Online Appendix

"All Roads Lead to Rome: Global Air Connectivity and Bilateral Trade"

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A. Construction of the instrument in a flight network

A.1. Flight journeys with two external transit points

We start with the case of a flight journey with two external transit points between an origin country and a destination airport. This is illustrated in equation (A1), where j is the origin country, i is the destination country, b is the first arrival airport (entry point) in i, airports c and d are the two external transit points located outside countries j and i, and services s and u are flight services that connect c to d and d to b, respectively. The external connecting route is the entire route that starts from airport c all the way to airport b, including the two transit points (c and d) and the two connecting flight services (s and u).

$$\text{(A1)} \quad \text{Origin country } j \longrightarrow \overbrace{\underbrace{\text{Airport } c \xrightarrow{\text{Service } s} \text{Airport } d}_{\text{Outside countries } i \text{ and } j} \xrightarrow{\text{Service } u} \underbrace{\text{Airport } b}_{\text{Country } i}}^{\textbf{External connecting route}}$$

We measure the capacity of the above external connecting route as the annual total number of passengers carried through the route by the above flight services, including passengers from all origin countries. However, this measure could still be partly driven by the travel demand between country j and airport d. This is because operating airlines could respond to the connecting demand of passengers from country j by increasing their capacity through more frequent schedules, using larger aircraft, or even adding seats in an existing airplane.

To address this concern, we refine the measure by excluding passengers from the origin country in question (country j) from the total route capacity. This is illustrated in equation (A2), where we construct the capacity measure based on the same route but only include passengers from countries other than j and i.

(A2) $$\underbrace{\text{Origin country } m}_{m\neq i,j} \longrightarrow \overbrace{\underbrace{\text{Airport } c}_{\text{Outside countries } i \text{ and } j} \xrightarrow{\text{Service } s} \text{Airport } d \xrightarrow{\text{Service } u} \underbrace{\text{Airport } b}_{\text{Country } i}}^{\textbf{External connecting route}}$$

Our measure thus isolates the exogenous part of the capacity that is driven by third countries' travel demand. Intuitively, when there is more demand for flights from third countries to airport b, airlines are more likely to increase their capacity on the route, which in turn improves connectivity for passengers traveling from country j to airport b.

A.2. Flight journeys with one external transit point

Now we consider the case of a journey with only one external transit point en route from country j to airport b. As illustrated in equation (A3), airport c is now the only transit point, and service v is the flight that links airports c and b.

(A3) $$\text{Origin country } j \longrightarrow \overbrace{\underbrace{\text{Airport } c}_{\substack{\text{Outside countries}\\ i \text{ and } j}} \xrightarrow{\text{Service } v} \underbrace{\text{Airport } b}_{\text{Country } i}}^{\textbf{External connecting route}}$$

The construction of the exogenous external connecting route capacity is illustrated in equation (A4). It follows the same steps as in the above case of a journey with two external transit points, except that there is only one transit point in this case.

(A4) $$\underbrace{\text{Origin country } m}_{m\neq i,j} \longrightarrow \overbrace{\underbrace{\text{Airport } c}_{\substack{\text{Outside countries}\\ i \text{ and } j}} \xrightarrow{\text{Service } v} \underbrace{\text{Airport } b}_{\text{Country } i}}^{\textbf{External connecting route}}$$

A.3. Passengers who start their journey from an external transit point

If connecting flight services pick up local passengers from any of the connecting airports, these passengers should be included in the external connectivity. In

our example, passengers who travel from airport c as their starting point with services s and u in the route of equation (A2) are already captured in equation (A4), where airport c is located in one of the third countries m. For the same reason, we calculate the number of passengers who fly from d as their starting point to b with non-stop service v (in equation (A2)), and add it back to equation (A4) as part of the external connectivity there.

A.4. Aggregation to the country-pair level

To align our air connectivity measure with the trade data, we further aggregate the above route-level capacity measure to the country-pair level. To do this, for a given year t and origin country j, we aggregate the capacities of country j's external connecting routes by each destination country i (which the destination airport is in). This then allows to have a capacity measure that is specified for each pair of origin and destination countries in each year, i.e., at the ijt level.

In the robustness checks (Sections B.1 and B.2 of this online Appendix), each external connecting route is weighted by the reciprocal of its squared relative travel distance (i.e., 1/(dist_ratio)^2) and/or by one minus the import similarity index (i.e., 1-ISI). After assigning the weights to these routes, the weighted capacities of these routes are then collapsed to (origin country)-(destination country)-year level (i.e., ijt level) using the same aggregation procedure as above.

B. Robustness checks

B.1. Irrelevant connecting routes

Our global flight data contains some irregular transit routes that are rarely used by travelers. These routes are unlikely to be relevant to our construction of external connectivity between countries that have access to much shorter routes. For example, the connecting route from Beijing to London via Singapore is unlikely to affect most travelers' travel decisions, as it is much longer than other more regularly used routes.[1]

To minimize measurement error due to irrelevant routes, we weight passenger flows on each route by the reciprocal of the squared relative distance of the route. The relative distance is defined as the travel distance divided by the shortest air travel distance between the two airports. This weighting scheme ensures that longer routes are weighted less heavily than shorter routes, which helps to reduce the influence of irrelevant routes on our external connectivity measure.[2] With this adjustment to the instrument, the estimation result in column (1) of Table B1 shows that the key estimates remain largely unaffected. This is not surprising, considering that only a small proportion of travelers are observed using these unusual connecting routes for their destinations.

B.2. Global value chain integration

It is possible that visits between other parts of the world and exporter i, and thus our measure of external connectivity, could be correlated with trade between j and i in the same period due to global value chain (GVC) integration. This correlation can be attributed to two scenarios, depending on the location of countries along the GVC. First, the importing country j and third countries m might be located in similar positions within the GVC, potentially competing

[1]The non-stop flight distance between Beijing and London is 8,150 kilometers. In contrast, the travel distance between Beijing and London via Singapore is 15,400 kilometers, which is nearly twice the distance of a non-stop service and significantly longer than any connecting route with a transit point in a European or Middle Eastern country.

[2]We could exclude certain exceptionally long detour routes, but we lack an objective rule for choosing a distance threshold to define an irrelevant route. However, we tried excluding connecting routes whose total air travel distance is more than 1.5 times the shortest distance between the two airports. For example, this procedure would exclude connecting routes which go from Beijing to London via a transit point in a Southeast Asian country (e.g., Singapore or Thailand). Reassuringly, such routes account for less than 5% of the global international air traffic, and the results with this restriction criterion do not deviate much from our baseline findings.

TABLE B1. ROBUSTNESS CHECKS: IRRELEVANT ROUTES AND CONFOUNDING CHANNELS

	Dep var: log imports in column (4) and log exports in others							
						Industries with share of capital and intermediate goods in trade lower than		
	Routes weighted by $(1/dist\_ratio)^2$ (1)	Competing countries weighted by (1-ISI) (2)	Routes weighted by $(1/dist\_ratio)^2$ & competing countries weighted by (1-ISI) (3)	Dep var: log imports (4)		90% (5)	95% (6)	100% (7)
Passenger flows	0.037	-0.009	0.000	0.049		0.098	0.079	0.063
	(0.015)	(0.019)	(0.019)	(0.013)		(0.019)	(0.018)	(0.017)
Contract intensity×Passenger flows	0.011	0.012	0.012	0.010		0.031	0.029	0.024
	(0.001)	(0.001)	(0.001)	(0.000)		(0.000)	(0.000)	(0.000)
RTA dummy & tariff	Yes	Yes	Yes	Yes		Yes	Yes	Yes
Exporter-importer FE	Yes	Yes	Yes	Yes		Yes	Yes	Yes
Exporter-industry-year FE	Yes	Yes	Yes	Yes		Yes	Yes	Yes
Importer-industry-year FE	Yes	Yes	Yes	Yes		Yes	Yes	Yes
Observations	4,133,775	2,607,267	2,667,991	2,694,864	2,623,660	1,494,491	796,176	2,821,576
Kleibergen-Paap F	314,676.00	56.94	55.69	57.33	57.86	390.24	135.35	131.77

Notes: Second-stage results of 2SLS estimations are reported. Dependent variable: log exports. Time period: 2013-2018. Unit of observation is exporter-importer-industry-year. "Passenger flows" is the log number of air passengers from the importing to the exporting country, "Contract intensity" is an industry-level standardized measure of reliance on relation-specific investments, "RTA dummy" is an indicator for both countries being in the same regional trade agreement, and "Tariff" is the log of one plus the weighted average tariff rates. "Passenger flows" is instrumented by external connecting capacity. In the construction of the instrument, each route is weighted by $(1/dist\_ratio)^2$ in column (1), each country is weighted by (1-ISI) in column (2), and both weights are used in column (3). Here "dist_ratio" is the relative distance, defined as the travel distance of a route divided by the shortest travel distance between the two airports. "ISI" is the country's import similarity index with the given importer for the given exporter (equation (B5)). Columns (4) to (6) report results by excluding industries where intermediate and capital goods account for more than 90%, more than 95%, and 100% of exports, respectively. See text for sources of data. Standard errors reported in parentheses and clustered at the importer-exporter level.

in sourcing similar products from the exporting country i, which in turn, could induce correlations with travel patterns. This could occur through three potential channels.

First, importing countries may share a similar trade pattern and the same travel routes for trade with exporter i, for example, if they have the same trade agreements with the exporting country i. If there are common unobserved shocks that affect air connectivity and trade with i simultaneously, our estimated trade effect may partially capture the trade effects on third countries.

Second, enhanced connectivity via an external connecting route may facilitate trade between other importers and i while crowding out j's imports from i due to increased import competition.

Third, when the products of exporter i are in demand, more imports by country j could induce a positive travel response from other importers. These importers may seek to secure their trade relationship with i through more frequent in-person interactions.

The first two channels represent omitted pathways that could introduce a bias in the estimate, in an upward direction in the first channel and a downward direction in the second. The third channel poses a concern of reverse causality, where trade influences the instrument, potentially resulting in an upward bias in our key estimate. These channels become more pertinent when importers share the same transit hub(s) for the same destination i and when they source similar products from this particular destination.

To mitigate the influence of the above confounding channels, we reduce the weight of those countries who have a similar import pattern and compete more directly with importer j for products produced by exporter i in our instrument. The weight is based on a measure of the degree of competition between importer j and an external importer m for a given exporter i. This measure is inspired by the widely used export similarity index which is designed to assess the similarity of the export structure of two countries (Finger and Kreinin, 1979). In our analysis, we adapt this index to focus on imports and define the import structure based on imports from a specific exporter instead of all exporters. Specifically, our import similarity index between importers (j and m) for exporter i is computed as:

$$ISI^{i}_{jm} = \sum_{k \in K} \min \left(\frac{Imports_{jik}}{\sum_{k \in K} Imports_{jik}}, \frac{Imports_{mik}}{\sum_{k \in K} Imports_{mik}} \right), \tag{B5}$$

where K is the set of products ever imported by j or m from i in 2013. The import similarity index (ISI) is calculated based on the overlap of products imported by j and m from i, ranging from zero to one. A value of zero indicates no common imported products, while a value of one represents an identical import structure from the given exporter. The computation is based on the initial-year (2013) data so that it is free of potential reverse causality coming from the response of import structure to competition from other countries sharing the same air travel routes for a trade partner. To refine our instrument, we incorporate a weighting scheme based on the import similarity index. Competing importers, including transit countries, are assigned a weight of $(1 - ISI)$. This weight ensures that importers who directly compete with the importer of interest (j) have a reduced influence on our estimations.[3]

The result using this refined instrument is reported in column (2) of Table B1. For industries with an average contract intensity, the estimated effect of connectivity on trade becomes statistically insignificant. However, the positive differential effect on industries with high contract intensity remains in line with our previous findings. We observe a similar outcome in column (3) where the weighting schemes for irrelevant routes and competing countries are both applied to the instrument.

A second concern regarding our instrumental variable is that it may capture correlated demand shocks across countries for a given country's exports, rather than reflecting exogenous technological changes that make travel more feasible. For instance, the rising popularity of a Japanese TV show might increase both interest in traveling to Japan and demand for Japanese products. As a result, improved air connectivity between third countries and the exporting country, Japan in this case, measured by an increase in air passengers, could be positively correlated with Japan's exports. Our inclusion of exporter-year fixed effects helps mitigate this concern by accounting for demand-side common shocks that affect all trade partners of the same exporting country.

To further address this concern, we conduct an additional analysis using the log of imports as the dependent variable. The logic is that if business travel alleviates information frictions between trade partners, it should promote trade

[3]We also tried excluding competing importers with an ISI greater than 0.1 (the median and mean values of the import similarity index are 0.88 and 0.12, respectively), and our main results still hold.

in both directions – facilitating not only exports but also imports. Focusing on imports helps mitigate the concern that our instrument may be capturing correlated global demand across countries, since import flows are less likely to be driven by external demand conditions in the same way as exports. Column (4) of Table B1 provides supporting evidence for this hypothesis: greater air connectivity is associated with higher import volumes, and the effect is particularly pronounced in industries with higher contract intensity. The magnitude of the estimated coefficients is comparable to our baseline results for exports (column 6 of Table 4), suggesting that air connectivity facilitates bilateral trade flows in a broadly symmetric manner.

A third way in which our instrumental variable could be directly correlated with trade between country j and country i stems from countries being in different positions along the GVC. Consider the case that the importing country j is located downstream of country i, which in turn is positioned downstream of third countries m. Increased travel from third countries to country i may facilitate the supply of intermediate inputs to country j via i. Alternatively, improved air connectivity between m and i could be driven by the import demand for intermediate inputs from country j. In both cases, the instrument would violate the exclusion restriction assumption. Note that our fixed effect strategy helps address these issues to some extent: the importer-industry-year fixed effects could absorb import demand shocks by country j and the exporter-industry-year fixed effects absorb export supply shocks.

To further alleviate these concerns, we perform additional robustness checks by excluding industries that are heavily integrated into the GVC. Specifically, we calculate the share of intermediate and capital goods in total export values for each six-digit NAICS industry in 2013 using the Broad Economic Categories (BEC) classification and exclude industries where these goods account for 100%, more than 95%, and more than 90% of exports. This removes 170,188, and 202 industries, respectively. Despite reducing the number of observations by half, the results in columns (5) to (7) of Table B1 corroborate our main findings and the estimated impacts of air connectivity become even stronger for all industries.

B.3. Small passenger flows

In our analytical sample, a notable proportion of country pairs exhibit very low passenger flows: 13% recorded fewer than two passengers, and 16% recorded

fewer than five. These low-traffic pairs predominantly involve at least one small country, either as the origin or destination. A concern is that small absolute change in very low initial flows (e.g., from one to two passengers) can generate a large change in the logarithmic scale, but this may not translate into a meaningful economic effect on trade flows. We address this issue as follows.

First, the use of country-pair fixed effects throughout our analysis helps mitigate concerns arising from systematic differences in the baseline levels of passenger flows. These fixed effects absorb all time-invariant heterogeneity across country pairs, including the presence of very small initial flows.

Second, we perform a series of robustness checks by reestimating our models after excluding country pairs with initially negligible or very small passenger flows. We vary the exclusion threshold across a wide range—from 1 to 500 passengers—to ensure comprehensive coverage. Across all specifications, the results remain stable and similar to our main findings, indicating that our conclusions are not driven by outliers or artifacts of small baseline values.

Taken together, these strategies allow us to account for and minimize potential distortions arising from extremely low initial passenger flows, and they reinforce the credibility of our empirical results.

TABLE B2. ROBUSTNESS CHECKS: SMALL PASSENGER FLOWS

	Dep var: log exports Number of passengers in initial year (2013) greater than:				
	2 (1)	5 (2)	10 (3)	50 (4)	100 (5)
Passenger flows	0.038	0.040	0.043	0.043	0.043
	(0.016)	(0.016)	(0.017)	(0.018)	(0.019)
Contract intensity×Passenger flows	0.012	0.012	0.011	0.011	0.011
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
RTA dummy & tariff	Yes	Yes	Yes	Yes	Yes
Exporter-importer FE	Yes	Yes	Yes	Yes	Yes
Exporter-industry-year FE	Yes	Yes	Yes	Yes	Yes
Importer-industry-year FE	Yes	Yes	Yes	Yes	Yes
Observations	2,765,629	2,759,192	2,751,862	2,705,338	2,671,406
Kleibergen-Paap F	47.00	41.06	37.84	27.26	24.17

Notes: Second-stage results of 2SLS estimations are reported. Dependent variable: log exports. Time period: 2013-2018. Unit of observation is exporter-importer-industry-year. "Passenger flows" is the log number of air passengers from the importing to the exporting country, "Contract intensity" is an industry-level standardized measure of reliance on relation-specific investments, "RTA dummy" is an indicator for both countries being in a same regional trade agreement, and "Tariff" is the log of one plus the weighted average tariff rates. "Passenger flows" is instrumented by external connecting capacity. See text for sources of data. Standard errors reported in parentheses and clustered at the importer-exporter level.

B.4. Additional checks

Our main findings remain robust when subjected to several additional checks that address concerns regarding the reliability of our results. Below we provide motivations for these checks, with the results reported in Tables B3-B6.

Schengen members as individual countries.—So far we have treated the Schengen Area as a "country" in the data, assuming its absence of restrictions on the movement of goods and people makes it equivalent to a "country". However, many studies have provided evidence suggesting the existence of substantial national border effects in trade within the European Union (most of which overlaps the single market and the Schengen Area) (Nitsch, 2000; Chen, 2004). Specifically, while certain Schengen countries such as Germany and France rank among the world's top trading nations and popular travel destinations, many others are economically smaller and less frequented by international travelers. By treating the entire Schengen Area as one data point, we might overlook valuable variations that could enhance our estimations. A robust check is to include Schengen members as individual countries, and the result is not much affected (column (1) of Table B3).

Country size.—It is possible that third-country connectivity could respond to changes in trade between important trade partners. This is because the economically most active countries and the largest traders are also among the most connected regions. For example, the US, China, and the Schengen Area are all major economic powers and also have extensive air connectivity (see Table C3). When there is an improvement (or deterioration) in a country's trade relationship with a prominent trading partner, it may create an expectation of increased (or decreased) travel demand. Consequently, this expectation could prompt a third country to invest (or divest) in enhancing the connectivity between the two trading partners.

To address this concern, we reestimate our baseline model by excluding observations where the US, China, or the Schengen Area is a trade partner. The results, presented in columns (2)-(4) of Table B3, show that the estimated coefficients remain almost unchanged. In a more systematic test, we reestimate our baseline 2SLS model by excluding one country (out of 190 countries in the sample) at a time and check how the two coefficients are affected. As shown in Figure B1, both estimated coefficients are highly concentrated around the baseline

TABLE B3. ADDITIONAL CHECKS: INFLUENCES OF SPECIFIC COUNTRIES AND DISTANCE

	Dep var: log exports							
	Schengen members as individual countries (1)	Excl. US (2)	Excl. China (3)	Excl. Schengen Area (4)	Excl. country pairs with shared land borders (5)	Country pairs where share of connecting services is consistently >50% (6)	Excl. country pairs with distance shorter than 6,000 miles (7)	Control. for the effect of distance (8)
Passenger flows	0.030	0.029	0.026	0.026	0.022	0.011	-0.003	0.030
	(0.022)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.024)	(0.015)
Contract intensity×Passenger flows	0.008	0.010	0.011	0.011	0.013	0.018	0.024	0.011
	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
RTA dummy & tariff	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Exporter-importer FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Exporter-industry-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Importer-industry-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4,133,775	2,607,267	2,667,991	2,694,864	2,623,660	1,494,491	796,176	2,821,576
Kleibergen-Paap F	314,676.37	56.94	55.69	57.33	57.86	390.24	135.35	131.77

Notes: Second-stage results of 2SLS estimations are reported. Dependent variable: log exports. Time period: 2013-2018. Unit of observation is exporter-importer-industry-year. "Passenger flows" is the log number of air passengers from the importing to the exporting country, "Contract intensity" is an industry-level standardized measure of reliance on relation-specific investments, "RTA dummy" is an indicator for both countries being in a same regional trade agreement, and "Tariff" is the log of one plus the weighted average tariff rates. "Passenger flows" is instrumented by external connecting capacity. See text for sources of data. Standard errors reported in parentheses and clustered at the importer-exporter level.

estimates reported in Table 4 of the main paper (i.e. 0.031 for air connectivity and 0.011 for the interaction of air connectivity and contract intensity). Even Viet Nam – the only country that slightly deviates from the trend in Panel (a), with a value of 0.018 (at the left end of the distribution) compared to the average of 0.031 – has only a minor impact on the estimated effect of air connectivity. This offers further reassurance that our findings are not driven by any single country.

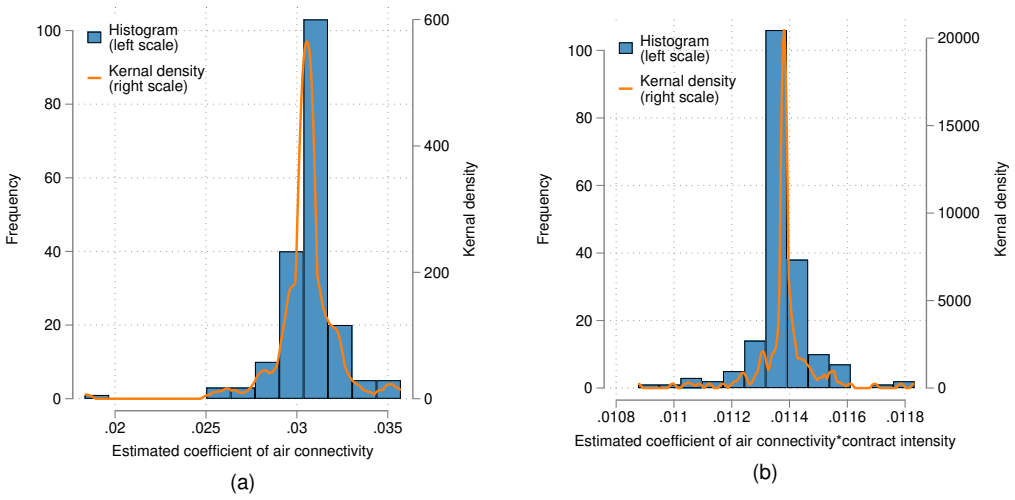

FIGURE B1. DISTRIBUTIONS OF THE ESTIMATED COEFFICIENTS WITH ONE COUNTRY EXCLUDED AT A TIME

Notes: Panels (a) and (b) show the distributions of the estimated coefficients of air connectivity (β) and of the interaction term of air connectivity and contract intensity (θ) in equation (1), respectively, using the 2SLS strategy outlined in Section I.B of the paper.

Distance between countries.—Distance could affect the relevance of connecting flights and air connectivity in general. We address several specific concerns here. First, we drop country pairs with shared land borders (column (5) of Table B3). This is because for these countries, non-air modes of transport (mainly road and railroad transport) could reduce the relevance of air connections for cross-country travel. Second, we exclude country pairs of whom less than half of the passengers travel via a connecting route (column (6) of Table B3). We do this because our instrument becomes less relevant for country pairs who rely primarily on non-stop flights for international travel. Third, we remove country pairs with distances less than 6,000 miles (approximately 9,656 kilometers) (column (7) of Table B3). This distance threshold corresponds to the range of most non-stop flights, as used in Campante and Yanagizawa-Drott (2018). This gives us a

sample in which most face-to-face communications are facilitated exclusively by connecting flights. Fourth, we control for the impact of distance by including in our model an interaction term between distance and the air connectivity measure (column (8) of Table B3). This eliminates from our estimation the influence of air connectivity that is confounded with distance. We continue to find the trade-promoting effects of air connectivity based on these alternations, especially for industries with high contract intensity.

Business travel.—A limitation with our air connectivity measure is that our passenger flow data does not contain information on the purpose of travel. In particular, we do not know how many passengers travel for business purposes. In fact, people can travel for various non-business purposes (e.g. leisure and study) or combine multiple purposes in one trip. As we expect the trade effects of improved air connectivity to be mainly through business travel, we make several efforts to at least partially address this point. Our first exercise is to focus on business-class travelers that can be identified from our data. Although the distinction between business and economy-class passengers does not correspond to travel purposes, we could reasonably assume that business-class passengers have a higher tendency to travel for business purposes. In column (1) of Table B4, we update the estimation results where the air connectivity and instrumental variables are now both based on business-class passengers only. We continue to find a highly significant result that air connections differentially improve the exports of contract-intensive products. The size of the coefficient turns out to be much larger than our baseline estimate. This could be due to the weak instrument problem (indicated by a small first-stage F value), and therefore the size should be interpreted with caution.

Second, we approximate the number of business visitors by using international visitors statistics from World Tourism Organization (2020).[4] Specifically, we use the total arrivals of (non-resident) visitors at national borders to focus only on travelers of short-term visit purposes, thus excluding migrants from our

[4]The data contained in the *Yearbook of Tourism Statistics, Data 2014-2018*, released by World Tourism Organization (2020), covers 63 arrival countries and regions for visitors. The coverage of source countries is more comprehensive, including over 230 countries and regions. According to the *Yearbook*, the counts on visitors are based on the number of arrivals instead of people, so that "when a person visits the same country several times a year, each visit is counted as one arrival" (World Tourism Organization, 2020). This definition is consistent with the one used in our passenger flow data.

TABLE B4. ADDITIONAL CHECKS: BUSINESS VISITS

	Dep var: log exports		
	Passenger flows: business-class passengers (1)	Passenger flows: visitors (2)	Passenger flows: business visitors to US from top 40 countries (3)
Passenger flows	3.090	-0.077	1.924
	(24.485)	(0.135)	(0.015)
Contract intensity×Passenger flows	0.115	0.026	0.321
	(0.008)	(0.001)	(0.013)
RTA dummy & tariff	Yes	Yes	Yes
Exporter-importer FE	Yes	Yes	No
Importer-year FE	No	No	Yes
Indsustry-year FE	No	No	Yes
Importer-industry FE	No	No	Yes
Exporter-industry-year FE	Yes	Yes	No
Importer-industry-year FE	Yes	Yes	No
Observations	2,839,161	440,482	37,776
Kleibergen-Paap F	0.01	2.77	60,870.69

Notes: Second-stage results of 2SLS estimations are reported. Dependent variable: log exports. Time period: 2013-2018. Unit of observation is exporter-importer-industry-year. "Passenger flows" is the log number of air passengers from the importing to the exporting country, "Contract intensity" is an industry-level standardized measure of reliance on relation-specific investments, "RTA dummy" is an indicator for both countries being in a same regional trade agreement, and "Tariff" is the log of one plus the weighted average tariff rates. "Passenger flows" is instrumented by external connecting capacity. See text for sources of data. Standard errors reported in parentheses and clustered at the importer-exporter level.

air connectivity measure. As shown in column (2) of Table B4, with this measure, the estimate of the interaction term remains positive and statistically significant, which further reassures the main finding.

Third, we make an extra effort to isolate business travelers from other visitors by focusing on one country, the US, for which the numbers of business visitor arrivals by sending country can be obtained from The International Trade Administration (ITA). The ITA data that is publicly available reports at a monthly frequency the number of non-US resident visitor arrivals to the US under three visa categories—business, pleasure, and student—for the top 40 sending countries.[5] We extract business visitor arrivals from this data as a more precise measure of foreign business travelers and rerun our estimation on this limited sample. In column (3) of Table B4, the two estimated coefficients reported are both positive and highly significant, but are of inflated sizes relative to the baseline and other results. While the signs of these estimates are consistent with our main findings, the larger estimated effect here could be attributed to the country composition of this particular sample—most of these top sending countries are important trade partners of the US or Latin American countries who have close business and geographical ties with the US.[6]

The role of non-stop flights.—Our instrument, as explained in Section B, leverages its predictability of transit passenger flows but cannot predict passenger flows through non-stop flights. In fact, it could potentially reduce direct travel, potentially lowering bilateral trade and leading to an underestimation of the true trade-enhancing effects of air connectivity. To address this influence, we first verify whether improved connectivity capability is associated with direct passenger flows and find evidence supporting this hypothesis (see column (1) in Table B5). In columns (2) and (3), we focus exclusively on connecting passenger flows as our measure of air connectivity. As expected, the correlation between external connecting capability and connecting passenger flows is slightly stronger (0.285 compared to 0.257 for total passenger flows), consistent with Figure 4. The second-stage estimation results in column (3), where we include non-stop

[5]The data can be downloaded from the ITA website at https://www.trade.gov/i-94-arrivals-program.

[6]Note that the estimates in columns (2) and (3) are based on samples which are much smaller than our main sample, the sizes of these estimates are not directly comparable to our baseline 2SLS estimates. Nevertheless, baseline estimation using the same restricted samples as used here yields similar results.

passenger flows as a control variable, show effects comparable to our baseline estimations. The coefficient for industries with an average contract intensity is slightly smaller, whereas the interaction effect is stronger. Not surprisingly, air connectivity through non-stop flights is positively correlated with exports.

TABLE B5. NON-STOP VS. CONNECTING SERVICE PASSENGERS

		2SLS	
	Dep var: non-stop passenger flows (1)	1st stage. Dep var: connecting passenger flows (2)	2nd stage. Dep var: log exports (3)
External connecting capacity	-0.016	0.285	
	(0.003)	(0.015)	
Connecting passenger flows			0.025
			(0.013)
Contract intensity×Connecting passenger flows			0.013
			(0.001)
Non-stop passenger flows			0.006
			(0.002)
RTA dummy & tariff	Yes	Yes	Yes
Exporter-year FE	Yes	Yes	No
Importer-year FE	Yes	Yes	No
Exporter-importer FE	Yes	Yes	Yes
Exporter-industry-year FE	No	Yes	Yes
Importer-industry-year FE	No	Yes	Yes
Observations	54,194	2,839,161	2,839,161
Kleibergen-Paap F			188.24

Notes: Time period: 2013-2018. Unit of observation is exporter-importer-year in columns (1)-(2), and exporter-importer-industry-year in column (3). "External connecting capacity" is the capacity of connecting flight services departing from a third country, "Contract intensity" is an industry-level standardized measure of reliance on relation-specific investments, "Connecting passenger flows" is the log number of air passengers from the importing to the exporting country via connecting services, "Non-stop passenger flows" is the log number of air passengers from the importing to the exporting country via non-stop services, "RTA dummy" is an indicator for both countries being in a same regional trade agreement, and "Tariff" is the log of one plus the weighted average tariff rate for an exporter-importer-year observation (columns (1)-(2)) or an exporter-importer-industry-year observation (column (3)). "Connecting passenger flows" is instrumented by external connecting capacity in column (3). See text for sources of data. Standard errors reported in parentheses and clustered at the importer-exporter level.

Contracting frictions.—To examine the role of contracting frictions, we follow Bailey et al. (2021) and interact air connectivity with the quality of contract enforcement at the country level. We measure the quality of contract enforcement by using the enforcing contracts score from the World Bank Doing Business database (World Bank, 2020*a*). The score evaluates the overall efficiency and quality of contract enforcement by evaluating practices of resolving commercial disputes in the local court system, with the values ranging from 0 (worst performance) to 100 (best performance). To address the issue of a change in the measurement method in 2015, we standardize the scores annually, ensuring they fall within the range of zero to one. A higher standardized score indicates comparatively easier enforcement of contracts relative to other countries in the same

year. Recognizing that contract enforcement in both importing and exporting countries is relevant to trade outcomes (Berkowitz, Moenius and Pistor, 2006), we interact air connectivity measure with the contract enforcement scores of importing and exporting countries separately.

The results are reported in Table B6. Column (1) shows the effects of contract enforcement on trade when the baseline interaction term between contract intensity and passenger flows is excluded. Column (2) adds back the interaction term to see how our baseline effect is affected by the inclusion of the influencing channels of contract enforcement. The positive coefficient of the interaction term between air connectivity and the exporter's contract enforcement score in both specifications suggests a predominantly complementary relationship between the two and does not support the notion that robust in-person relationships compensate for weak formal institutions. The importing country's contract enforcement, however, turns out to be statistically and economically insignificant.

TABLE B6. THE ROLE OF CONTRACT ENFORCEMENT

	Dep var: log exports	
	(1)	(2)
Passenger flows	0.020	0.029
	(0.016)	(0.016)
Contract intensity×Passenger flows		0.011
		(0.001)
Exporter enforcing contracts×Passenger flows	0.005	0.006
	(0.001)	(0.001)
Importer enforcing contracts×Passenger flows	0.000	0.001
	(0.001)	(0.001)
RTA dummy & tariff	Yes	Yes
Exporter-importer FE	Yes	Yes
Exporter-industry-year FE	Yes	Yes
Importer-industry-year FE	Yes	Yes
Observations	2,649,376	2,616,157
Kleibergen-Paap F	58.91	43.66

Notes. Second-stage results of 2SLS estimations are reported. Dependent variable: log exports. Time period: 2013-2018. Unit of observation is exporter-importer-industry-year. "Passenger flows" is the log number of air passengers from the importing to the exporting country, "Contract intensity" is an industry-level standardized measure of reliance on relation-specific investments, "Exporter enforcing contracts" and "Importer enforcing contracts" are standardized measures of the strength of contract enforcement in the exporting and importing country respectively, "Tariff" is the log of one plus the weighted average tariff rates, and "RTA dummy" is an indicator for both countries being in a same regional trade agreement. "Passenger flows" is instrumented by external connecting capacity. See text for sources of data. Standard errors reported in parentheses and clustered at the importer-exporter level.

One possible explanation for this observed asymmetry between importing and exporting countries could be attributed to the uneven distribution of risks inherent in international trade transactions. Sellers, relative to buyers, have more responsibilities for the production process, product quality, and the transfer of goods to the international carrier. Therefore, a good reputation and effectiveness of contract enforcement in the exporting country, relative to that in the importing country, could make in-person communications more effective in facilitating trade.

C. Additional tables and figures

TABLE C1. DESCRIPTION OF OAG INTERNATIONAL AIR TRAFFIC DATA - NUMBER OF COUNTRY PAIRS AND PASSENGERS

	Country pairs	All passengers	Non-stop passengers	Connecting passengers
2013	26,276	986,631,620	838,663,891	147,967,729
2014	26,336	1,043,134,160	885,301,996	157,832,164
2015	26,678	1,106,346,345	936,644,490	169,701,855
2016	26,786	1,189,779,881	1,010,109,571	179,670,310
2017	26,996	1,279,156,257	1,091,092,079	188,064,178
2018	27,043	1,350,996,795	1,156,567,488	194,429,307
Total	160,115	6,956,045,058	5,918,379,515	1,037,665,543

TABLE C2. NEW AIRPORTS, NEW ROUTES, AND NEW FLIGHT SERVICES IN INTERNATIONAL CONNECTING SERVICES

	New airports			New routes			New flight services		
	Passengers (persons)	Share in served country-pair connections (%)	Share in global connecting capacity (%)	Passengers (persons)	Share in served country-pair connections (%)	Share in global connecting capacity (%)	Passengers (persons)	Share in served country-pair connections (%)	Share in global connecting capacity (%)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
2014							2,823,116	2.07	1.79
2015				194,143	0.26	0.11	5,646,429	3.57	3.33
2016	6	1.44	0.00	595,446	0.52	0.33	7,919,598	4.62	4.41
2017	1,844	0.11	0.00	1,047,636	0.79	0.56	10,042,242	5.53	5.34
2018	32,807	0.24	0.02	1,679,661	1.15	0.86	12,160,611	6.46	6.26

Notes: New airports are airports which started their operation of scheduled passenger flights during the period 2013-2018. New routes are flight routes which started their operation of scheduled passenger flights between existing airports during the period 2013-2018. New flight services are scheduled passenger flight services which started their operation on existing flight routes during the period 2013-2018.

TABLE C3. MOST CONNECTED COUNTRY PAIRS

Ranked by all passengers (two-way)					Ranked by connecting passengers (two-way)				
Rank	Country pairs	All passengers (mn people)	Share of connecting passengers (%)	Trade value (tn USD)	Rank	Country pairs	Connecting passengers (mn people)	Share of connecting passengers (%)	Trade value (tn USD)
1	GBR - SCH	0.64	0.6	106.24	1	SCH - USA	0.03	16.4	39.96
2	SCH - USA	0.17	16.4	39.96	2	IND - USA	0.02	78.4	15.10
3	MEX - USA	0.15	0.7	64.03	3	SCH - THA	0.01	46.3	2.34
4	CAN - USA	0.15	1.0	72.07	4	AUS - SCH	0.01	99.8	0.52
5	SCH - TUR	0.10	0.9	14.63	5	IND - SCH	0.01	49.5	13.28
6	GRC - SCH	0.09	1.9	7.64	6	AUS - GBR	0.01	85.3	0.97
7	GBR - USA	0.09	8.9	17.32	7	PHL - USA	0.01	64.1	2.18
8	JPN - KOR	0.08	0.5	14.29	8	GBR - USA	0.01	8.9	17.32
9	CHN - KOR	0.08	0.4	28.07	9	IND - SAU	0.01	36.5	1.14
10	CHN - JPN	0.07	4.9	48.91	10	USA - VNM	0.01	98.5	13.97
11	NOR - SCH	0.07	1.0	6.03	11	CHN - SCH	0.01	18.8	65.45
12	IRL - SCH	0.07	5.3	30.89	12	CHN - USA	0.01	17.1	83.78
13	RUS - SCH	0.07	3.1	16.05	13	PAK - SAU	0.01	27.7	0.14
14	GBR - IRL	0.06	0.1	7.64	14	AUS - IND	0.01	90.2	0.79
15	CHN - THA	0.05	5.3	5.82	15	GBR - IND	0.01	39.2	3.24
16	MAR - SCH	0.05	0.6	4.21	16	IDN - SCH	0.01	81.1	2.91
17	CHN - HKG	0.05	0.5	30.77	17	THA - USA	0.01	96.2	3.81
18	ARE - IND	0.05	3.7	5.48	18	JPN - SCH	0.01	23.5	8.48
19	JPN - USA	0.05	5.8	29.31	19	ISR - USA	0.01	38.1	3.13
20	CHN - USA	0.04	17.1	83.78	20	CAN - IND	0.00	79.4	0.91

Notes: The code "SCH" denotes the Schengen Area.

TABLE C4. ROBUSTNESS CHECKS: ALTERNATIVE DEFINITIONS OF DIFFERENTIATED PRODUCTS

	Dep var: log exports			
	Relation-specific products: Neither sold on organized exchange nor reference priced		Relation-specific products: Not sold on organized exchange	
	Rauch's classification used for organized exchange and reference priced products		Rauch's classification used for organized exchange and reference priced products	
	Conservative (1)	Liberal (2)	Conservative (3)	Liberal (4)
Passenger flows	0.042	0.042	0.039	0.040
	(0.015)	(0.015)	(0.015)	(0.015)
Contract intensity×Passenger flows	0.012	0.015	0.002	0.003
	(0.000)	(0.000)	(0.000)	(0.000)
RTA dummy & tariff	Yes	Yes	Yes	Yes
Exporter-importer FE	Yes	Yes	Yes	Yes
Exporter-industry-year FE	Yes	Yes	Yes	Yes
Importer-industry-year FE	Yes	Yes	Yes	Yes
Observations	2,839,161	2,839,161	2,839,161	2,839,161
Kleibergen-Paap F	230,226.39	230,223.17	230,242.53	230,242.71

Notes: Second-stage results of 2SLS estimations are reported. Dependent variable: log exports. Time period: 2013-2018. Unit of observation is exporter-importer-industry-year. "Passenger flows" is the log number of air passengers from the importing to the exporting country, "Contract intensity" is an industry-level standardized measure of reliance on relation-specific investments, "RTA dummy" is an indicator for both countries being in a same regional trade agreement, and "Tariff" is the log of one plus the weighted average tariff rates. See text for sources of data. Standard errors reported in parentheses and clustered at the importer-exporter level.

TABLE C5. RESULTS WITH DIFFERENT FIXED EFFECTS

	Dep var: log exports							
	(A) OLS results							
	Low-contract-intensity industries				High-contract-intensity industries			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Passenger flows	0.097	0.047	0.058	-0.011	0.116	0.079	0.104	0.054
	(0.020)	(0.022)	(0.021)	(0.023)	(0.020)	(0.023)	(0.021)	(0.023)
RTA dummy & tariff	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Exporter-importer FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Exporter-year FE	No	Yes	No	Yes	No	Yes	No	Yes
Importer-year FE	No	No	Yes	Yes	No	No	Yes	Yes
Observations	54,194	54,194	54,194	54,194	54,194	54,194	54,194	54,194
Adjusted R^2	0.860	0.865	0.862	0.867	0.863	0.866	0.864	0.867
	(B) 2SLS results (2nd stage)							
	Low-contract-intensity industries				High-contract-intensity industries			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Passenger flows	0.116	0.044	0.089	-0.015	0.156	0.105	0.187	0.114
	(0.045)	(0.059)	(0.050)	(0.064)	(0.045)	(0.059)	(0.051)	(0.065)
RTA dummy & tariff	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Exporter-importer FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Exporter-year FE	No	Yes	No	Yes	No	Yes	No	Yes
Importer-year FE	No	No	Yes	Yes	No	No	Yes	Yes
Observations	54,194	54,194	54,194	54,194	54,194	54,194	54,194	54,194
Kleibergen-Paap F	10,319.44	6,591.88	8,687.42	5,885.41	10,319.44	6,591.88	8,687.42	5,885.41

Notes: OLS and 2SLS (second-stage) estimates are reported in panels (A) and (B), respectively. Time period: 2013-2018. Unit of observation is exporter-importer-year. "Passenger flows" is the log number of air passengers from the importing to the exporting country, "Tariff" is the log of one plus the weighted average tariff rate for an exporter-importer-year observation, and "RTA dummy" is an indicator for both countries being in a same regional trade agreement. "Passenger flows" is instrumented by external connecting capacity in 2SLS estiomations. See text for sources of data. Standard errors reported in parentheses and clustered at the importer-exporter level.

TABLE C6. ROBUSTNESS CHECKS: ADDING BACK ZERO TRADE FLOWS

	Dep var: log/asinh exports	
	(1)	(2)
Passenger flows (log)	0.259	
	(0.012)	
Contract intensity×Passenger flows (log)	0.006	
	(0.000)	
Passenger flows (asinh)		0.277
		(0.012)
Contract intensity×Passenger flows (asinh)		0.005
		(0.000)
RTA dummy & tariff	Yes	Yes
Exporter-importer FE	Yes	Yes
Exporter-industry-year FE	Yes	Yes
Importer-industry-year FE	Yes	Yes
Observations	4,089,933	4,089,933
Kleibergen-Paap F	411,595.55	455,081.40

Notes: Second-stage results of 2SLS estimations are reported. Dependent variable: exports, transformed by log or asinh. Time period: 2013-2018. Unit of observation is exporter-importer-industry-year. Zero trade and passenger flows are added back to all exporter-importer-industry triads. Note that the samples are not fully rectangular because observations with missing tariff and RTA data are dropped. In column (1), export values and passenger flows are added one and then logged. In column (2), export values and passenger flows are converted to their inverse hyperbolic sine (asinh) values. "Passenger flows" is the log number of air passengers from the importing to the exporting country, "Contract intensity" is an industry-level standardized measure of reliance on relation-specific investments, "RTA dummy" is an indicator for both countries being in a same regional trade agreement, and "Tariff" is the log of one plus the weighted average tariff rates. "Passenger flows" is instrumented by external connecting capacity. See text for sources of data. Standard errors reported in parentheses and clustered at the importer-exporter level.

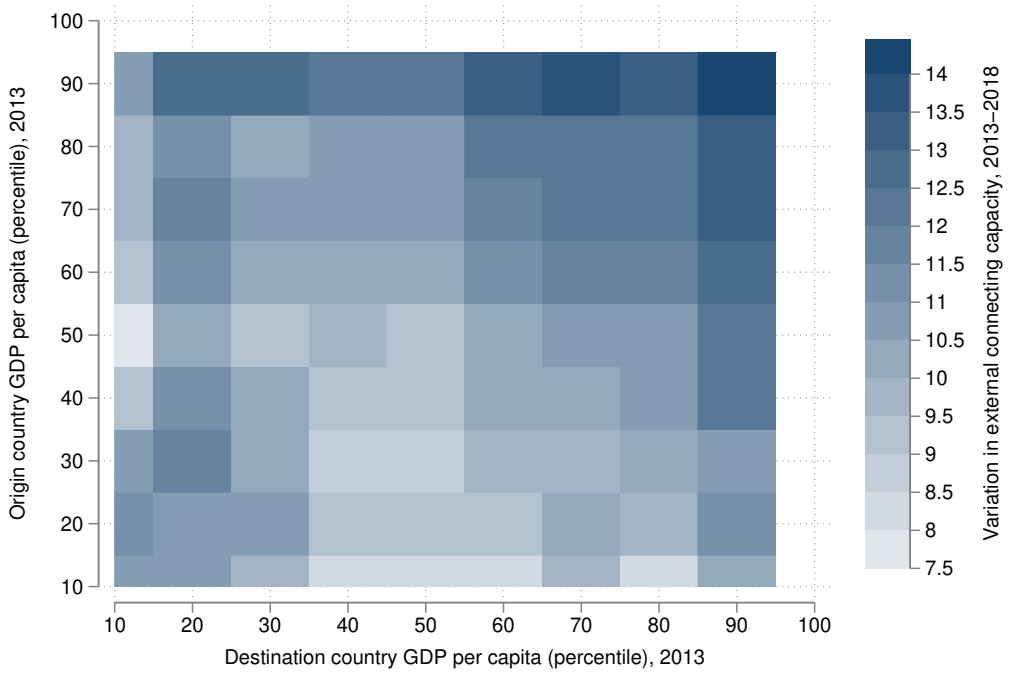

FIGURE C1. COUNTRY-PAIR INCOMES AND VARIATION IN EXTERNAL CONNECTIVITY

Notes: The horizontal and vertical axes measure the percentiles of GDP per capita of origin and destination countries in 2013, respectively. The darkness of the colored squares indicates the variation in external connectivity for the period 2013-2018 that is contributed by the origin-destination countries in a percentile square. Sources of data: authors' calculation based on data compiled from various sources (see Section C).