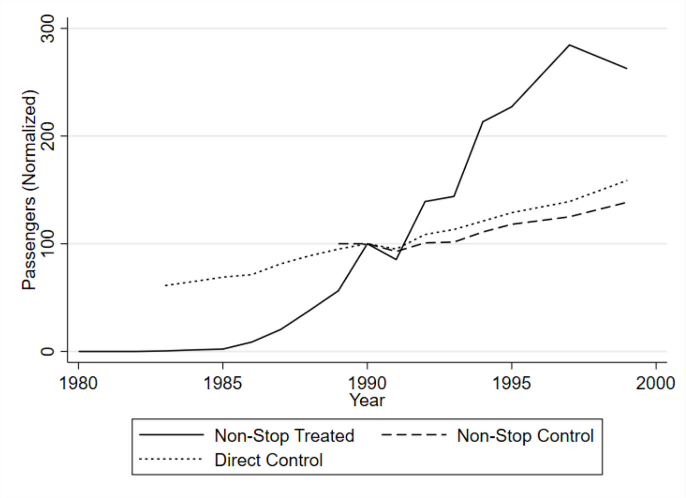
[23] The growth in non-stop passenger traffic between Western Europe and East Asia also stands out when breaking down air traffic to a more disaggregate levels, see Figure A.3 in the Appendix.

Figure 5: Passenger Traffic Among Treated and Control Origin-Destination Pairs



Notes: This figure shows the normalized number of non-stop passengers flying between treated and control origin-destination country pairs as well as the normalized number of direct passengers flying between control origin-destination country pairs. The difference between non-stop flight data and direct flight data is how flights with stopovers are recorded. A flight from city A to city C that has a stopover in city B are recorded as two observations in the non-stop data, A to B and B to C. The flight will be recorded as two observations in the direct flight data if the flight A to B and B to C have different flight numbers. The flight will be recorded as one observation in the direct flight data if flight A to B and B to C have the same flight number. The base year in the figure is 1990. The number of non-stop passengers flying between Western Europe and East Asia was approximately 2.7 million in 1990, five years after the liberalization of the Soviet Airspace. Although not shown in the graph, direct flights between treated country pairs grew faster than for the control group after 1985 as well. The difference in growth between treated subjects and controls is smaller for direct flights, primarily due to two reasons. First, the number of non-stop flights between Western Europe and East Asia were initially limited after the liberalization. Second, much of the growth in passenger traffic between Western Europe and East Asia after 1985 is likely not captured by the direct flight data. The reason for this is that much of the increase in traffic between Western Europe and East Asia is likely to have happened on routes where passengers changed flight numbers somewhere between these regions. For instance, if more passengers starts to fly between Western Europe and East Asia but makes stopovers in India where they change flight number, this would not be recorded as increased direct flight traffic between Western Europe and East Asia.

While the data show a rapid increase in the number of non-stop passengers, few treated country pairs actually received a non-stop connection. In 1990 only about 14% of the country pairs had a non-stop connection and about 21% had a direct connection, see Figure A.4 in the Appendix.[24] Thus, while many passengers travelling between Western Europe and East Asia could enjoy shorter flight routes,

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[24] Revisit Section 2 for an explanation of the difference between non-stop and direct flights.

most passengers still needed to transfer flights in major hubs.[25]

To conclude, the liberalization of the Soviet airspace had a substantial impact on the time cost of travel between Europe and East Asia. The liberalization was largely unanticipated and was primarily driven by domestic factors within the Soviet Union. The data show that the liberalization was associated with a substantial increase in non-stop air traffic between the affected regions. Yet, only a minority of the treated country pairs obtained a non-stop connection.

5 Empirical Analysis

In this section I will analyze the causal impact of business travel time on trade using the liberalization of the Soviet airspace as a source of exogeneous variation. Before proceeding to any regression results, I first provide a descriptive overview of the evolution of trade among treated country pairs and controls. I then move to a rigorous empirical analysis to estimate the effect of business travel time on bilateral trade. I do this by first introducing the gravity model of trade. The gravity model is the theoretical foundation that allows me to both estimate the impact of business travel time on trade and to compute how much of the variation in business travel time can account for the distance elasticity of trade. I describe the general gravity equation from the literature, along with specific assumptions I make about bilateral trade frictions and how I obtain the estimating equation. I then present the main results and a number of robustness checks. After having presented the results, I revisit the gravity model and describe carefully how I estimate how much business travel time can account for trade frictions that arise as a result of geographical distance. Finally, I estimate the general equilibrium impact of the liberalization of the Soviet airspace on trade.

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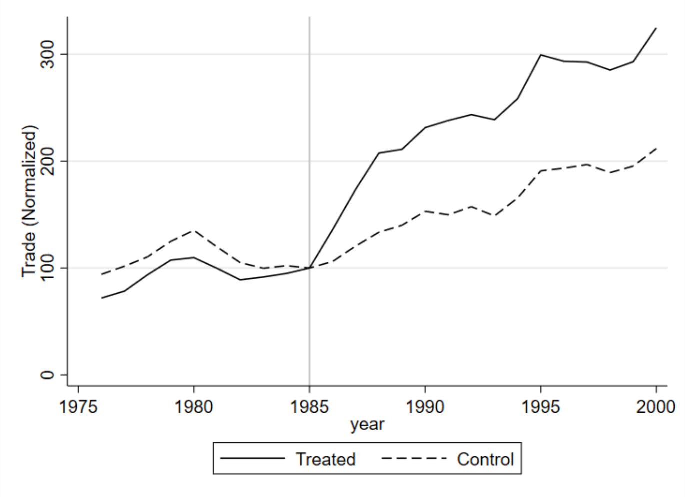
[25] For further descriptive statistics, see Figure A.5 in the Appendix which shows the number of treated subjects that had at least a weekly non-stop connection. Figure A.6 in the Appendix shows the number of weekly departures between the busiest non-stop routes among the treated subjects.

5.1 Changes in Trade Patterns

To give an overview of changes in trade patterns around the time of the liberalization of the Soviet airspace, I compare the normalized volume of trade among treated exporter-importer pairs and controls. Figure 6 shows that the treatment and control group follow similar trends prior to 1985. After the liberalization, however, trade among the treated country pairs experience a sudden boom in 1986 and 1987. From 1988, growth in trade in the treatment group returns to comparable levels as in the control group.

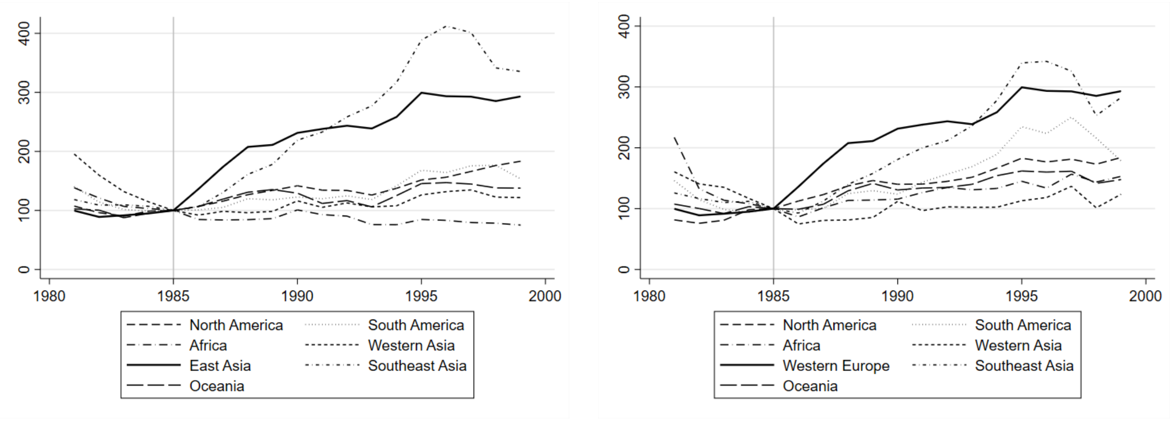
Figure 6: Normalized Trade Among Treated and Control Exporter-Importer Pairs



Notes: This figure shows the normalized volume of trade among treated exporter-importer pairs and controls. The group of treated countries include all exporter-importer pairs that can be formed between Western Europe and East Asia. The control group include all other exporter-importer pairs of the world excluding the Eastern Bloc. The base year is 1985. The vertical line indicates the year of the liberalization of the Soviet airspace.

The growth in trade among the group of treated country pairs also stands out when solely focusing on the trade of Western Europe and East Asia. Figure 7 compares normalized trade flows between Western Europe as well as East Asia and the rest of the world by region. We see that trade between Western Europe and East Asia grows the fastest for both regions after the liberalization of the Soviet airspace in 1985.[26]

Figure 7: Normalized Trade between Western Europe/East Asia
and the Rest of the World by Region


(a) Western Europe

(b) East Asia

Notes: The figure to the left shows the normalized volume of trade between Western Europe and the rest of the world by region. The figure to the right shows the normalized volume of trade between East Asia and the rest of the world by region. Normalized trade between Western Europe and East Asia is captured by the bold solid line in both figures. The base year is 1985. The vertical line in each figure indicates the year of the liberalization of the Soviet airspace.

5.2 The Gravity Model of Trade

To assess the causal impact of business travel cost, I formulate an estimating equation where I regress flight time on trade. I derive the estimating equation from the gravity model of trade. The gravity model is one of the most widely used models to analyze determinants of bilateral trade. It builds on the idea that trade between two countries can be related to the size of each country and the geographical distance between them. Anderson and van Wincoop (2003) derive a theoretically founded gravity equation which I use as a starting point. The equation takes the following form:

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[26] Figure 7 also shows that normalized trade with Southeast Asia surpasses trade between East Asia and Western Europe around 1990. The growth in trade with Southeast Asia coincides with the boom in offshoring to this region. While the growth in trade is remarkable, it is not unique for Western Europe and East Asia. For instance, trade between North America and Southeast Asia experience similar growth from the late 1980s and onward.

$$x_{ijt} = \frac{y_{it}y_{jt}}{y_{wt}} \left(\frac{\tau_{ijt}}{P_{it}P_{jt}} \right)^{1-\sigma} \tag{1}$$

where x_{ijt} captures goods trade from country i and j at time t, y_{it} and y_{jt} are the respective income of the two countries, y_{wt} is world income, and τ_{ijt} captures bilateral trade frictions which is assumed to be partially determined by the geographical distance between i and j. P_{it} and P_{jt} are multilateral resistance terms and σ denotes the elasticity of substitution across products.[27]

In the gravity framework, business travel cost is a bilateral trade friction and should be an argument of a function that determines τ_{ijt}. I choose to model trade frictions in a way that closely resembles Head and Mayer (2013). I assume that trade costs are determined by tariffs, business travel costs, transport costs, time-invariant country pair specific factors and a residual term. The function can be expressed as follows:

$$\tau_{ijt} = \theta_{ijt} c_{ij} b_{ijt}^{\rho_b} s_{ijt}^{\rho_s} u_{ijt}^{\rho_u} \tag{2}$$

where θ_{ijt} is one plus the tariff rate between i and j, c_{ij} captures all time-invariant bilateral trade costs, b_{ijt} is the cost of transporting people from i to j measured by flight time, s_{ijt} is the cost of transporting goods from i to j and u_{ijt} are all unobserved bilateral time-varying trade costs that rise with distance.[28] ρ_b is the business travel cost elasticity of trade, ρ_s is the transport cost elasticity of trade and ρ_u is the elasticity of unknown trade costs. Similar to Head and Mayer (2013), I assume that b_{ijt}, s_{ijt}, and u_{ijt} all are proportional functions of distance. This means that ρ_b

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[27] The multilateral resistance term of the exporter, P_{it}, captures the cost of the exporting country to export its output to the rest of the world relative to all other countries. The multilateral resistance term of the importer, P_{jt}, captures how costly it is to deliver goods to the importing country relative to all other countries.

[28] Head and Mayer (2013) do not include a variable for flight time. The key similarity is that the trade cost function includes a residual term, u_{ijt}, that captures unobserved bilateral frictions that rise with distance. Time-invariant bilateral trade costs, c_{ij}, include aspects such as common language status, past colonial linkages or the sharing of borders. The reason for including this term is to stress the fact that I can control for this variation in the estimating equation using exporter-importer fixed effects.

captures how much business travel costs increase with distance. Similarly, ρ_s captures how much transport costs increase with distance and ρ_u how much unknown trade costs increase with distance. This bilateral trade cost function essentially divides the distance variable in the gravity regression into a business travel cost component, a transport cost component, and an unobserved residual component:

$$d_{ijt}^{\rho} = b_{ijt}^{\rho_b} s_{ijt}^{\rho_s} u_{ijt}^{\rho_u} \tag{3}$$

where d_{ijt} is the distance between country i and country j and ρ is the distance elasticity of trade.[29] This implies that the distance elasticity of trade can be expressed as the sum of the elasticity of business travel cost, the elasticity of transport costs and the elasticity of unknown trade costs, $\rho = \rho_b + \rho_s + \rho_u$.

By substituting (2) into (1) and taking logs we end up with the following expression:

$$\begin{aligned} \ln x_{ijt} = {} & \ln y_{it} + \ln y_{jt} - \ln y_{wt} + (1-\sigma)\ln\theta_{ijt} + (1-\sigma)\ln c_{ij} \\ & + (1-\sigma)\rho_b \ln b_{ijt} + (1-\sigma)\rho_s \ln s_{ijt} + (1-\sigma)\rho_u \ln u_{ijt} \\ & - (1-\sigma)\ln P_{it} - (1-\sigma)\ln P_{jt} \end{aligned} \tag{4}$$

Here we are interested in estimating $(1-\sigma)\rho_b$, which is the elasticity of the cost of transporting people on trade. It is a function of both the elasticity of substitution σ and ρ_b. I formulate the following equation to estimate the transport cost elasticity:

$$\ln x_{ijt} = \beta \ln b_{ijt} + \delta_{it} + \gamma_{jt} + \omega_{ij} + \varepsilon_{ijt} \tag{5}$$

where β captures $(1-\sigma)\rho_b$. δ_{it} and γ_{jt} are exporter-time and importer-time fixed effects that control for the income and multilateral resistance terms in the gravity equation, ω_{ij} are exporter-importer fixed effects that controls for time-invariant trade

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[29] d_{ijt} should be thought of as an abstract term that may change over time rather than geographical distance which is fixed.

frictions, and ε_{ijt} is the error term.[30]

The key identifying assumption for the empirical model to estimate $(1-\sigma)\rho_b$ is that of parallel trends between the treatment and the control group.[31] As all variation in business travel cost comes from the change in flight time caused by the liberalization of the Soviet airspace, I am able to control for both exporter and importer specific time trends as well as time-invariant exporter-importer specific factors. Given this empirical specification, the parallel trend assumptions presupposes that differences in time-varying exporter-importer specific factors that influence trade, other than flight time, should have remained the same around the time of the liberalization of the Soviet airspace across the treatment and the control group. Hence, treated and control exporter-importer pairs should have experienced similar changes in tariffs (θ_{ijt}), transport costs (s_{ijt}), and unknown trade costs (u_{ijt}). Finally, if a reduction in flight time, b_{ijt}, is associated with an increase in bilateral trade between i and j, the expected sign of β is negative.

5.3 Baseline Results

I estimate Equation (5) using both total goods trade and goods not typically transported by air as dependent variables. The reason for looking at goods not typically transported by air separately is that the liberalization of the Soviet airspace may have reduced air shipping costs by shortening air shipping routes. Hence, results may be driven by lower costs of transporting goods by air rather than lower time cost of transporting people.[32] I define a good as not typically transported by air if less than 20 percent of the value of trade between the EU and East Asia of a good cross the EU border by air, see Section A.7 in the Appendix for details. I

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[30] While it is not possible to directly estimate ρ_b, it can be backed out by using a value of σ from the literature.

[31] The pool of treated subjects is all exporter-importer pairs that can be formed between Western Europe and East Asia. All remaining exporter-importer pairs, apart from countries in the Eastern Bloc, belong to the control group.

[32] The impact of lower shipping costs on trade is likely to be limited. The empirical literature suggests that transport costs generally account for a small share of total trade costs. For instance, Glaeser and Kohlhase (2003) find that for 80% of all shipments by value, transport costs make up less than 4% of the value of the good.

restrict the sample to only look at years from 1980 to 1990. The flight time variable, b_{ijt}, changes in the year 1986 for the treated exporter-importer pairs. Hence, the pre-treatment period covers the period 1980 to 1985 and the post-treatment period covers the period 1986 to 1990. The treatment effect captures the average change in trade between the pre- and post-period among treated subjects relative to the control group as a consequence of shorter travel time.

Table 1 shows an estimate of $\beta = -1.22$ and $\beta = -1.26$ for total trade and trade not typically transported by air respectively. The result implies that a 10% reduction in flight time is associated with an approximate 12.2% increase in total goods trade and an approximate 12.6% increase in goods trade not typically transported by air.[33]

Table 1: Impact of Shorter Flight Time on Trade

Dependent Variable:	ln(Trade) (1)	ln(Non-Air Trade) (2)
ln(Flight Time)	-1.220***	-1.260***
	(0.200)	(0.220)
Observations	113,249	103,737
R-squared	0.903	0.896

Notes: This table reports estimates of the impact of flight time on bilateral trade using Equation (5). The dependent variable captures log of total bilateral goods trade in column (1) and log of bilateral goods trade that is typically not transported by air in column (2). The independent variable captures log bilateral flight time. The regression includes exporter-time fixed effects, importer-time fixed effects, and exporter-importer fixed effects. Standard errors are clustered at the exporter-importer level. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

To better show pre-trends and the timing of the impact of the liberalization of the Soviet airspace, I also estimate the effect year-by-year:

$$\ln x_{ijt} = \sum_{t=1976}^{1995} (\beta_t(\ln b_{ij}^{Post} - \ln b_{ij}^{Pre})) \times \mu_t + \delta_{it} + \gamma_{jt} + \omega_{ij} + \varepsilon_{ijt} \tag{6}$$

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[33] One have to be careful when interpreting the impact of flight time on trade. There might be simultaneous general equilibrium effects that affect several components of the gravity model. See Section 5.6 for an estimation of the general equilibrium effects on trade.

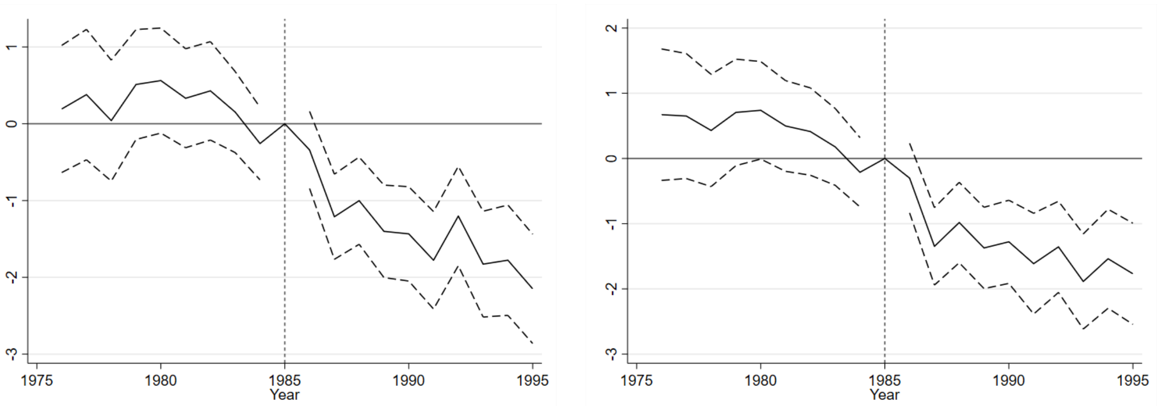
The treatment variable is now the log difference between the travel after and before the liberalization of the Soviet airspace, $\ln b_{ij}^{Post} - \ln b_{ij}^{Pre}$, and μ_t is a vector of time fixed effect. β_t captures the interaction between the treatment variable and the time fixed effects for years 1976 to 1995. I estimate results for both total trade and trade not typically transported by air.

Figure 8 shows a fairly stable pre-trend followed by a large impact of shorter travel time on trade after the Soviet's decision to allow non-stop flights over its territory.

Figure 8: Impact of Soviet Airspace Liberalization on Trade

(a) All Goods Trade

(b) Goods Not Typically Transported by Air



Notes: This figure reports estimates of the impact of flight time on bilateral trade, year-by-year, with a 95% confidence interval, using Equation (6). The dependent variable is the log of total bilateral goods trade in Subfigure (a) and the log of bilateral goods trade that is not typically transported by air in Subfigure (b). The independent variable captures the interaction between the log of flight time after the liberalization of the Soviet airspace minus the log of flight time before the liberalization and a vector of time dummies. The year the Soviet airspace was liberalized, 1985, represents the base year. The regression includes exporter-time fixed effects, importer-time fixed effects, and exporter-importer fixed effects. Standard errors are clustered at the exporter-importer level.

5.4 Robustness Checks

In this section, I check the robustness of the results in two main ways. First, I examine if the estimated impact of flight time on trade hold up when changing the dependent variable, the independent variables, and the sample. Second, I test if lower costs of meeting face-to-face is what drives the main results. I do this by comparing the impact of flight time on trade across different groups of products that are likely to require different levels of face-to-face interaction when traded.

5.4.1 Robustness of Estimated Impact of Flight Time on Trade

I check the robustness of the baseline results by estimating Equation (5) and (6) by altering the sample in a number of different ways. Estimated robustness results using Equation (5) are presented in Table 2. Robustness results estimated year-by-year can be found in Section A.8 in the Appendix.[34]

Alternative Treatment and Trade Variables. In Panel A of the robustness checks I use alternative treatment and trade variables to address concerns of measurement and price shocks. One potential issue is whether travel time are measured correctly or not. If the treatment variable is measured incorrectly, results will be biased. In column (1) I use route distance instead of time. The route distance variable is based on the routes mapped out in ArcGIS but does not rely on assumptions of average flight speed and stop-over time. The estimates based on distance show to be larger than the baseline specification. This is because of lower variation in the distance variable as it does not take into account that the liberalization meant that airplanes could start to fly non-stop between hubs in Western Europe and East Asia instead of making a half-way stopover.

In column (2), I use a binary treatment variable which does not rely on any specific assumptions about the change in travel cost. The binary variable simply takes the value one if an exporter-importer pair is affected by the liberalization of the Soviet airspace and if the year is after 1985. The estimated effect implies that average trade increased 28.7% more for the treated country pairs compared to the control group.[35]

Another cause of concern is if there were sharp price changes occurring around the time of the liberalization of the Soviet airspace that affected trade among treated subjects and controls differently. If price changes are correlated with both the treatment variable and the dependent variable, estimated results are biased. One price

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[34] All robustness checks are based on trade not typically transported by air. The robustness results do not change much if instead using total trade.

[35] The estimate of the binary variable is positive as the treatment variable is positive rather than negative, as in the case of travel time.

shock that may have affected treated subjects and controls differently is the 1980s oil glut. The 1980s oil glut happened due to a large surplus of crude oil caused by falling demand following the 1970s energy crisis. The surplus of oil caused prices to fall sharply between 1980 and 1985. As a robustness check, I estimate results by excluding all oil and gas trade from the sample in column (3). Removing oil and gas trade reduces the effect of the liberalization of the Soviet airspace slightly.

Alternative Control Variables and Control Groups. In Panel B, I continue addressing concerns that differences in underlying trends between the treatment and control group are driving the baseline results by adding control variables and altering the control group. The estimating gravity equation assumes that both treated subjects and controls do not experience any systematic differences for any time-varying bilateral trade costs other than travel time. One possible reason for the strong growth in trade among the group of treated subjects could stem from liberal trade reforms. I partially account for such channels in column (4) where I add free trade agreement and common currency status to the baseline specification. Adding time-varying gravity controls increases the effect of the liberalization of the Soviet airspace slightly.

Still, there are other unobserved variables that vary between exporter-importer pairs and across time. For instance, the control group contain countries that are significantly poorer than any country in the treatment group. These countries are likely to trade different goods compared to the treatment group and could therefore potentially be on a different time trend. To address this, I exclude the poorest 10% of the sample in column (5) and the poorest 50% in column (6).[36] Excluding the poorest 10% increases the effect slightly while excluding the poorest 50% countries reduces the estimated effect.

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[36] I use income per capita in 1985 as the measure of income. When excluding the poorest 50% of the sample I choose to still keep China and India in the sample. The reason for keeping China and India is that these are vast countries where most trade occur in regions that are significantly richer than the countries' averages.

Other Robustness Checks. Finally, I carry out a number of robustness checks to make sure that results are not driven by specific choices when creating the baseline dataset. For instance, I choose to exclude the Eastern Bloc in the baseline dataset as it is difficult to know exactly how this group of countries were affected by the liberalization of the Soviet Airspace. The estimate in column (7) shows that the effect decreases slightly when including the countries belonging to the Eastern Bloc.

Another issue is that I do not observe actual flight routes during the 1980s. Hence, it could be that some country pairs in the control group were potentially marginally affected by the liberalization of the Soviet airspace. To address the concern of treated controls, I exclude a great number of country pairs that are connected by routes that are close to the Eastern Bloc or China.[37] Results in column (8) show that excluding potentially treated country pairs increases the effect somewhat.

As zero trade flows are excluded from the sample, there is also a risk that results are driven by changes in the extensive country margin. If the composition of exporter-importer pairs change over the period of interest, it could bias the estimates. To deal with this I exclude exporter-importer pairs that trade less than 7 years during the period 1980 to 1990 in column (9). Doing this increases results slightly compared to the baseline estimation.

Finally, exporter-importer pairs that do not trade much tend to exhibit larger variance in trade volume. To make sure results are not driven by small trade flows, I exclude the bottom quartile exporter-importer pairs based on trade volume in 1985. The estimate in column (10) shows that dropping small trade flows from the sample increases the effect slightly.

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[37] See Section A.9 to see which country pairs are excluded.

Table 2: Robustness Checks

Panel A. Alternative Treatment and Trade Variables

	Distance (1)	Binary Treatment (2)	No Oil and Gas Trade (3)
	-1.575***	0.287***	-1.158***
	(0.281)	(0.054)	(0.214)
Observations	103,737	103,737	103,107
R-squared	0.896	0.896	0.901

Panel B. Alternative Control Variables and Control Groups

	Gravity Controls (4)	Poorest 10% Dropped (5)	Poorest 50% Dropped (6)
	-1.307***	-1.403***	-1.123***
	(0.221)	(0.224)	(0.247)
Observations	102,611	88,159	51,378
R-squared	0.896	0.899	0.914

Panel C. Other Robustness Checks

	Eastern Bloc Included (7)	Potentially Treated Dropped (8)	Infrequent Trade Dropped (9)	Small Flows Dropped (10)
	-1.176***	-1.550***	-1.290***	-1.342***
	(0.219)	(0.252)	(0.218)	(0.197)
Observations	118,138	70,445	92,568	78,030
R-squared	0.895	0.890	0.897	0.910

Notes: This table reports the robustness estimates of the impact of the liberalization of the Soviet airspace on bilateral trade. All specifications, except in column (2), uses the log of flight time as the treatment variable. The specification in column (2) uses a treatment dummy that takes the value one if the exporter-importer pair was treated and if the year is after 1985. The dependent variable captures the log of bilateral goods trade that is not typically transported by air. All regressions include exporter-time fixed effects, importer-time fixed effects, and exporter-importer fixed effects. Standard errors are clustered at the exporter-importer level. Robust standard errors in parentheses *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

5.4.2 Testing the Face-to-Face Hypothesis

While the baseline results suggest that shorter travel distance causes trade to increase, it is not self evident that lower costs of face-to-face interactions are what drive these results.[38] To examine the channel of lower costs of physical presence, I compare trade of goods that are likely to rely on business travel to different degrees. If trade increased due to lower costs of business travel, goods that rely more intensively on business travel should also experience a larger impact of the treatment. Here I assume that goods that are technically advanced require more face-to-face interaction compared to goods that are simple.

To distinguish between technically advanced goods and simple goods, I use classification from Lall (2000). Lall (2000) classifies SITC product codes into resource-based, low technology, medium technology and high technology manufactures. Lall (2000) deem low technology and resource-based products as simple while medium and high technology products are considered advanced.[39] Based on this classification, I estimate the following product level gravity model:

$$\ln x_{ijngt} = \beta \ln b_{ijt} + \delta_{it} + \gamma_{jt} + \omega_{ij} + \kappa_{ngt} + \varepsilon_{ijngt} \tag{7}$$

where x_{ijngt} captures trade from country i to country j in product n in technology group g at time t and b_{ijt} is the cost of transporting people from i to j measured by travel time. In addition to the fixed effects in the baseline regression, κ_{ngt} captures product-time fixed effects. I estimate Equation (7) for each product type separately.

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[38] I define face-to-face interaction broadly to include everything that would require someone to have to travel for business. For instance, an engineer that would travel to inspect equipment at an offshore plant without actually meeting with someone would thus still be defined as face-to-face interaction.

[39] Low technology products rely on well-diffused technologies, primarily embodied in capital. Many products in this category are undifferentiated, have simple skill requirements and compete on price. Resource-based products tend to be simple and labor intensive such as simple food and leather processing products. This category also contain a few exceptions of more advanced technology including petroleum refining and modern processed foods. Medium technology products consists primarily of capital goods and intermediate products that are skill- and scale-intensive. This group of products tend to rely on complex technologies with moderately high levels of R&D, advanced skill needs and lengthy learning periods. High technology products rely on advanced and rapidly changing technologies, with high R&D requirements. Many products in this category require sophisticated technology infrastructure, high levels of specialized technical skills and close interactions between firms and research institutions. Lall (2000) also classifies primary products, which I choose exclude from the analysis, as trade in this type of goods is largely driven by commodity prices.

Table 3 shows that the effect of shorter travel distance between East Asia and Western Europe has a larger impact on more advanced manufactures (Medium Technology and High Technology) compared to simple manufactures (Low Technology and Resource-Based). This confirms the notion that products that are likely to require more business travel also were affected more by the liberalization of the Soviet airspace. These results are further validated when estimating the product level gravity model year-by-year, see Section A.10 in the Appendix.[40]

Table 3: Impact of Shorter Flight Time Across Technology Groups

	Simple Technology		Advanced Technology	
	Low Tech (1)	Resource-Based (2)	Med Tech (3)	High Tech (4)
ln(Flight Time)	-0.169	-0.360***	-0.637***	-0.726***
	(0.114)	(0.112)	(0.106)	(0.147)
Observations	1,259,130	1,138,773	1,475,650	503,624
R-squared	0.566	0.383	0.557	0.652

Notes: This table compares the impact of flight time on bilateral trade for different groups of goods, based on their technological advancement, using Equation (7). The dependent variable captures the log of bilateral product level trade on the 3-digit level. The independent variable captures log bilateral flight time. The sample is split into four product groups: low technology, resource-based, medium technology, and high technology goods. Low technology and resource-based goods rely on simple technology while medium and high technology goods rely on advanced technology. The regression includes exporter-time fixed effects, importer-time fixed effects, product-time fixed effects, and exporter-importer fixed effects. Standard errors are clustered at the exporter-importer level. Robust standard errors in parentheses *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

5.5 Accounting for Distance Elasticity Using Travel Time

In this section I will estimate how much of the variation of the distance elasticity of trade can be accounted for by business travel time. Before turning to the estimation results, I first proceed with a short background of what previous scholars have done to explain the distance elasticity of trade.

As mentioned in the introduction, the empirical trade literature has struggled to

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[40] The estimated magnitude of the impact on flight time on trade is significantly smaller when estimated on the product level. I address this point in Section 5.5.

find observable variables that generate trade frictions that can explain why countries that are far apart trade so little in comparison to countries that are close. For the gravity model of trade to hold, there needs to be trade frictions in addition to typical barriers of trade such as tariffs and transport costs. Head and Mayer (2013) coin the term "dark" trade costs to refer to trade frictions required to make the gravity model of trade hold but that is not observed.[41] The elasticity of dark trade costs to trade is captured by $(1-\sigma)\rho_u$ in Equation (4).

Head and Mayer (2013) review the literature to see how much of the distance elasticity can be accounted for by transport costs, specifically the cost of freight and insurance. The transport costs elasticity of trade is captured by $(1-\sigma)\rho_s$ in Equation (4). Focusing on studies that utilize CIF-FOB ratios, the authors conclude that a reasonable range of the elasticity of ρ_s is between 0.01 and 0.07.[42] The authors point out that the best estimate is likely to be at the lower end of the range. Based on the range of ρ_s, Head and Mayer (2013) find that the remaining dark trade costs account for 72% to 96% of the rise in trade costs due to distance. As ρ_s is likely to be on the lower end of the spectrum, dark trade costs are likely to account for variation of trade friction closer to 96%. The goal of the present study is the estimate ρ_b to reduce the unexplained elasticity, ρ_u.

To be able to compute how much the cost of business travel can account for dark trade costs, we first need to estimate the distance elasticity of trade, $(1-\sigma)\rho$.[43] I approximate $(1-\sigma)\rho$ by estimating the trade elasticity of *geographical* distance. It is important to separate the notion of the distance term d_{ijt} from geographical distance

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[41] The term dark trade costs is borrowed from cosmology where dark energy is used to explain why the universe is expanding at an accelerating rate and dark matter is used to explain a number of astrophysical observations including the movement of galaxies. Common to dark matter and dark energy is that none of them are observed but their presence is necessary to explain a number of properties of the universe.

[42] CIF stands for "cost, insurance, and freight" and FOB stands for "free on board." The FOB value of a good is the sum of the factory gate price plus the cost of transporting the good to a carrier. The CIF value of a good is the FOB value plus the cost of shipping and insurance. The CIF-FOB ratio is one plus the ad valorem trade cost for freight and insurance.

[43] Using Equation (2) and (3) we can express the bilateral trade cost function as a function of distance as $\tau_{ijy} = \theta_{ijt} c_{ij} d_{ijt}^{\rho}$. We obtain $(1-\sigma)\rho$ as part of the gravity equation by substituting $\tau_{ijy} = \theta_{ijt} c_{ij} d_{ijt}^{\rho}$ into the 1 and taking logs.

as the latter does not vary over time. I denote geographical distance $\bar{d}_{ij}$ and the term that captures the effect of geographical distance on the cost of delivery as $\bar{\rho}$. Thus, we end up with the following function of bilateral trade frictions:

$$\tau_{ijt} = \theta_{ijt} c_{ij} \bar{d}_{ij}^{\bar{\rho}} \tag{8}$$

As geographical distance does not vary over time, the geographical distance elasticity cannot be estimated separately from other time-invariant trad frictions c_{ij} by using exporter-importer fixed effects. Instead I formulate the following gravity equation:

$$\ln x_{ijt} = \beta \ln \bar{d}_{ij} + \delta_{it} + \gamma_{jt} + g_{ijt} + \varepsilon_{ijt} \tag{9}$$

where g_{ijt} is a vector of bilateral variables that indicate if i and j share a border, share official common language, have a colonial linkage, have a common currency, and have signed a free trade agreement. Data on bilateral geographical distance, sharing of borders, colonial linkages, common currency and free trade agreement status is obtained from the CEPII Gravity Dataset. β captures $(1-\sigma)\bar{\rho}$. Table 4 shows that the structural distance elasticity is equal to -1.43.[44]

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[44] Running a naive gravity regression with distance as the sole dependent variable yields an estimate of -0.842. The results are in line with previous findings. For instance, Head and Mayer (2014) compile 1835 estimated distance elasticises grouped into 328 structural elasticises and 1507 naive elasticises. The authors find an average structural elasticity of -1.1 and an average naive elasticity of -0.89. The median structural elasticity is -1.14. It should be noted that the authors adopt a broad definition of structural gravity and include all results that use some form of country dummies or ratio type estimation.

Table 4: Geographical Distance Elasticity

Dependent Variable:	ln(Trade)
ln(Distance)	-1.430***
	(0.027)
Observations	113,380
R-squared	0.716

Notes: This table reports the estimated impact of geographical distance on bilateral trade using a structural gravity equation, Equation (9). The dependent variable captures the log of total bilateral goods trade. The regression includes controls that indicate if exporter-importer pairs share a border, share official common language, have a colonial linkage, have a common currency and have signed a free trade agreement along with exporter-time fixed and importer-time fixed effects. Standard errors are clustered at the exporter-importer level. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

To compute how much travel time can account for the distance elasticity of trade, I express the ratio of the travel time elasticity to the distance elasticity as follows:

$$\frac{(1-\sigma)\rho_b}{(1-\sigma)\rho} = \frac{\rho_b}{\rho} = \frac{\rho_b}{\rho_b + \rho_s + \rho_u}$$

From Table 4 we know that the geographical distance elasticity of trade $(1-\sigma)\bar{\rho} = -1.43$. I assume that the geographical distance elasticity is a good approximation of the distance elasticity, $(1-\sigma)\bar{\rho} \approx (1-\sigma)\rho$. Finally, we know the travel time elasticity from Table 1, $(1-\sigma)\rho_b = -1.22$, which gives $\frac{\rho_b}{\rho_b+\rho_s+\rho_u} = 0.853$. Thus, travel time can account for about 85.3% the total distance elasticity of trade.[45] To my knowledge, this is the first paper that has found an observable that is able to account for a large share of distance elasticity of trade.

Finally, as seen in Table 3, the estimated impact of flight time on trade shows to be much smaller when estimated on the product level. However, when estimating the geographical distance elasticity on the product level, the magnitude is much smaller as well, see Table 7 in Section A.10 in the Appendix. Thus, the travel time elasticity

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[45] This result is based on total trade. Doing the same exercise for goods not typically traded by air yields a share of 89.9%.

is able to account for approximately the same share of the distance elasticity also when the gravity model is estimated on the product level.

5.6 General Equilibrium Trade Impact

Having estimated the business travel cost elasticity of trade, $(1-\sigma)\rho_b$, I proceed to estimate the total impact of the liberalization of the Soviet airspace on trade. The reason for why one cannot simply exponentiate the coefficient of business travel cost to obtain the effect on trade has to do with general equilibrium effects of the gravity model. Any change to bilateral trade frictions between a set of countries will also affect income, expenditures, and prices (multilateral resistance) of all countries. These changes will also affect trade patterns indirectly. In order to estimate the general equilibrium change of trade, one needs to allow for income, expenditures, and prices to adjust along with changes in bilateral trade frictions.

To allow for all components of the gravity model to adjust, I choose to follow Head and Mayer (2014) and estimate the general equilibrium trade impact (GETI).[46] In short, the methodology of Head and Mayer (2014) involves retrieving the travel time elasticity of trade to compute changes in bilateral accessibility between the treated exporter-importer pairs. Then, the value of the change of bilateral accessibility, the value of production in each country, and the trade share matrix is plugged into a system of equations to obtain changes in income as a consequence of the liberalization of the Soviet airspace. A solution is obtained by initially guessing and updating a vector of changes in income until the system of equations is satisfied.[47]

As the GETI method requires trade with itself, I follow Head and Mayer (2014) and use the CEPII Trade and Production Data developed by de Sousa et al. (2012) instead of the COMTRADE data used in the rest of the paper. Trade with self is computed as the difference between total manufacturing production and total manufacturing exports. The main advantage of doing this is that a regular measure of GDP only captures value added and not purchases of intermediates, which should

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[46] Anderson and van Wincoop (2003) was likely the first to compute GETI counterfactuals. The authors' approach is closely related to the hat algebra method first developed by Dekle et al. (2007).

[47] See Section A.11 in the Appendix for more detailed description of the GETI method.

be included when computing trade with itself. I use production data for the year 1983, which is before news about the Soviet airspace liberalization reached the public. This leaves me with trade between 90 countries. The only treated countries that are not in the sample are Switzerland and Mongolia.

I find that general equilibrium effect for the treated exporter-importer pairs was an increase in trade by 23.5%. The corresponding figure for the control group was a decline in trade by 3.2%. Both figures are defined as the median percentage change in trade.[48] The total treatment effect can be computed as: $(1.235/0.968) - 1 = 0.276$. This figure can be compared to the baseline results by exponentiating the partial equilibrium trade impact, which only adjusts flight time but no other components of the gravity equation. I do this by multiplying the estimated travel cost elasticity of total trade from Table 1 with the median reduction in flight time for the treated exporter-importer pairs. The median reduction in flight time is 16.9% which gives a partial trade impact of $-0.169 \times -1.220 = 0.206$. Hence, the general equilibrium increase in trade is slightly larger compared to the partial trade impact.

It is easy to estimate the impact on welfare having computed the GETI. Arkolakis et al. (2012) show that the import ratio and the trade cost elasticity constitute sufficient statistics to calculate changes in welfare for a large class of trade models. The change in the import ratio is already computed, and I choose to take the trade cost elasticity from the literature. I compare the median percentage change in aggregate welfare for countries in Western Europe and East Asia to the median percentage change in aggregate welfare for rest of the world. The aggregate welfare increases for countries in Western Europe and East Asia by 0.1% while it is unchanged for countries in the rest of the world. The welfare impact might seem small in rela-

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[48] The reason for why trade declines among the control group is that countries that do not belong to either Western Europe or East Asia become relatively less accessible as trading partners. Countries in Western Europe redirect trade to East Asia from the rest of the world, and countries in East Asia redirect trade to Western Europe. Changes in expenditures of countries in Western Europe and East Asia also affect income in the rest of the world and cause trade to decline among country pairs where neither belong to Western Europe or East Asia. For exporter-importer pairs in the control group where one country belongs to either Western Europe or East Asia, the median percentage reduction in trade is 3.8%. For exporter-importer pairs where neither country belong to Western Europe or East Asia, the median percentage reduction in trade is 3.1%.

tionship to the impact on trade, yet it is in line with the results obtained by Head and Mayer (2014). The reason is that the welfare effect depends on the change in trade with itself. If the initial trade shares between two countries are small, a large increase in trade still would not affect domestic trade much. The median initial trade share among the treated exporter-importer pairs in the sample is only 0.1%. The reason why the liberalization of the Soviet airspace has a limited impact on the rest of the world is that it only directly impacted 2.5% of the country pairs in the sample. Consequently, welfare effects would be greater if flight distances are reduced between larger trading partners.

6 Conclusion

Robust evidence shows that standard barriers to trade, including tariffs and transport, cannot account for the negative impact of geographical distance on trade. I provide causal evidence that a majority of the distance elasticity of trade can be accounted for by business travel time. The underlying logic is that face-to-face interaction through business travel is important for trade, and that transporting people is costly. I use the liberalization of the Soviet airspace for civil aviation in 1985 as a source of exogenous variation. The opening of the Soviet airspace radically reduced travel time between Europe and East Asia and was associated with a substantial increase in trade volumes. I show that the trade elasticity to travel time could account for approximately 85.3% of the distance elasticity of trade. Results are robust to a number of different specifications including when solely analyzing trade in goods not typically transported by air. This indicates that results are not driven by a reduction in air shipping costs. I also show that trade in products relying on advanced technology, which typically requires more business travel, experienced a larger impact compared to trade in products utilizing simple technologies. Finally, I show that the impact on trade is larger when also taking indirect general equilibrium effects into consideration.

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A Appendix

A.1 Passenger Traffic from London to Tokyo 1982-1989

Figure A.1: Passenger Traffic from London to Tokyo

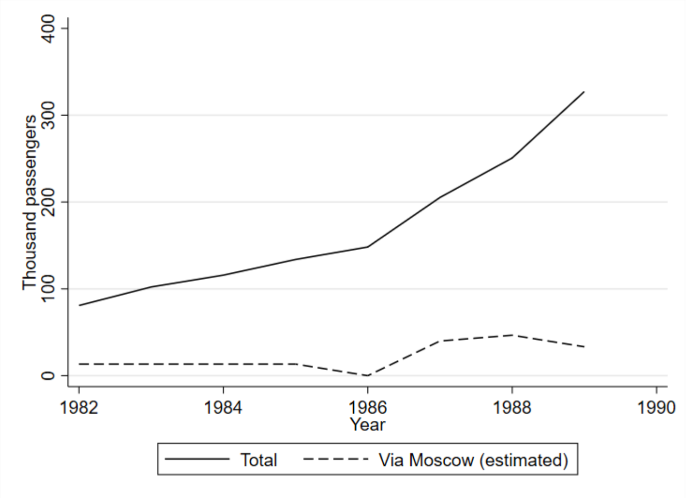


Figure A.1 is based on the number of weekly departures obtained from the *ABC World Airways Guide*. I estimate the number of passengers by using additional data from ICAO's TFS data set. See Section A.2 in the Appendix for a detailed description of how the number of non-stop passengers is estimated. If one would also count the passengers that had to make at least one transfer between London and Tokyo, the fraction of flights that made stopovers in Moscow would be even smaller. The Soviet air carrier Aeroflot did not report statistics to ICAO. Hence, all passenger traffic from London to Tokyo via Moscow by Aeroflot is excluded. The timetable data, however, indicated that Aerflot's capacity was typically limited to only one or two weekly flights. Moreover, Aeroflot had a notoriously bad reputation due to inferior quality and flight safety concerns and was generally not popular in the business community.

A.2 Computing Non-Stop Passengers Prior to 1989

The number of annual non-stop passengers between East Asia and Western Europe prior to 1989 is computed using data from the *ABC World Airways Guide* timetables and the TFS dataset as follows:

$$non\text{-}stop\,passengers_{ijamt} = weekly\,departures^{ABC}_{ijamt} \times passengers\ per\ flight^{TFS}_{m} \times 52$$

i = city of departure, j = city of arrival, a = airline, m = airplane type, t = year

where $weekly\,departures$ is the average number of weekly non-stop departures obtained from the timetables and $passengers\,per\,flight^{TFS}_{m}$ is the average number of passengers per departure by airplane type taken from the TFS dataset. To compute the average number of passengers by airplane type, I use all non-stop flights between Europe and East Asia in 1989, the first year of observation, and divide the number of travelling passengers by the number of departures for each airplane type. During this time the Boeing 747 dominated the non-stop traffic between Europe and East Asia, but a few airlines also used the McDonnell Douglas DC-10. I then aggregate the number of estimated number of non-stop passengers by year.

A.3 Treated Exporter-Importer Pairs

The pool of treated subjects in the analysis consists of all exporter-importer pairs that can be formed between Western Europe and East Asia that have recorded positive trade at least one year between 1976 and 1995. The control group consists of the remaining exporter-importer pairs of the world excluding the Eastern Bloc. In total there are 251 subjects in the treatment group and 18,143 subjects in the control group.

Table 5: Treated Exporter-Importer Pairs

Western Europe		**East Asia**
Austria	Italy	China
Belgium-Luxembourg	Malta	Hong Kong
Denmark	Netherlands	Japan
France	Norway	South Korea
Finland	Portugal	Mongolia
West Germany	Spain	Taiwan
Greece	Sweden	Macao
Iceland	Switzerland	
Ireland	United Kingdom	

A.4 Flight and Trade Patterns

Figure A.2: World Regions

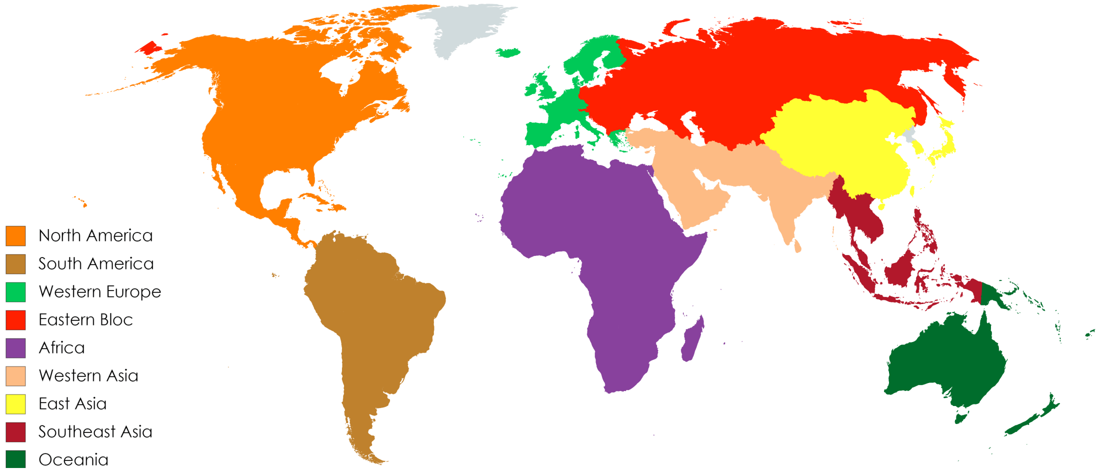
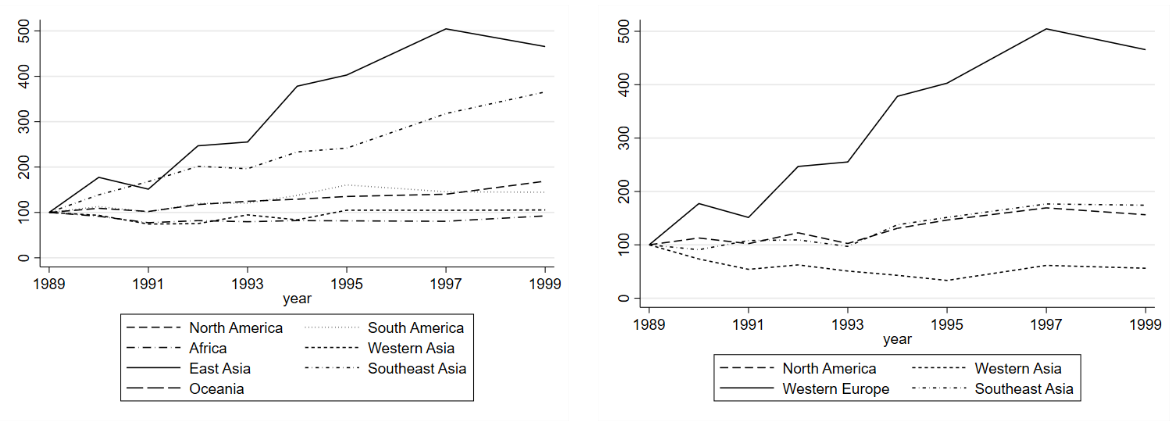
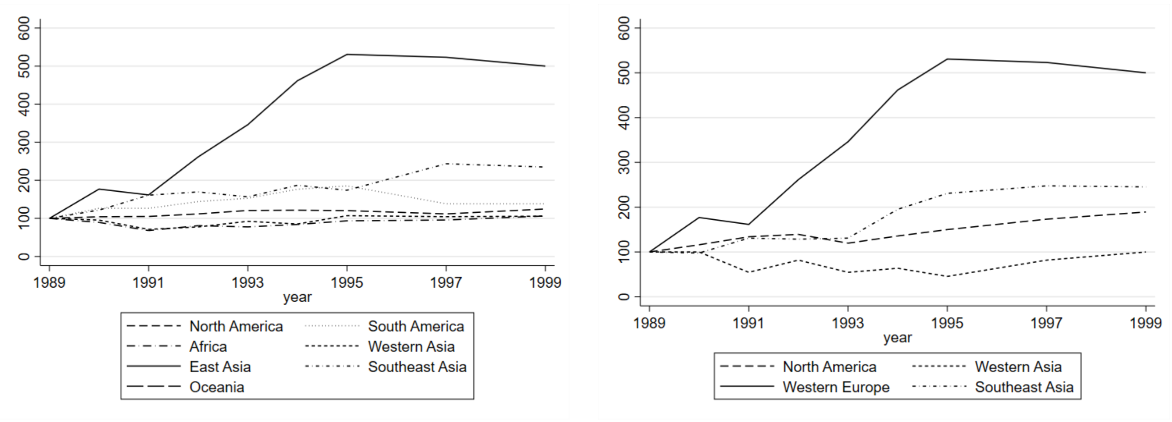


Figure A.3: Normalized Air Traffic from Western Europe and East Asia to the Rest of the world



(a) Non-Stop Passenger Traffic between Western Europe and the Rest of the World

(b) Non-Stop Passenger Traffic between East Asia and the Rest of the World

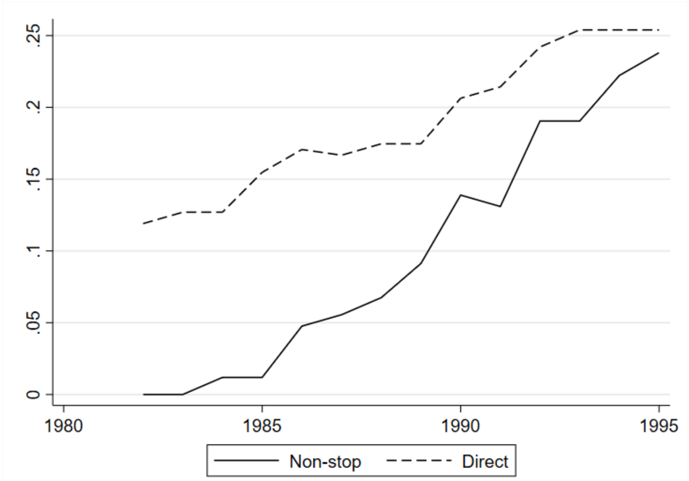


(c) Non-Stop Routes between Western Europe and the Rest of the World

(d) Non-Stop Routes between East Asia and the Rest of the World

Notes: A route is defined as an origin-destination city pair with at least 10,000 annual non-stop passengers. Routes between East Asia and Africa, South America, and Oceania are excluded due to negligible levels of air traffic.

Figure A.4: Share of Treated Origin-Destination Pairs with Direct and Non-Stop Connections



Notes: A connection is defined as an origin-destination city pair with at least 10,000 annual passengers. 252 origin-destination country pairs can be formed between Western Europe and East Asia in total.

Figure A.5: Number of Treated Origin-Destination Country Pairs with at Least One Weekly Non-Stop Connection

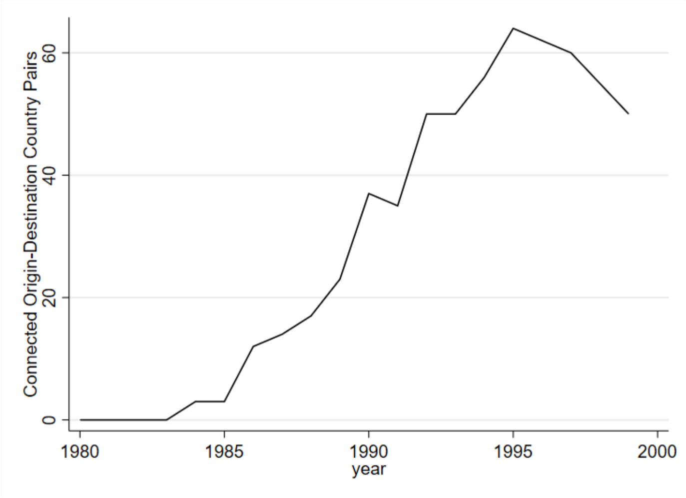
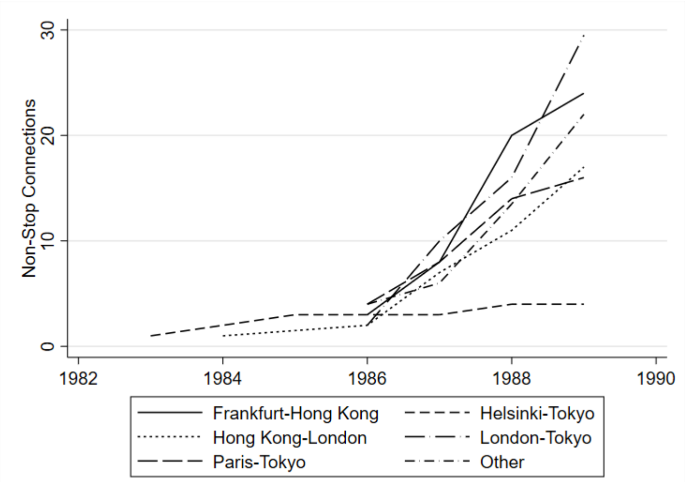


Figure A.6: Number of Weekly Non-Stop Departures on Busiest Routes between Western Europe and East Asia



Notes: Passenger traffic is aggregated to the city pair level. Thus, every city pair captures passengers travelling in both directions. Other busy city pairs include Amsterdam-Tokyo, Copenhagen-Tokyo, Frankfurt-Tokyo, Rome-Hong Kong, Milan-Tokyo, and Zurich-Tokyo.

A.5 Computing Travel Time

I use the geoprocessing software ArcGIS to compute travel time between the country pairs that were affected by the liberalization of the Soviet airspace. I start by creating two networks of routes that connect countries in Western Europe with countries in East Asia. The first network captures the period before the liberalization and contains routes that avoid Soviet airspace. The second network reflects the period after the liberalization and contains routes that cross Soviet airspace but still avoids the parts of the Chinese airspace that were still prohibited.[49] Both networks consist of points that represent the city in each country in Western Europe and East Asia with the most departing passengers in 1985 according to the OFOD dataset.

The first step to set up the networks is to determine which countries have airports with intercontinental air traffic between Western Europe and East Asia. I am not able to use the actual hubs that channeled passengers between Western Europe and East Asia as this may be endogenous to the trading relationship between country pairs. Instead I choose the two cities with the most departing passengers during the 1980s in Western Europe and East Asia. These cities are London, Paris, Tokyo, and Hong Kong. I refer to London, Paris, Tokyo and Hong Kong as hubs, while the remaining points are referred to as spokes.

The network is then set up in the following way: Each spoke receives a non-stop connection to both hubs in its respective region. For instance, Copenhagen is the city with most departing passengers in Denmark in 1985. Hence, Copenhagen receives a non-stop connection to both Paris and London. Then, each hub receives an intercontinental connection to hubs in the other region. Hence, London and Paris each receives connections to Tokyo and Hong Kong.

The difference between the networks I create is that intercontinental routes between the hubs prior to the liberalization completely avoid Soviet airspace. The intercontinental routes that avoid Soviet airspace are routed both over the Middle East and Anchorage, Alaska.[50] The intercontinental routes in the network after the

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[49] The reason why parts of the Chinese airspace was prohibited is explained in Section 3.

[50] These routes both represent the shortest detour routes between Western Europe and East Asia prior to 1985 depending on the point of departure and destination.

liberalization represent the shortest routes between the hubs that still avoided the parts of the Chinese airspace that were not available. Using these networks I compute the shortest distance between all country pairs before and after the liberalization of the Soviet airspace.

To translate distances into flight time, I need to make assumptions with regards to the number of stopovers on each route, stopover time, and average flight speed. I assume that passengers need to make stopovers whenever they pass through hubs. I also assume that every intercontinental flight prior to the liberalization needs to make a stopover. For instance, a flight from Sweden to South Korea prior to the liberalization would consist of four legs. It would start in Stockholm and end end in Seoul. As neither Stockholm or Seoul are hubs, the flight would be routed Stockholm-London-Anchorage-Tokyo-Seoul. The same flight after the liberalization of the Soviet airspace would be routed Stockholm-London-Tokyo-Seoul.[51] I assume that a stopover adds 1.5 hours of flight time and that the average flight speed between any two points is 850 km/h. 850 km/h is slightly below the average cruising speed of a typical Boeing 747 or a McDonnell Douglas DC-10, which were the most common airplane models to operate routes between Western Europe and East Asia during the 1980s.

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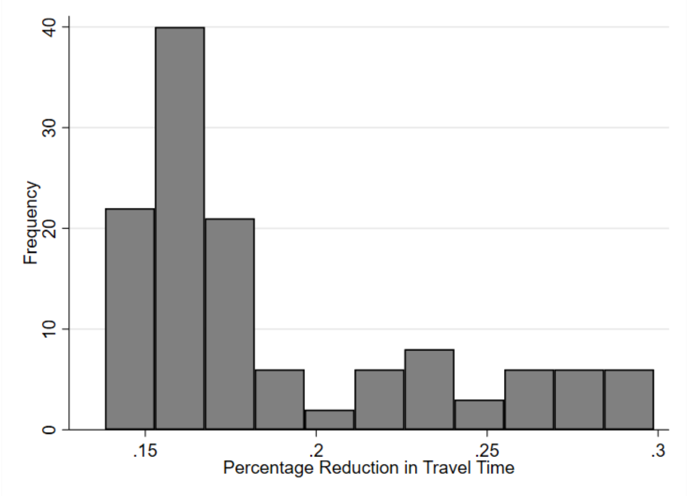
[51] All routes are assumed to be symmetric, which implies that the route from Seoul to Stockholm would be routed Seoul-Tokyo-Anchorage-London-Stockholm.

A.6 Distribution of the Treatment Variable

Figure A.7: Percentage Reduction in Travel Time between Treated Origin-Destination Country Pairs



Notes: The figure illustrates the distribution of the percentage reduction in air travel time between all 252 treated subjects.

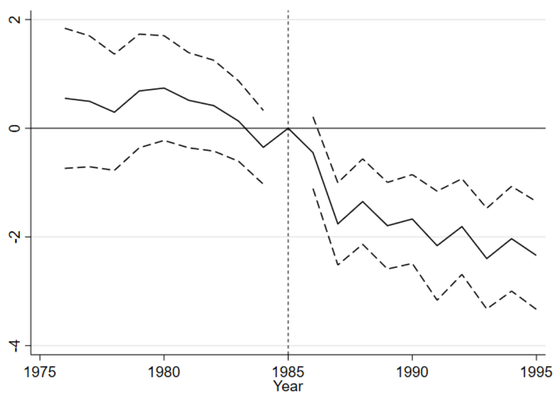
A.7 Identifying Goods Not Typically Transported by Air

I use Eurostat data from 2002 to 2004 to identify product codes not typically transported by air. The data cover all trade between the EU and East Asia divided on 6 digit HS product codes and the mode of shipment. I convert the HS product codes to 4 digit SITC product codes and compute the average share of the value that crosses the EU border by air for each product between 2002 and 2004. A good is defined as not typically transported by air if less than 20 percent of the value of trade between the EU and East Asia of that good crosses the EU border by air. The fact that the data cover a period over a decade and a half after the liberalization of the Soviet airspace should not be seen as a major concern. Hummels (2007) documents a monotonic decline in the air-to-sea freight price ratio which implies that goods not shipped by air in the early 2000s are even less likely to be shipped by air in the mid-1980s. The share of goods not typically transported by air constitute approximately 65 percent of total world trade around the time of the liberalization.

A.8 Robustness Results

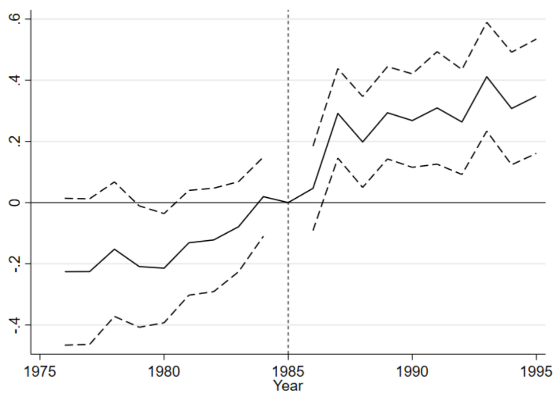
A.8.1 Panel A. Alternative Treatment and Trade Variables

Figure A.8: Effect with Distance Change as Treatment Variable



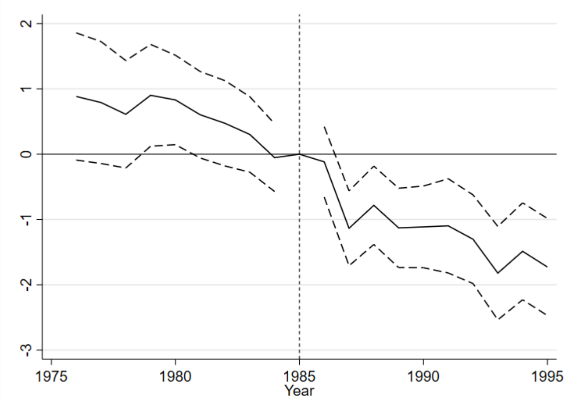
Notes: This figure reports estimates of the impact of flight time on bilateral trade with a 95% confidence interval, using Equation (6). The dependent variable is the log of bilateral goods trade that is not typically transported by air. The independent variable captures the interaction between the change in flight distance and a vector of year dummies. The regression includes exporter-time fixed effects, importer-time fixed effects, and exporter-importer fixed effects. Standard errors are clustered at the exporter-importer level.

Figure A.9: Effect with a Binary Treatment Dummy



Notes: This figure reports estimates of the impact of flight time on bilateral trade with a 95% confidence interval, using Equation (6). The dependent variable is the log of bilateral goods trade that is not typically transported by air. The independent variable captures the interaction between a treatment dummy and a vector of year dummies. The regression includes exporter-time fixed effects, importer-time fixed effects, and exporter-importer fixed effects. Standard errors are clustered at the exporter-importer level.

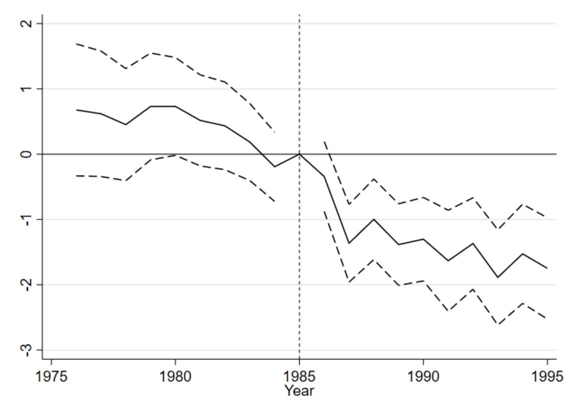
Figure A.10: Effect Excluding Oil and Gas Trade



Notes: This figure reports estimates of the impact of flight time on bilateral trade with a 95% confidence interval, using Equation (6). The dependent variable is the log of bilateral goods trade that is not typically transported by air. The dependent variable also excludes all oil and gas products. The independent variable captures the interaction between the change in flight time and a vector of year dummies. The regression includes exporter-time fixed effects, importer-time fixed effects, and exporter-importer fixed effects. Standard errors are clustered at the exporter-importer level.

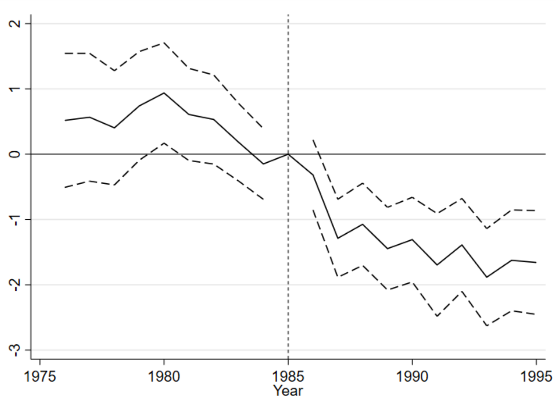
A.8.2 Panel B. Alternative Control Variables and Control Groups

Figure A.11: Effect Adding Free Trade Agreement and Common Currency Status Control Variables



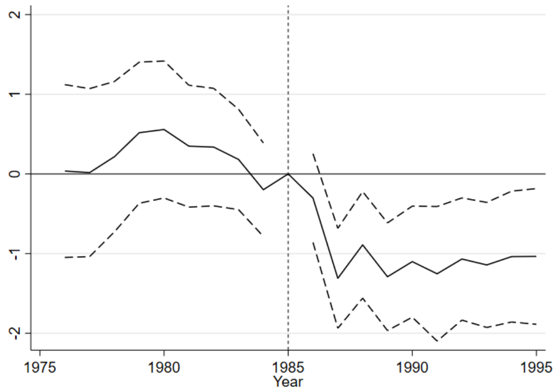
Notes: This figure reports estimates of the impact of flight time on bilateral trade with a 95% confidence interval. The regression is based on Equation (6) with two additional dummy variables that takes the value one if the exporter-importer pair has signed a free trade agreement and shares a common currency. The dependent variable is the log of bilateral goods trade that is not typically transported by air. The estimates in the figure captures the interaction between the change in flight time and a vector of year dummies. The regression includes exporter-time fixed effects, importer-time fixed effects, and exporter-importer fixed effects. Standard errors are clustered at the exporter-importer level.

Figure A.12: Effect Excluding the 10% Poorest Countries in the Sample



Notes: This figure reports estimates of the impact of flight time on bilateral trade excluding the poorest 10% of the countries in the sample. Income is based on per capita GDP in 1985. The regression is based on Equation (6) and the figure displays a 95% confidence interval. The dependent variable is the log of bilateral goods trade that is not typically transported by air. The independent variable captures the interaction between the change in flight time and a vector of year dummies. The regression includes exporter-time fixed effects, importer-time fixed effects, and exporter-importer fixed effects. Standard errors are clustered at the exporter-importer level.

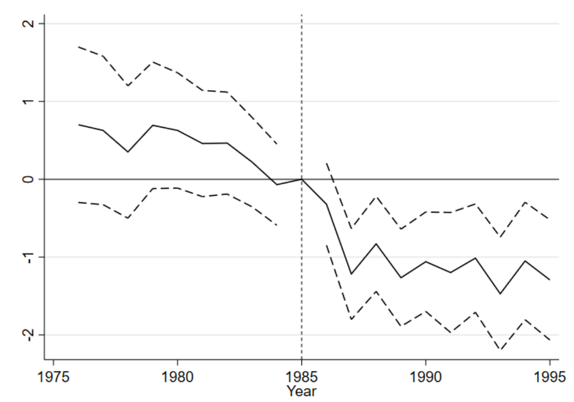
Figure A.13: Effect Excluding the 50% Poorest Countries in the Sample



Notes: This figure reports estimates of the impact of flight time on bilateral trade excluding the poorest 50% of the countries in the sample. Income is based on per capita GDP in 1985. Both China and India are kept in the sample despite belonging to the poorer half of the countries in the sample. The reason for doing this is that China and India are large countries where trade is concentrated to regions that are significantly richer than the country average. The regression is based on Equation (6) and the figure displays a 95% confidence interval. The dependent variable is the log of bilateral goods trade that is not typically transported by air. The independent variable captures the interaction between the change in flight time and a vector of year dummies. The regression includes exporter-time fixed effects, importer-time fixed effects, and exporter-importer fixed effects. Standard errors are clustered at the exporter-importer level.

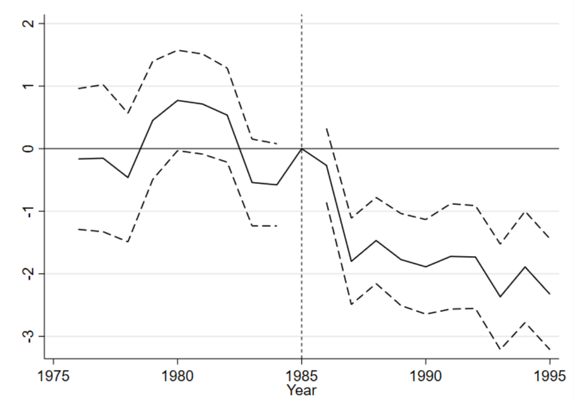
A.8.3 Panel C. Other Robustness Checks

Figure A.14: Effect Including Countries Belonging to the Eastern Bloc



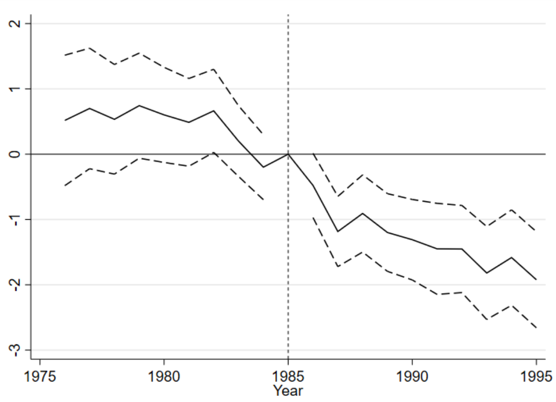
Notes: This figure reports estimates of the impact of flight time on bilateral trade including all countries belonging to the Eastern Bloc in the sample. The regression is based on Equation (6) and the figure displays a 95% confidence interval. The dependent variable is the log of bilateral goods trade that is not typically transported by air. The independent variable captures the interaction between the change in flight time and a vector of year dummies. The regression includes exporter-time fixed effects, importer-time fixed effects, and exporter-importer fixed effects. Standard errors are clustered at the exporter-importer level.

Figure A.15: Effect Excluding Potentially Treated Controls



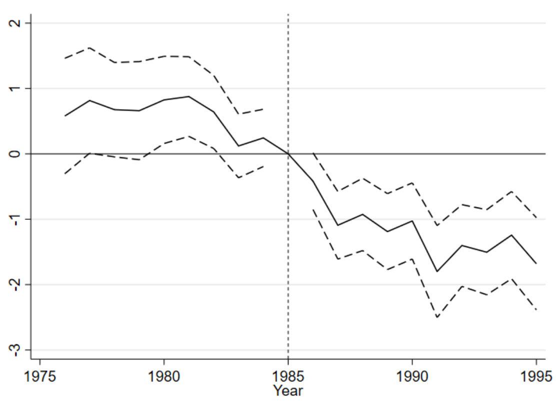
Notes: This figure reports estimates of the impact of flight time on bilateral trade excluding all exporter-importer country pairs that were potentially affected by the liberalization of the Soviet airspace. See Section A.9 for details on which exporter-importer pairs are excluded from the sample. The regression is based on Equation (6) and the figure displays a 95% confidence interval. The dependent variable is the log of bilateral goods trade that is not typically transported by air. The independent variable captures the interaction between the change in flight time and a vector of year dummies. The regression includes exporter-time fixed effects, importer-time fixed effects, and exporter-importer fixed effects. Standard errors are clustered at the exporter-importer level.

Figure A.16: Effect Excluding Exporter-Importer Pairs that Only Trade Few Years



Notes: This figure reports estimates of the impact of flight time on bilateral trade excluding all exporter-importer country pairs that record positive trade less than 15 years between 1976 and 1995. The regression is based on Equation (6) and the figure displays a 95% confidence interval. The dependent variable is the log of bilateral goods trade that is not typically transported by air. The independent variable captures the interaction between the change in flight time and a vector of year dummies. The regression includes exporter-time fixed effects, importer-time fixed effects, and exporter-importer fixed effects. Standard errors are clustered at the exporter-importer level.

Figure A.17: Effect Excluding Exporter-Importer Pairs that Record Low Volume Trade



Notes: This figure reports estimates of the impact of flight time on bilateral trade excluding the exporter-importer pairs that recorded the least positive trade in 1985 from the sample. All exporter-importer pairs that recorded no trade in 1985 are excluded as well. The regression is based on Equation (6) and the figure displays a 95% confidence interval. The dependent variable is the log of bilateral goods trade that is not typically transported by air. The independent variable captures the interaction between the change in flight time and a vector of year dummies. The regression includes exporter-time fixed effects, importer-time fixed effects, and exporter-importer fixed effects. Standard errors are clustered at the exporter-importer level.

A.9 Routes Potentially Crossing the Eastern Bloc or China

As I lack information about the exact flight routes of airlines during the 1980s and 1990s I do a robustness check where I exclude a large set of exporter-importer country pairs that could have been connected by flights that were routed over or close to the Eastern Bloc or China. I group all countries into nine regions and exclude region pairs that contain country pairs that could have been connected by a flight that potentially would have crossed the airspace over the Eastern Bloc or China. Regions are shown in Figure A.2. The list of excluded region pairs are listed below.

Table 6: Routes Potentially Crossing the Eastern Bloc or China

East Asia	Western Asia
Southeast Asia	Western Asia
Africa	East Asia
Africa	Southeast Asia
Western Europe	Western Europe
Africa	Western Europe
Western Asia	Western Europe
East Asia	North America
North America	Western Asia
North America	Southeast Asia
Southeast Asia	Western Europe

Notes: These region pairs contain 5171 exporter-importer pairs, which is approximately 28% of the total number of exporter-importer pairs in the sample.

A.10 Product Level Analysis

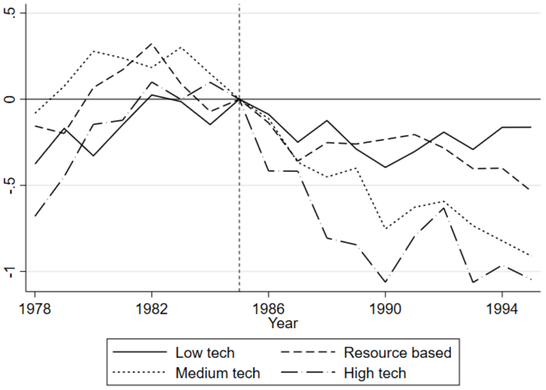
A.10.1 Product Level Analysis Year-by-Year Results

I estimate the following year-by-year product level gravity model:

$$x_{ijnt} = \alpha + \sum_{t=1978}^{1995} (\beta_t(ln\ b_{ij}^{Post} - ln\ b_{ij}^{Pre})) \times \mu_t + \delta_{it} + \gamma_{jt} + \omega_{ij} + \kappa_{nt} + \varepsilon_{ijt} \qquad (10)$$

where x_{ijnt} captures trade from country i to country j in product n at time t. $ln\ b_{ij}^{Post} - ln\ b_{ij}^{Pre}$ is the log difference between the travel after and before the liberalization of the Soviet airspace. β_t captures the interaction between the treatment variable and a vector of year dummies that span the years 1978 to 1995. δ_{it} and γ_{jt} capture exporter-time and importer-time fixed effects, ω_{ij} controls for exporter-importer fixed effects and κ_{nt} captures product-time fixed effects. I estimate Equation (10) for resource-based products, low technology products, medium technology products, and high technology products separately.

Figure A.18: Impact of Shorter Flight Time Across Technology Groups Year-by-Year



Notes: This figure compares the impact of flight time on bilateral trade for different groups of goods, based on their technological advancement, using Equation (10). The dependent variable captures the log of bilateral product level trade on the 3-digit level. The independent variable captures the interaction between the change in flight time and a vector of year dummies. The sample is split into four product groups: low technology, resource-based, medium technology, and high technology goods. Low technology and resource-based goods rely on simple technology while medium and high technology goods rely on advanced technology. The regression includes exporter-time fixed effects, importer-time fixed effects, product-time fixed effects, and exporter-importer fixed effects. Standard errors are clustered at the exporter-importer level.

A.10.2 Distance Elasticity Estimated on the Product Level

I run the following product level gravity regression to estimate the geographical distance elasticity of trade:

$$x_{ijnt} = \alpha + \beta ln\ \bar{d}_{ij} + \delta_{it} + \gamma_{jt} + g_{ijt} + \kappa_{nt} + \varepsilon_{ijnt} \tag{11}$$

where x_{ijnt} captures trade from country i to country j in product n at time t and $\bar{d}_{ij}$ captures the weighted geographical distance between i and j. g_{ijt} is a vector that captures variables of bilateral friction including sharing of borders, colonial linkages, common currency and free trade agreement status, all obtained from the CEPII Gravity Dataset. Results are presented below in Table 7.

Table 7: Geographical Distance Elasticity Estimated on the Product Level

	ln(Trade)
ln(Distance)	-0.710***
	(0.021)
Observations	5,022,872
R-squared	0.372

Notes: This table reports the estimated impact of geographical distance on bilateral trade on the 3-digit product level using a structural gravity equation, Equation (11). The dependent variable captures the log of total bilateral goods trade. The regression includes controls that indicate if exporter-importer pairs share a border, share official common language, have a colonial linkage, have a common currency and have signed a free trade agreement along with exporter-time fixed effects, importer-time fixed effects, and product-time fixed effects. Standard errors are clustered at the exporter-importer level. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

A.11 Notes on GETI and Welfare

This section contains notes on how the General Trade Impact (GETI) and welfare of the liberalization of the Soviet airspace is computed. We start by describing the structural gravity equation in the following form:

$$X_{ni} = \frac{Y_i}{\Omega_i}\frac{X_n}{\Phi_n}\phi_{ni} \tag{12}$$

where X_{ni} are total exports from country i to country n,

$$Y_i = \sum_n X_{ni} \tag{13}$$

is the total value of production in i, $X_n = \sum_i X_{ni}$ is total expenditures in n and ϕ_{ni} captures bilateral accessibility. Ω_i and Φ_n capture exporter and importer multilateral resistance terms which are defined as follows:

$$\Omega_i = \sum_\ell \frac{\phi_{\ell i} X_\ell}{\Phi_\ell} \qquad \Phi_n = \sum_\ell \frac{\phi_{n\ell} Y_\ell}{\Omega_\ell} \tag{14}$$

The bilateral accessibility term can be expressed as:

$$\phi_{ni} = \tau_{ni}^{\varepsilon} \tag{15}$$

where τ_{ni} is the iceberg trade cost and ε is the trade elasticity. Let τ_{ni} be a function of a vector of $N+1$ bilateral variables including business travel time, $\tau_{ni}(Time_{ni}, B_{ni}^1, B_{ni}^2, ..., B_{ni}^N)$. Further assume that ϕ_{in} can be expressed as a linear function of the vector of the bilateral variables:

$$ln\phi_{ni} = \beta Time_{ni} + \gamma^1 B_{ni}^1 + \gamma^2 B_{ni}^2, ..., \gamma^N B_{ni}^N \tag{16}$$

In this setting, GETI is defined as the change in bilateral trade between countries due to the liberalization of the Soviet airspace, $GETI_{ni} = \frac{X'_{ni}}{X_{ni}} = \hat{X}_{ni}$, where X'_{ni} denotes bilateral trade after the liberalization. Expressing GETI using Equation

(12) gives:

$$\frac{X'_{ni}}{X_{ni}} = \frac{\frac{Y'_i}{\Omega'_i}\frac{X'_n}{\Phi'_n}\phi'_{ni}}{\frac{Y_i}{\Omega_i}\frac{X_n}{\Phi_n}\phi_{ni}} = \frac{Y'_i X'_n \Omega_i \Phi_n \phi'_{ni}}{Y_i X_n \Omega'_i \Phi'_n \phi_{ni}} \tag{17}$$

We can start by rewriting $\hat{\phi}_{ni} = \frac{\phi'_{ni}}{\phi_{ni}}$ in terms of observables using Equation (16). Note that no bilateral variables change except $Time_{ni}$ when the Soviet airspace is liberalized. Thus:

$$\begin{aligned} \frac{\phi'_{ni}}{\phi_{ni}} &= \frac{e^{(\beta Time'_{ni} + \gamma^1 B^{1\prime}_{ni}, \ldots, \gamma^N B^{N\prime}_{ni})}}{e^{(\beta Time_{ni} + \gamma^1 B^1_{ni} +, \ldots, \gamma^N B^N_{ni})}} \\ &= e^{(\beta Time'_{ni} + \gamma^1 B^{1\prime}_{ni}, \ldots, \gamma^N B^{N\prime}_{ni}) - (\beta Time_{ni} + \gamma^1 B^1_{ni}, \ldots, \gamma^N B^N_{ni})} \\ &= e^{\beta (Time'_{ni} - Time_{ni})} \end{aligned} \tag{18}$$

Next, we turn to the changes in income and expenditures, $\hat{Y}_i$ and $\hat{X}_n$. First, Y_i can be expressed as a function of aggregate income, $Y_i = w_i L_i$. Since the labor endowment is fixed over the period of the liberalization of the Soviet airspace, the entire change of Y_i will solely depend on changes on w_i. Thus, we have that $\hat{w}_i = \hat{Y}_i$. Due to trade deficits we cannot assume that total expenditure of a country equals its total income. We can express a country's aggregate deficit in per capita terms, $D_n = L_n d_n$. Then total expenditure can be expressed as $X_n = w_n L_n (1 + d_n)$. Assuming that d_n is exogenous and constant over the period of the liberalization of the Soviet airspace we have that: $\hat{X}_n = \hat{w}_n = \hat{Y}_n$. Thus, in addition to $\hat{\phi}_{in}$, we only need an expression for equilibrium change of income, $\hat{Y}_i$, to compute $\hat{X}_{ni}$.

Let π_{ni} denote import shares from all countries as $\pi_{ni} = \frac{X_{ni}}{X_n}$. Then we can use the market clearing condition (13) as follows:

$$\hat{Y}_i = \frac{\sum_n \pi'_{ni} X'_n}{Y_i} \tag{19}$$

Dekle et al. (2007) shows that:

$$\hat{\pi}_{ni} = \frac{(\hat{Y}_i \hat{\tau}_{ni})^{\varepsilon}}{\sum_{\ell} \pi_{n\ell} (\hat{Y}_i \hat{\tau}_{n\ell})^{\varepsilon}} \tag{20}$$

As $\pi'_{ni} = \pi_{ni}\hat{\pi}_{ni}$ we can rewrite (20):

$$\pi'_{ni} = \frac{\pi_{ni}(\hat{Y}_i\hat{\tau}_{ni})^{\varepsilon}}{\sum_{\ell} \pi_{n\ell}\hat{Y}_{\ell}\hat{\tau}_{n\ell})^{\varepsilon}} \tag{21}$$

Plugging (21) into (19) we get:

$$\hat{Y}_i = \frac{1}{Y_i}\sum_{n} \frac{\pi_{ni}(\hat{Y}_i\hat{\tau}_{ni})^{\varepsilon}}{\sum_{\ell} \pi_{n\ell}(\hat{Y}_{\ell}\hat{\tau}_{n\ell})^{\varepsilon}} X'_n \tag{22}$$

As $\frac{X'_n}{X_n} = \hat{Y}_n = \frac{Y'_n}{Y_n}$ we can rewrite $X'_n = \hat{Y}_n X_n$ and use (15) to get:

$$\hat{Y}_i = \frac{1}{Y_i}\sum_{n} \frac{\pi_{ni}\hat{Y}_i^{\varepsilon}\hat{\phi}_{ni}}{\sum_{\ell} \pi_{n\ell}\hat{Y}_{\ell}^{\varepsilon}\hat{\phi}_{n\ell}} \hat{Y}_n X_n \tag{23}$$

(23) is the key equation used to calculate GETI and welfare effects.

The procedure of computing GETI starts with guessing a vector of changes in income for all origin and destination countries in the sample, $\hat{w}_{i0}$ and $\hat{w}_{n0}$.[52] I choose to use an elasticity of substitution from the literature, $\varepsilon = 5.03$.[53] Then I compute $\hat{\phi}_{in}$ using (18) with data on changes in travel time for the treated exporter-importer pairs and the estimated travel time elasticity of total trade from Table 1. With (20) I compute $\hat{\pi}_{in}$. Then I plug in all computed variables into (23) to obtain an updated vector of changes in income, $\hat{w}_{i1}$ and $\hat{w}_{n1}$. I repeat the procedure until the vector of wages converges. I plug $\hat{w}_n$ into (20) to compute $\hat{\pi}_{in}$. I also use $\hat{w}_n$ to calculate counterfactual expenditures as follows: $X'_n = \hat{w}_n X_n$. I then obtain counterfactual trade flows as follows: $X'_{in} = \hat{\pi}_{in}\pi_{in}X'_n$. Finally, I compute GETI and welfare changes as follows:

$$GETI = \frac{X'_{in}}{X_{in}} \tag{24}$$

$$Welfare = \hat{\pi}_{in}^{\frac{1}{-\varepsilon}} \tag{25}$$

---

[52] Note that $\hat{w}_i$=$\hat{Y}_i$.

[53] This is the same elasticity used by Head and Mayer (2014).