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The Gravity Model and Trade in Intermediate Inputs

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Abstract

Is the gravity model as applicable to trade in intermediate inputs as it is to trade in final goods? One of the contributions of this paper is that we explicitly account for the dual nature of products that can be used as either intermediate inputs or final goods. We find that the structural gravity model performs extremely well for describing bilateral trade in final goods and in intermediate inputs. Moreover, this continues to hold even when we focus on a subset of countries in which intermediate inputs trade accounts for a growing share of trade, namely ‘Factory Asia’. However, the gravity model may perform poorly due to model misspecification (i.e., exclusion of intranational trade) and/or sample selection, even after the model considers the dual nature of products. We demonstrate that the poor performance of the gravity model is not attributable to the large trade flow of intermediate inputs, which supports the continued use of the model as these trade flows continue to grow in importance worldwide.

Key words: Structural gravity model, Intermediate inputs, Intranational trade, Factory Asia
JEL Classification codes: F14

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1. Introduction

The gravity model has been used to analyze the determinants of bilateral trade for over 50 years, since Tinburgen (1962). As Yotov, et al. (2016, p.5) state "Often referred to as the workhorse in international trade, the gravity model is one of the most popular and successful frameworks in economics." Despite this high praise and voluminous literature using the gravity model to estimate bilateral trade relationships, one may question whether the gravity model is equally applicable to trade in intermediate inputs as it is to trade in final products. While consumers in many countries may share similar demands for apparel and autos, for example, the demands for textiles and auto parts presumably differ widely across countries depending on whether a country hosts apparel and auto manufacturing plants or not. Do the same determinants apply equally well to trade in consumer (i.e., final) goods as to trade in producer (i.e., intermediate) goods?

This is not a trivial question since international trade in intermediate inputs accounts for the vast majority of world trade flows in recent years thanks to production fragmentation and the development of global value chains. The share of intermediate inputs in total imports increased from 56.9 percent in 1995 to 63.4 percent in 2011 for all industries, and a similar pattern is confirmed when we focus on the imports of tradable industries and those of manufacturing industries, as shown in Figure 1.[1] Given the large and increasing role of intermediate inputs in world trade, we set out to examine whether the gravity model performs as well for describing trade in intermediate inputs as it does for trade in final consumer products.

=== Figure 1 ===

[1] Based on the OECD Trade in Value-Added dataset covering 63 economies, which is described further in our data section.

If the pattern of trade in intermediate inputs is largely proportional to trade in final goods, then our inquiry may be short-lived. However, we find that the correlation between bilateral final goods trade and bilateral intermediate goods trade has declined noticeably in recent years, as shown in Figure 1. Although the correlation is strongly positive, it declined over the period from 0.959 in 1995 to 0.861 in 2011. This result suggests that the pattern of trade in intermediate inputs is diverging somewhat from that of trade in final goods. Baldwin and Taglioni (2014), hereafter referred to as "BT", find that the gravity model performs well for bilateral trade in all goods, final goods and intermediate inputs when the analysis covers a wide range of countries but it performs poorly when applied to a particular subset of countries (i.e., 'Factory Asia') in which intermediate inputs account for a rapidly growing share of trade.

We pursue a similar line of inquiry while making two contributions to the literature by applying a structural gravity equation inclusive of intranational trade and by explicitly taking into account the dual nature of goods that can be used as either final consumer goods or intermediate inputs. Our major findings are twofold. We find that the structural gravity equation performs extremely well for describing bilateral trade in final goods and in intermediate inputs. In fact, the gravity model performs well even when we focus on a subset of countries in which intermediate inputs trade accounts for a large and growing share of trade, namely 'Factory Asia'. This result is in contrast to the BT finding that the standard gravity model performs poorly when focused on Factory Asia countries.

Second, we find that the performance of the gravity model declines if the model excludes intranational trade and/or if it focuses on a very small subset of countries, even after the model accounts for the dual nature of products. Our results suggest that the poor performance of the gravity model previously attributed to rising shares of intermediate inputs in total trade is more likely due to misspecification (i.e., the exclusion of intranational trade in estimating the gravity equation), as was pointed out by Yotov (2012), and/or sample selection, as was similarly argued by Rose (2017). While this may not sound like a novel finding at first sight, its new important insight is that the poor performance is not attributable to large trade flows of intermediate inputs.

The remainder of the paper is structured as follows. In the next section we discuss related strands of literature and how our work fits into these strands. Then we present the methodology and data used in this study in section 3, followed by our estimation results in section 4. A summary of our findings and their implications is presented in the final section.

2. Literature Review

This research relates to four strands of literature, one theoretical and three empirical. The original theoretical backing for the gravity model relied on a demand-side structure with constant elasticity of substitution preferences for final goods that are differentiated by their place of origin (i.e., the Armington (1969) assumption). Since this demand-side framework focused on final goods trade, growing trade in intermediate goods may present a problem for users of the gravity model. Demand for intermediate inputs is related to the production locations of final goods producers rather than to the location of homogeneous consumers worldwide. However, Anderson (2011) summarizes recent research contributions that allow the structural gravity model[2] to be derived from a supply-side framework so that the gravity model can be applied to trade in intermediate inputs by replacing consumer expenditure shares with producer cost shares.[3]

[2] A gravity model with solid theoretical foundations is called a 'structural' gravity model.
[3] Examples of this literature are Eaton and Kortum (2002), Chaney (2008), and Costinot, Donaldson and Komunjer (2012). Note, however, that the gravity model can be derived from a large class of trade models (Yotov, Piermartini, Monteiro and Larch, 2016).

In conjunction with these theoretical developments, a number of empirical studies have addressed the issue of intermediate inputs trade in the gravity model framework. This empirical work can be classified into two strands of research. One strand examines differences in the determinants of final goods trade and intermediate inputs trade by first classifying products into final goods and intermediates, and then estimating the gravity model for each type of good. This strand includes such studies as Athukorala and Yamashita (2006), Kimura et al. (2007), Hayakawa (2014) and BT.

The other strand consists of more recent studies that focus on value-added trade rather than gross trade. This strand of research first estimates the value-added trade, stripping out the value of imported inputs from gross trade, and then applies the gravity model to value-added trade. To estimate the value-added trade, these studies typically utilize international input-output tables. This strand includes such studies as Johnson and Noguera (2012), Aichele and Heiland (2018) and Kaplan et al. (2018).[4]

While these empirical studies made significant contributions to the literature, there is a room for further investigation. On the one hand, the first strand of studies explicitly focuses on intermediate inputs but does not take into account the dual nature of goods which is taken into account in the second strand. For example, computers are directly used as final products by consumers, thereby directly contributing to consumer utility, but they are also used as intermediate inputs by firms to produce other products and services. On the other hand, while the second strand of studies takes into account the dual nature of goods, the trade in intermediate inputs is not analyzed explicitly because these studies focus on net trade flows (gross trade minus

[4] An earlier literature focuses on measuring "vertical specialization" in trade, as defined by Hummels, Ishii and Yi (2001) and further examined in Chen, Kondratowicz and Yi (2005).

trade in intermediate inputs).[5] Moreover, as we will discuss below, these studies focus only on international trade. None of them takes into account the role of intranational trade.

Building upon these studies, this study attempts to fill in the missing link. We contribute to the literature by explicitly focusing on intermediate inputs trade like the first strand of studies while accounting for the dual nature of goods like the second strand of studies. This combination has not been investigated previously in the literature, to the best of our knowledge. More specifically, we examine whether the gravity model is as applicable to trade in intermediate inputs as it is to trade in final goods. In order to distinguish the difference between trade in intermediate inputs and final goods while taking account of the dual nature of goods, we utilize the OECD Trade in Value-Added (TiVA) database which allows for dual uses of goods through an input-output table framework. Therefore, trade in final goods is defined as the final demand from foreign consumers whereas trade in intermediate inputs is defined as the intermediate inputs used by foreign producers. Our analysis thus provides an alternative decomposition of trade flows, which is a simple but non-trivial contribution to the literature.[6]

The last strand of related empirical work focuses on estimation issues involving the structural gravity model. Our study builds on the work of Yotov (2012) and Borchert and Yotov (2017) that emphasize the importance of including intranational trade in gravity model estimations. These studies resolved the “distance puzzle” and “missing globalization puzzle” by applying the structural gravity model to international and intranational trade flows. We find that

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[5] Instead of estimating the relationship between value-added trade and value-added output (i.e., GDP), Jang and Song (2017) propose estimating the relationship between gross trade and gross output in the presence of intermediate inputs, but their study also does not explicitly analyze the trade in intermediate inputs.

[6] In a different context, Wang, Wei, Yu and Zhu (2018) and Taniguchi (2019) emphasized the importance of distinguishing between trade in final goods and trade in intermediate inputs in analyzing the effects of Chinese imports on local labor markets in the U.S. and Japan, respectively.

the poor performance of the gravity model in explaining Factory Asia trade identified by BT can be resolved with the inclusion of intranational trade flows.

3. Methodology and Data

3.1 Methodology

We estimate a gravity model of bilateral trade for both final goods and intermediate inputs. Let $Trade_{ij}$ be the imports of country j from country i. The standard gravity equation is:

$$Trade_{ij} = \exp\left(\mathbf{d}_i'\alpha + \mathbf{d}_j'\beta + \mathbf{w}_{ij}'\gamma\right) \times \varepsilon_{ij}, \qquad (1)$$

where exp(•) denotes exponential function; $\mathbf{d}_i$ and $\mathbf{d}_j$ are the vectors of the origin- and destination-country dummies to capture the origin- and destination-country fixed effects, respectively; $\mathbf{w}_{ij}$ is the vector of characteristics of the origin-destination pair (e.g., distance) and ε_{ij} is the disturbance term. The origin- and destination-country fixed effects are the "multilateral resistance terms" in the gravity model of trade (Anderson and van Wincoop, 2003; Feenstra, 2016). Although BT utilized a remoteness variable as a proxy for the multilateral resistance term, Head and Mayer (2014) argued that remoteness variables do not have a rigorous theoretical foundation. We thus use fixed effects as multilateral resistance terms while capturing the effects of country size by origin and destination GDPs, as described below.[7]

[7] de Mello-Sampayo (2017) offers an alternate approach to handling multilateral resistance by including a "competition factor" that is a distance-weighted sum of all other supplier countries' characteristics in supplying a product. In order to compare our gravity model results with prior literature, we adopt the traditional approach of using origin- and destination-country fixed effects to handle multilateral resistance.

Note also that the disturbance term is assumed to multiply the exponential function. By specifying the disturbance multiplicatively and assuming Poisson distribution for the disturbance, we can estimate the gravity model directly by employing Pseudo-Poisson Maximum Likelihood (PPML) estimation proposed by Santos Silva and Tenreyro (2006).[8] Although the estimation can be done by non-linear least squares, the PPML estimator is more efficient than the non-linear least squares estimator (Santos Silva and Tenreyro, 2006).[9] In particular the PPML estimator accounts for heteroskedasticity in the trade data and allows us to include the information contained in observations of zero trade flows.[10]

The standard gravity equation in equation (1) can be improved by applying it to panel data and by including intranational trade flows, $Trade_{iit}$, along with international trade flows, $Trade_{ijt}$, as in Yotov (2012) and Borchert and Yotov (2017).[11] These changes produce the following gravity specification:

$$Trade_{ijt} = \exp\left(\mathbf{d}_i'\alpha + \mathbf{d}_j'\beta + \mathbf{w}_{ij}'\gamma + \mathbf{x}_{ijt}'\lambda + \mathbf{y}_{it}'\delta + \mathbf{z}_{jt}'\zeta + \mathbf{d}_{ii}'\xi + \mathbf{d}_t'\chi\right) \times \varepsilon_{ijt}, \qquad (2)$$

where $\mathbf{x}_{ijt}$ is the vector of time-variant country-pair-specific factors; $\mathbf{y}_{it}$ and $\mathbf{z}_{jt}$ are the vectors of the time-variant origin- and destination-country-specific characteristics, respectively; $\mathbf{d}_{ii}'$ is the vector of country-specific dummies for intranational trade that capture both internal trade costs

[8] Several methods have been proposed to estimate the gravity equation. Based on a Monte Carlo exercise, Head and Mayer (2014) argued that structurally-iterated least squares (Anderson and van Wincoop, 2003) are not worth the computational effort. Similarly, they argued that Bonus Vetus OLS (Baier and Bergstrand, 2009) is no longer advisable because its estimates are not robust to missing data and lack preciseness. A more recent study by Anderson, Larch and Yotov (2018) developed a procedure to perform general equilibrium comparative static analysis of the gravity model with the PPML estimator.

[9] Similarly, the use of negative binomial estimates depends on the units of measurement for the dependent variable. For more detail, see Bosquet and Boulhol (2014).

[10] In our dataset, zero trade flows account for less than 1% of observations.

[11] See Yotov, Piermartini, Monteiro and Larch (2016) for a discussion of the advantages of estimating the gravity equation using panel data.

and any home biases in consumption; and $\mathbf{d}_t$ is the vector of year dummies that capture the year fixed effects. We follow Yotov (2012) and Borchert and Yotov (2017) in including intranational trade flows along with international trade flows so that our estimates of bilateral trade costs and policies are theory-consistent (i.e., measured relative to internal trade frictions). For observations of intranational trade flows, zeroes are assigned to the time-invariant and time-variant country-pair-specific factors (i.e., $\mathbf{w}_{ij}$ and $\mathbf{x}_{ijt}$). In this paper, we estimate equation (2) using PPML estimation.

As an alternative specification, we allow the origin-country-specific effects and the destination-country-specific effects in equation (2) to vary over time by estimating the following equation:

$$Trade_{ijt} = \exp\left(\mathbf{d}'_{it}\alpha + \mathbf{d}'_{jt}\beta + \mathbf{w}'_{ij}\gamma + \mathbf{x}'_{ijt}\lambda + \mathbf{d}'_{ii}\xi\right) \times \varepsilon_{ijt}, \quad (3)$$

where $\mathbf{d}_{it}$ and $\mathbf{d}_{jt}$ are the vectors of country-year dummies that capture the country-year fixed effects and the other right-hand-side variables are the same as in equation (2). Note that this specification, unlike equation (2), cannot accommodate other country-year variables such GDP because the effects in $\mathbf{y}_{it}$ and $\mathbf{z}_{jt}$ are completely subsumed in α and β respectively.[12]

[12] One may argue that we should employ a three-way fixed effect model: origin-country-year, destination-country-year, and country-pair fixed effects as in Egger and Pfaffermayr (2003), Baltagi, Egger and Pfaffermayr (2015), and Yotov et. al. (2016). While the three-way fixed effects model has strong theoretical backing, some of the results are difficult to interpret because most of the effects are captured by dummies. This paper includes geographic and cultural distance variables explicitly rather than including country-pair fixed effects because we need to estimate distance coefficients in order to compare our results with previous literature.

3.2 Data

One of the important data issues is to distinguish between final goods trade and intermediate inputs trade. Unfortunately, this distinction is not made in standard national trade statistics. To overcome this problem, we employ the OECD's TiVA dataset which distinguishes final goods and intermediate inputs in bilateral trade.[13] The trade data covers 63 economies, including 35 OECD members and 28 non-OECD economies, and a rest of world (ROW) aggregate from 1995 to 2011.[14] The ROW data is used for descriptive statistical analysis only.

Our trade data includes not only international trade but also intranational trade, as suggested by Yotov (2012) and Borchert and Yotov (2017). Intranational trade is defined as the difference between gross output and total exports. Accordingly, when we focus on intermediate goods trade, we measure intranational trade as the difference between the gross output of intermediate inputs and the exports of intermediate inputs. In contrast, when we focus on final goods trade, we define intranational trade as the difference between the value-added and the exports of final goods so that gross output for all goods is consistent with the sum of output of final goods and intermediate inputs. The data also come from the OECD's TiVA database where gross output and value-added are available at the same country-industry level.[15]

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13 The TiVA dataset is constructed from an international input-output table, which is based on 34 industrial sectors including both manufacturing and non-manufacturing sectors. The TiVA database is advantageous in allowing for dual uses of products as inputs and as final consumer goods but it is disadvantageous in that its current framework is not sufficiently disaggregated to allow us to present product-level statistics on dual use (e.g., extensive and intensive margins). The 2016 edition of the TiVA dataset is available online at: http://www.oecd.org/sti/ind/measuring-trade-in-value-added.htm.

14 We utilize the OECD's TiVA database rather than other databases such as World Input-Output Database (WIOD) because of the wide coverage of countries and years. The WIOD Release 2013 covers only 40 countries between 1995 and 2011 (17 years) while the WIOD Release 2016 covers 43 countries from 2000 to 2014 (15 years). See online Appendix Table A1 for a list of countries included in this study. All Appendix tables are available at: https://sites.google.com/site/greaneyecon/research.

15 In the OECD's TiVA database, gross output is smaller than value-added in a few country-industries, which leads to negative intranational trade. These observations are dropped from our analysis.

The data for the gravity equation determinants comes from various sources. For time-invariant country-pair specific variables ($\mathbf{w}_{ij}$), we use a standard set of gravity variables such as distance and dummy variables for common language, colonial relationship and contiguity. These variables are obtained from the CEPII (Centre d'Etudes Prospectives et d'Informations Internationales) gravity data.[16]

The time-variant country-pair variable ($\mathbf{x}_{ijt}$) is a dummy variable for pair participation in a Regional Trade Agreement (RTA). We use Mario Larch's Regional Trade Agreements Database (Egger and Larch, 2008) to judge if a country pair belongs to a common RTA.[17] The RTAs in this database include customs unions (e.g., European Union), free trade agreements and economic integration agreements (e.g., North America Free Trade Agreement and Japan-Singapore economic partnership agreement), and partial scope agreements (e.g., South Asian Preferential Trade Arrangement).

The origin- and destination-country-specific characteristics ($\mathbf{y}_{it}$ and $\mathbf{z}_{jt}$) are GDP's to control for market size. GDP is measured in current thousand US dollars and the data is obtained from the CEPII gravity data.

4. Estimation Results

4.1 Baseline results

Table 1 presents the estimation results of the gravity model for manufactured goods trade between all 63 economies in our dataset. We capture the multilateral resistance effects by using time-invariant origin and destination dummies in columns (1)-(3) and time-variant origin and

16 In the CEPII gravity data, distance is measured as the population-weighted distance between major economic centers across countries.

17 The database includes all multilateral and bilateral RTAs as notified to the World Trade Organization from 1950 to 2017.

destination dummies in columns (4)-(6). For each three-column set of results, we show the estimated coefficients for trade in all goods, final goods only and intermediate inputs only. The results suggest that the determinants of final goods trade are similar to the determinants of intermediate inputs trade and almost all of the coefficients are significant and of the expected sign and approximate size.[18] Bilateral trade is decreasing in trade partner distance and increasing in trade partners' economic size, participation in an RTA, and sharing of a common language and/or a common border. The only insignificant trade determinant is the colonial relationship dummy which impacts only 106 directional country-pairs out of approximately 3,905 for each year in our dataset which includes fewer developing countries than some past studies.[19]

=== Table 1 ===

Following Santos Silva, Tenreyro, and Windmeijer (2015), we compute R-squared as the square of the correlation between the dependent variable and the estimated conditional mean. Table 1 shows that the fit of the gravity equation is very high for both final goods and for intermediate inputs, with R-squared values greater than 0.995 in all of the specifications. The strong fit plus reasonable coefficient estimates for both final goods and intermediate inputs trade confirm that the gravity model is applicable to both types of trade.

[18] The seemingly small size coefficients compared with gravity estimates in earlier literature can be explained by noting that the inclusion of intranational trade changes the interpretation of these coefficients. They now represent the effect of market size on sales inclusive of home market size, not the effect of trade partner size on sales relative to the size of other trade partners. As we will confirm in Table 3, once we exclude intranational trade, we get size coefficients that are comparable to the earlier literature.

[19] Fifty-three colonial relationships become 106 directional country-pairs because trade is measured by imports, so each colonial relationship is counted twice for each partner's imports from the other.

4.2 Results for Factory Asia

Next we consider whether the gravity model performs equally well when we focus on a subset of countries that are closely linked through global value chains. Indeed, BT argue that the gravity model performs poorly when it is applied to a subset of countries in which intermediate inputs trade accounts for a growing share of total trade, namely ‘Factory Asia’ countries. They find that the size coefficient is somewhat small and declining over time and the distance coefficient is much lower (in absolute value) than estimates found in previous studies. To examine the cause of these disparities, we apply our structural gravity model to the seven economies included in BT’s Factory Asia (i.e., Indonesia, Japan, Malaysia, the Philippines, South Korea, Taiwan and Thailand).[20]

Table 2 shows gravity results for manufactured goods’ trade between Factory Asia economies only. These results indicate that the gravity model works equally well for final goods and intermediate inputs even when we restrict trade flows to the Factory Asia subset of economies. The R-squared values are extremely high for each specification and the size and distance coefficients are significant and of the expected signs for both types of goods. The size coefficient on origin country may seem somewhat small at 0.409 for all goods Factory Asia trade compared with 0.582 found previously for all goods all countries trade, but we should not expect very similar coefficients when we restrict the variation in trade observations to a small subset of countries.[21] The origin-country size estimate is consistent with applying the gravity model to an

[20] Our data also confirm the trend identified in BT of the increasing role of intermediate inputs in total Factory Asia trade. Intermediates accounted for 59.6 percent of total Factory Asia trade in 1995 and 73.9 percent in 2011. Note also that the definition of ‘Factory Asia’ is different across studies. For example, ‘Factory Asia’ in Ito and Vézina (2016) consist of nine countries (i.e., the seven countries included in BT plus China and Singapore). As we will discuss, our main results continue to hold even when the analysis includes China while excluding Japan.

[21] In fact, for these seven economies, intra-Factory-Asia trade was only 5.1 percent of total manufactured goods imports in 1995, and 3.9 percent in 2011.

alternative subset of countries such as the European Union (0.445) or to an expanded subset such as East and Southeast Asia (0.518).[22]

=== Table 2 ===

The distance coefficient for Factory Asia trade, at -0.615 for all goods, is only slightly smaller (in absolute value) than the -0.737 found for all countries' trade. With the small subset of economies, the RTA and common language dummies are no longer significant trade determinants, while colonial ties and contiguity now have negative impacts on trade. The RTA result is unsurprising since five of the seven economies have RTAs in place with each other prior to the start of our trade dataset in 1995 (i.e., Indonesia, Malaysia, the Philippines, South Korea, and Thailand) and one has no RTAs with other Factory Asia economies (i.e., Taiwan). This leaves the RTA dummy changing value only for Japan's RTAs with Indonesia, Malaysia, the Philippines and Thailand during our dataset time period. The common language result reflects only one Factory Asia country pair, Malaysia and Taiwan, with a common official language (i.e., Chinese), while colonial ties are limited to only two country pairs (i.e., Japan and South Korea, Japan and Taiwan) and contiguity is limited to only one country pair (i.e., Malaysia and Thailand).

We also test the robustness of our results by estimating the structural gravity model for manufactured goods trade for two alternative subsets of economies, the EU and an expanded group of economies in East and Southeast Asia.[23] We confirm the strong fit of the gravity model

[22] The online Appendix Tables A2 and A3 present the estimation results for the EU and East and Southeast Asia, respectively. The EU includes the 27 member countries that joined prior to 2012 and East and Southeast Asia includes 12 countries, including all seven Factory Asia countries. See online Appendix Table A1 for a complete list.
[23] These results are shown in online Appendix Tables A2 and A3.

for both final goods and intermediate inputs trade for these alternate subsets of economies.[24] We also test the robustness of our results to our selection of industry coverage which has been limited to manufactured goods thus far.[25] Again, we find the gravity model works well for describing trade in both final goods and intermediate goods for Factory Asia even when we expand the industries included.

4.3 When does gravity fail?

We found that the poor performance of the gravity model is not caused by intermediate inputs trade, as was proposed by the BT study. We now seek alternate explanations. Tables 3 and 4 show the gravity model results for manufactured goods trade for all countries and for Factory Asia only after we drop intranational trade observations. Table 3 shows results that are very comparable to standard gravity model results in terms of the size coefficients (0.74 to 0.84) and the distance coefficients (-0.73 to -0.79) for final goods and intermediate inputs. However, reducing the country coverage to Factory Asia only while excluding intranational trade, as in Table 4, we see the problematic result of an insignificant and small (in absolute value) distance coefficient in most of the specifications. We also see much wider gaps between the size coefficients for final goods relative to intermediate goods. A comparison of Tables 2 and 4 illustrates that the gravity model performs well for Factory Asia trade provided the estimation includes intranational trade.

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[24] The EU results in the online Appendix Table A2 show particularly strong distance and RTA estimates. The former is likely caused by greater reliance on expensive land-based transportation methods relative to ocean-based shipping when we focus only on intra-EU trade and the latter is likely caused by ten countries joining the EU in 2004 and two more joining in 2007.

[25] The online Appendix Tables A4 and A5 show gravity model estimates for Factory Asia trade in tradable sectors (i.e., agriculture, mining and manufactured goods industries) and all sectors, respectively.

=== Tables 3 & 4 ===

We also can find problematic gravity results if we consider alternate subsets of countries even when intranational trade is included. When we estimate the gravity model for Factory Asia minus Japan the origin-country size estimate becomes negative or close to zero and insignificant for all goods, final goods and intermediate inputs.[26] If Japan is dropped from Factory Asia while China is added, we can recover significance in the origin-country size coefficient and the gravity model appears to "work" again.[27] Table 5 presents a summary description of the gravity estimations done in BT and in our study, with table references, along with a bottom-line assessment of whether the gravity model has worked or not in each case. A negative assessment reflects insignificant and/or unusual coefficients for size and/or distance.

=== Table 5 ===

In summary, the poor performance of the gravity model in a previous study does not seem attributable to intermediate inputs trade but rather to other factors such as model specification (i.e., inclusion of intranational trade) and/or sample selection.[28] The gravity model should be applied to international and intranational trade flows for large sets of countries to get better estimates of trade determinants based on wider variation in observations. Rose (2017) also emphasizes the importance of using larger datasets (i.e., many countries and years of observed

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[26] The online Appendix Table A6 shows the estimation results for Factory Asia minus Japan, but including intranational trade.

[27] The online Appendix Table A7 presents the estimation results for Factory Asia, dropping Japan and adding China.

[28] BT differs from our study in several other ways (e.g., longer time period, log linear OLS instead of PPML, and different division of goods into consumer goods versus intermediates by industry coding rather than by usage) but we focus here on what we find to be an important difference—their exclusion of intranational trade.

trade) to obtain unbiased estimates of currency union trade effects. Smaller datasets can produce biased multilateral resistance estimates through the use of time-varying country fixed effects, which in turn biases estimates of time-varying country-pair trade determinants. The preferred specification in Rose (2017) cannot be used to resolve the BT problem with the gravity model because size and distance effects are subsumed in fixed effects in Rose (2017), but the small sample critique is applicable.[29]

5. Concluding Remarks

This paper estimates the gravity model separately for intermediate inputs trade and final goods trade by utilizing the OECD TiVA database that covers 1995 through 2011. Our major findings are twofold. First, the structural gravity equation performs extremely well for describing bilateral trade in final goods and in intermediate inputs. Moreover, this continues to hold even when we focus on a subset of countries in which intermediate inputs trade accounts for a large and growing share of trade, namely ‘Factory Asia’.

Second, the gravity model may perform poorly due to model misspecification (i.e., exclusion of intranational trade) and/or sample selection issues even after the model takes into account the dual nature of products. We demonstrate that the poor performance of the gravity model is not attributable to the large trade flow of intermediate inputs, which supports the continued use of the model as these trade flows continue to grow in importance worldwide.

[29] Heid et al. (2017) present a new strategy for using the structural gravity model to estimate effects of non-discriminatory trade policies while also controlling for multilateral resistance.

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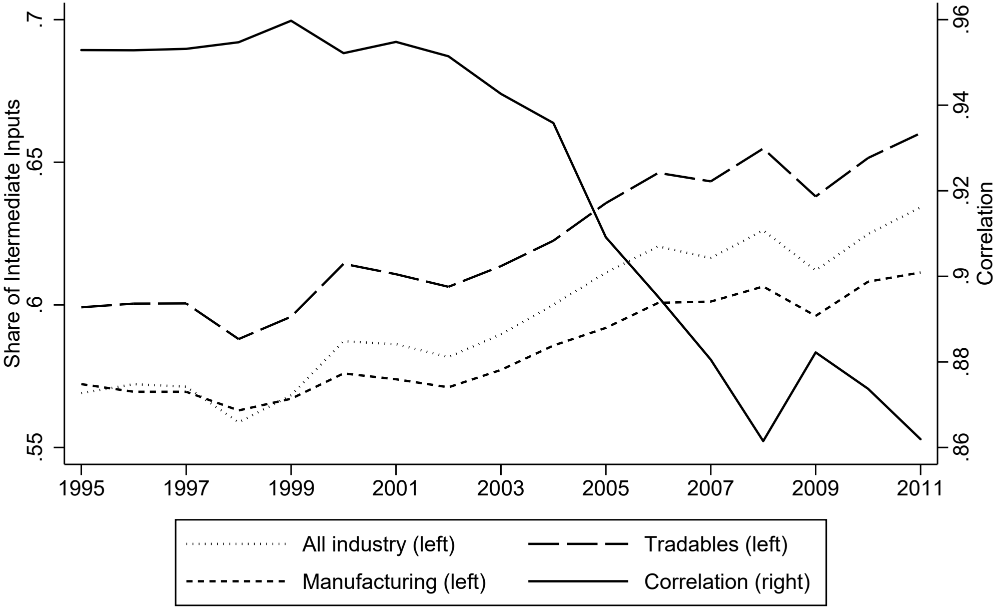
Figure 1. Share of Intermediate Inputs to Total Imports

and Correlation between the Imports of Intermediate Inputs and Final Goods, 1995-2011



Notes: Figure indicates the import share of intermediate inputs to total imports and the correlation between the imports of intermediate inputs and those of final goods. For sources, see main text.

Table 1. Regression Results: Manufacturing and All Countries

	(1)	(2)	(3)	(4)	(5)	(6)
	All goods	Final goods	Inter-mediate inputs	All goods	Final goods	Inter-mediate inputs
Origin country's GDP (log value)	0.582***	0.604***	0.566***			
	[0.067]	[0.076]	[0.071]			
Destination country's GDP (log value)	0.627***	0.546***	0.646***			
	[0.068]	[0.071]	[0.072]			
Distance (log value)	-0.737***	-0.680***	-0.773***	-0.740***	-0.686***	-0.776***
	[0.022]	[0.024]	[0.022]	[0.022]	[0.024]	[0.022]
RTA dummy	0.393***	0.473***	0.360***	0.385***	0.472***	0.351***
	[0.049]	[0.051]	[0.050]	[0.049]	[0.052]	[0.049]
Common official language dummy	0.233***	0.242***	0.225***	0.233***	0.252***	0.222***
	[0.071]	[0.069]	[0.072]	[0.070]	[0.068]	[0.071]
Colonial relationship dummy	-0.019	-0.039	-0.006	-0.020	-0.041	-0.006
	[0.087]	[0.089]	[0.087]	[0.086]	[0.088]	[0.086]
Contiguity dummy	0.366***	0.389***	0.343***	0.366***	0.382***	0.344***
	[0.057]	[0.061]	[0.055]	[0.057]	[0.062]	[0.055]
Number of observations	67,360	67,360	67,360	67,360	67,360	67,360
R-squared	0.99511	0.99639	0.99392	0.99943	0.99836	0.99964
Intranational trade	Yes	Yes	Yes	Yes	Yes	Yes
Fixed effects						
Year	Yes	Yes	Yes	No	No	No
Origin and destination	Yes	Yes	Yes	No	No	No
Origin-year and destination-year	No	No	No	Yes	Yes	Yes

Notes: We employ PPML to estimate the gravity model. ***, **, and * indicate statistically significant at 1%, 5% and 10% levels, respectively. Figures in brackets are standard errors, clustered by country pairs. R-squared is computed as the correlation between actual and fitted values.

Table 2. Regression Results: Manufacturing and Factory Asia

	(1)	(2)	(3)	(4)	(5)	(6)
	All goods	Final goods	Inter-mediate inputs	All goods	Final goods	Inter-mediate inputs
Origin country's GDP (log value)	0.409***	0.509***	0.364***			
	[0.110]	[0.085]	[0.130]			
Destination country's GDP (log value)	0.631***	0.584***	0.614***			
	[0.109]	[0.087]	[0.129]			
Distance (log value)	-0.615***	-0.636***	-0.607***	-0.622***	-0.645***	-0.615***
	[0.033]	[0.028]	[0.038]	[0.031]	[0.024]	[0.034]
RTA dummy	0.119	0.094	0.143	0.143	0.147	0.180*
	[0.111]	[0.107]	[0.119]	[0.101]	[0.091]	[0.104]
Common official language dummy	0.079	-0.027	0.126	0.087	-0.006	0.144
	[0.173]	[0.156]	[0.179]	[0.172]	[0.157]	[0.177]
Colonial relationship dummy	-0.252**	-0.187	-0.267**	-0.256**	-0.191*	-0.276**
	[0.126]	[0.120]	[0.134]	[0.122]	[0.114]	[0.131]
Contiguity dummy	-0.268**	-0.410***	-0.205	-0.275**	-0.390***	-0.210
	[0.126]	[0.128]	[0.134]	[0.125]	[0.127]	[0.131]
Number of observations	831	831	831	831	831	831
R-squared	0.99854	0.99976	0.99745	0.99997	0.99996	0.99996
Intranational trade	Yes	Yes	Yes	Yes	Yes	Yes
Fixed effects						
Year	Yes	Yes	Yes	No	No	No
Origin and destination	Yes	Yes	Yes	No	No	No
Origin-year and destination-year	No	No	No	Yes	Yes	Yes

Notes: We employ PPML to estimate the gravity model. ***, **, and * indicate statistically significant at 1%, 5% and 10% levels, respectively. Figures in brackets are standard errors, clustered by country pairs. R-squared is computed as the correlation between actual and fitted values. Common currency dummy is not included because none of the country is applicable.

Table 3. Regression Results: Manufacturing and All Countries without Intranational Trade

	(1)	(2)	(3)	(4)	(5)	(6)
	All goods	Final goods	Inter-mediate inputs	All goods	Final goods	Inter-mediate inputs
Origin country's GDP (log value)	0.784***	0.843***	0.744***			
	[0.048]	[0.048]	[0.055]			
Destination country's GDP (log value)	0.846***	0.880***	0.814***			
	[0.047]	[0.045]	[0.051]			
Distance (log value)	-0.758***	-0.729***	-0.779***	-0.764***	-0.731***	-0.787***
	[0.031]	[0.033]	[0.031]	[0.031]	[0.033]	[0.031]
RTA dummy	0.335***	0.371***	0.323***	0.329***	0.389***	0.305***
	[0.055]	[0.056]	[0.057]	[0.058]	[0.059]	[0.059]
Common official language dummy	0.238***	0.249***	0.231***	0.247***	0.266***	0.236***
	[0.071]	[0.069]	[0.072]	[0.069]	[0.067]	[0.070]
Colonial relationship dummy	-0.041	-0.074	-0.021	-0.047	-0.077	-0.029
	[0.087]	[0.090]	[0.087]	[0.087]	[0.089]	[0.086]
Contiguity dummy	0.359***	0.365***	0.347***	0.348***	0.347***	0.339***
	[0.059]	[0.063]	[0.058]	[0.059]	[0.063]	[0.058]
Number of observations	66,371	66,371	66,371	66,371	66,371	66,371
R-squared	0.91688	0.91767	0.91450	0.93515	0.94306	0.93202
Intranational trade	No	No	No	No	No	No
Fixed effects						
Year	Yes	Yes	Yes	No	No	No
Origin and destination	Yes	Yes	Yes	No	No	No
Origin-year and destination-year	No	No	No	Yes	Yes	Yes

Notes: We employ PPML to estimate the gravity model. ***, **, and * indicate statistically significant at 1%, 5% and 10% levels, respectively. Figures in brackets are standard errors, clustered by country pairs. R-squared is computed as the correlation between actual and fitted values.

Table 4. Regression Results: Manufacturing and Factory Asia without Intranational Trade

	(1)	(2)	(3)	(4)	(5)	(6)
	All goods	Final goods	Inter-mediate inputs	All goods	Final goods	Inter-mediate inputs
Origin country's GDP (log value)	0.462***	0.703***	0.373***			
	[0.096]	[0.123]	[0.099]			
Destination country's GDP (log value)	0.689***	0.780***	0.590***			
	[0.106]	[0.127]	[0.112]			
Distance (log value)	-0.212	-0.200	-0.225	-0.274*	-0.214	-0.278*
	[0.154]	[0.156]	[0.154]	[0.154]	[0.168]	[0.151]
RTA dummy	-0.041	0.015	-0.047	0.054	0.061	0.033
	[0.104]	[0.104]	[0.114]	[0.115]	[0.139]	[0.109]
Common official language dummy	0.147	0.086	0.172	0.177	0.097	0.199
	[0.171]	[0.153]	[0.177]	[0.173]	[0.166]	[0.176]
Colonial relationship dummy	0.072	0.178	0.035	0.011	0.164	-0.020
	[0.167]	[0.192]	[0.167]	[0.162]	[0.204]	[0.156]
Contiguity dummy	0.299	0.164	0.348	0.256	0.194	0.309
	[0.276]	[0.271]	[0.275]	[0.262]	[0.259]	[0.263]
Number of observations	714	714	714	714	714	714
R-squared	0.94776	0.92735	0.94871	0.96365	0.96832	0.96430
Intranational trade	No	No	No	No	No	No
Fixed effects						
Year	Yes	Yes	Yes	No	No	No
Origin and destination	Yes	Yes	Yes	No	No	No
Origin-year and destination-year	No	No	No	Yes	Yes	Yes

Notes: We employ PPML to estimate the gravity model. ***, **, and * indicate statistically significant at 1%, 5% and 10% levels, respectively. Figures in brackets are standard errors, clustered by country pairs. R-squared is computed as the correlation between actual and fitted values.

Table 5: Summary of Gravity Model Tests

Author	Countries	Industries	Include Intra-national Trade?	Gravity Model Works?	Table
Baldwin-Taglioni (2014)	All	Manufacturing	No	Yes	BT 1
	Factory Asia	Manufacturing	No	No	BT 2
Greaney-Kiyota (2019)	All	Manufacturing	Yes	Yes	1
	Factory Asia	Manufacturing	Yes	Yes	2
	All	Manufacturing	No	Yes	3
	Factory Asia	Manufacturing	No	No	4
	EU	Manufacturing	Yes	Yes	A2
	SE Asia	Manufacturing	Yes	Yes	A3
	Factory Asia	Tradable	Yes	Yes	A4
	Factory Asia	All	Yes	Yes	A5
	Factory Asia w/o Japan	Manufacturing	Yes	No	A6
	Factory Asia w/o Japan, w/China	Manufacturing	Yes	Yes	A7

Notes: We use Baldwin and Taglioni's (2014) definition of Factory Asia (i.e., Indonesia, Japan, Malaysia, the Philippines, South Korea, Taiwan and Thailand). The gravity model is assessed to "not" work when it produces insignificant and/or unusual size and/or distance coefficients.

Table A1. List of Countries

ISO Code	Country name	OECD	EU	E&SE Asia	Factory Asia	ISO Code	Country name	OECD	EU	E&SE Asia	Factory Asia
ARG	Argentina					LTU	Lithuania		*		
AUS	Australia	*				LUX	Luxembourg	*	*		
AUT	Austria	*	*			MYS	Malaysia			*	*
BEL	Belgium	*	*			MLT	Malta		*		
BRA	Brazil					MEX	Mexico	*			
BRN	Brunei Darussalam					MAR	Morocco				
BGR	Bulgaria		*			NLD	Netherlands	*	*		
KHM	Cambodia			*		NZL	New Zealand	*			
CAN	Canada	*				NOR	Norway	*			
CHL	Chile	*				PER	Peru				
CHN	China			*		PHL	Philippines			*	*
COL	Colombia					POL	Poland	*	*		
CRI	Costa Rica					PRT	Portugal	*	*		
HRV	Croatia					ROU	Romania		*		
CYP	Cyprus		*			RUS	Russian Federation				
CZE	Czech Republic	*	*			SAU	Saudi Arabia				
DNK	Denmark	*	*			SGP	Singapore			*	
EST	Estonia	*	*			SVK	Slovak Republic	*	*		
FIN	Finland	*	*			SVN	Slovenia	*	*		
FRA	France	*	*			ZAF	South Africa				
DEU	Germany	*	*			KOR	South Korea	*		*	*
GRC	Greece	*	*			ESP	Spain	*	*		
HKG	Hong Kong, China			*		SWE	Sweden	*	*		
HUN	Hungary	*	*			CHE	Switzerland	*			
ISL	Iceland	*				TWN	Taiwan			*	*
IND	India					THA	Thailand			*	*
IDN	Indonesia			*	*	TUN	Tunisia				
IRL	Ireland	*	*			TUR	Turkey	*			
ISR	Israel	*				GBR	United Kingdom	*	*		
ITA	Italy	*	*			USA	United States	*			
JPN	Japan	*		*	*	VNM	Viet Nam			*	
LVA	Latvia	*	*								

Notes: EU includes 27 EU member countries before 2012. E&SE Asia includes 12 East and Southeast Asian countries. Factory Asia includes seven countries that are focused by Baldwin and Taglioni (2014).

Table A2. Regression Results: Manufacturing and European Union

	(1)	(2)	(3)	(4)	(5)	(6)
	All goods	Final goods	Inter-mediate inputs	All goods	Final goods	Inter-mediate inputs
Origin country's GDP (log value)	0.445***	0.529***	0.429***			
	[0.109]	[0.128]	[0.118]			
Destination country's GDP (log value)	0.512***	0.686***	0.413***			
	[0.103]	[0.113]	[0.116]			
Distance (log value)	-1.159***	-1.111***	-1.189***	-1.155***	-1.108***	-1.185***
	[0.059]	[0.064]	[0.060]	[0.060]	[0.065]	[0.060]
RTA dummy	3.232***	3.231***	3.252***	3.203***	3.209***	3.222***
	[0.421]	[0.454]	[0.422]	[0.422]	[0.457]	[0.424]
Common official language dummy	0.354***	0.380***	0.334***	0.357***	0.383***	0.337***
	[0.117]	[0.122]	[0.118]	[0.117]	[0.123]	[0.118]
Colonial relationship dummy	0.078	0.114	0.053	0.081	0.118	0.056
	[0.094]	[0.102]	[0.092]	[0.095]	[0.105]	[0.093]
Contiguity dummy	0.095*	0.074	0.112**	0.097*	0.076	0.112**
	[0.052]	[0.055]	[0.053]	[0.052]	[0.055]	[0.053]
Number of observations	12,358	12,358	12,358	12,358	12,358	12,358
R-squared	0.99453	0.98926	0.99489	0.99915	0.99575	0.99946
Intranational trade	Yes	Yes	Yes	Yes	Yes	Yes
Fixed effects						
Year	Yes	Yes	Yes	No	No	No
Origin and destination	Yes	Yes	Yes	No	No	No
Origin-year and destination-year	No	No	No	Yes	Yes	Yes

Notes: We employ PPML to estimate the gravity model. ***, **, and * indicate statistically significant at 1%, 5% and 10% levels, respectively. Figures in brackets are standard errors, clustered by country pairs. R-squared is computed as the correlation between actual and fitted values.

Table A3. Regression Results: Manufacturing and East and Southeast Asia

	(1)	(2)	(3)	(4)	(5)	(6)
	All goods	Final goods	Inter-mediate inputs	All goods	Final goods	Inter-mediate inputs
Origin country's GDP (log value)	0.518***	0.551***	0.506***			
	[0.101]	[0.132]	[0.097]			
Destination country's GDP (log value)	0.642***	0.508***	0.655***			
	[0.101]	[0.130]	[0.097]			
Distance (log value)	-0.550***	-0.507***	-0.567***	-0.553***	-0.509***	-0.571***
	[0.021]	[0.023]	[0.020]	[0.021]	[0.023]	[0.020]
RTA dummy	0.378***	0.378***	0.391***	0.408***	0.404***	0.436***
	[0.113]	[0.115]	[0.112]	[0.106]	[0.114]	[0.101]
Common official language dummy	0.337*	0.349	0.329*	0.344*	0.366*	0.338*
	[0.201]	[0.217]	[0.191]	[0.192]	[0.209]	[0.182]
Colonial relationship dummy	-0.366	-0.394	-0.315	-0.360	-0.383	-0.310
	[0.232]	[0.240]	[0.220]	[0.223]	[0.234]	[0.211]
Contiguity dummy	0.258**	0.430***	0.155	0.255**	0.409***	0.155
	[0.112]	[0.136]	[0.096]	[0.110]	[0.134]	[0.095]
Number of observations	2,431	2,431	2,431	2,431	2,430	2,431
R-squared	0.99885	0.99893	0.99860	0.99988	0.99970	0.99992
Intranational trade	Yes	Yes	Yes	Yes	Yes	Yes
Fixed effects						
Year	Yes	Yes	Yes	No	No	No
Origin and destination	Yes	Yes	Yes	No	No	No
Origin-year and destination-year	No	No	No	Yes	Yes	Yes

Notes: We employ PPML to estimate the gravity model. ***, **, and * indicate statistically significant at 1%, 5% and 10% levels, respectively. Figures in brackets are standard errors, clustered by country pairs. R-squared is computed as the correlation between actual and fitted values.

Table A4. Regression Results: Tradable Sectors and Factory Asia

	(1)	(2)	(3)	(4)	(5)	(6)
	All goods	Final goods	Inter-mediate inputs	All goods	Final goods	Inter-mediate inputs
Origin country's GDP (log value)	0.440***	0.536***	0.400***			
	[0.093]	[0.084]	[0.106]			
Destination country's GDP (log value)	0.594***	0.587***	0.585***			
	[0.099]	[0.085]	[0.117]			
Distance (log value)	-0.583***	-0.715***	-0.516***	-0.587***	-0.717***	-0.522***
	[0.033]	[0.027]	[0.037]	[0.031]	[0.026]	[0.035]
RTA dummy	0.165	0.131	0.162	0.181*	0.121	0.196**
	[0.102]	[0.109]	[0.107]	[0.093]	[0.103]	[0.092]
Common official language dummy	0.076	-0.012	0.118	0.082	-0.025	0.136
	[0.200]	[0.151]	[0.228]	[0.199]	[0.155]	[0.225]
Colonial relationship dummy	-0.356**	-0.277**	-0.379**	-0.358**	-0.268**	-0.385**
	[0.142]	[0.118]	[0.159]	[0.140]	[0.116]	[0.157]
Contiguity dummy	-0.269	-0.475***	-0.153	-0.272	-0.466***	-0.154
	[0.179]	[0.130]	[0.214]	[0.177]	[0.132]	[0.211]
Number of observations	831	831	831	831	831	831
R-squared	0.99871	0.99972	0.99765	0.99996	0.99997	0.99995
Intranational trade	Yes	Yes	Yes	Yes	Yes	Yes
Fixed effects						
Year	Yes	Yes	Yes	No	No	No
Origin and destination	Yes	Yes	Yes	No	No	No
Origin-year and destination-year	No	No	No	Yes	Yes	Yes

Notes: Tradable sectors include agriculture, mining and manufacturing industries. We employ PPML to estimate the gravity model. ***, **, and * indicate statistically significant at 1%, 5% and 10% levels, respectively. Figures in brackets are standard errors, clustered by country pairs. R-squared is computed as the correlation between actual and fitted values. Common currency dummy is not included because none of the country is applicable.

Table A5. Regression Results: All Industry and Factory Asia

	(1)	(2)	(3)	(4)	(5)	(6)
	All goods	Final goods	Inter-mediate inputs	All goods	Final goods	Inter-mediate inputs
Origin country's GDP (log value)	0.432***	0.426***	0.435***			
	[0.081]	[0.094]	[0.096]			
Destination country's GDP (log value)	0.586***	0.552***	0.599***			
	[0.082]	[0.094]	[0.100]			
Distance (log value)	-0.630***	-0.726***	-0.576***	-0.632***	-0.729***	-0.580***
	[0.030]	[0.025]	[0.034]	[0.029]	[0.023]	[0.033]
RTA dummy	0.134	0.037	0.147	0.145	0.052	0.168*
	[0.100]	[0.106]	[0.105]	[0.095]	[0.101]	[0.096]
Common official language dummy	0.063	0.053	0.075	0.070	0.058	0.088
	[0.190]	[0.132]	[0.224]	[0.188]	[0.134]	[0.222]
Colonial relationship dummy	-0.322**	-0.201*	-0.363**	-0.325**	-0.200*	-0.369**
	[0.136]	[0.107]	[0.154]	[0.134]	[0.105]	[0.153]
Contiguity dummy	-0.306*	-0.312***	-0.268	-0.307*	-0.303***	-0.268
	[0.164]	[0.111]	[0.205]	[0.163]	[0.112]	[0.204]
Number of observations	831	831	831	831	831	831
R-squared	0.99989	0.99993	0.99934	0.99999	1.00000	0.99998
Intranational trade	Yes	Yes	Yes	Yes	Yes	Yes
Fixed effects						
Year	Yes	Yes	Yes	No	No	No
Origin and destination	Yes	Yes	Yes	No	No	No
Origin-year and destination-year	No	No	No	Yes	Yes	Yes

All industry includes agriculture, mining, manufacturing and services industries. Notes: We employ PPML to estimate the gravity model. ***, **, and * indicate statistically significant at 1%, 5% and 10% levels, respectively. Figures in brackets are standard errors, clustered by country pairs. R-squared is computed as the correlation between actual and fitted values. Common currency dummy is not included because none of the country is applicable.

Table A6. Regression Results: Manufacturing and Factory Asia, Dropping Japan

	(1)	(2)	(3)	(4)	(5)	(6)
	All goods	Final goods	Inter-mediate inputs	All goods	Final goods	Inter-mediate inputs
Origin country's GDP (log value)	-0.030	0.120	-0.069			
	[0.144]	[0.145]	[0.154]			
Destination country's GDP (log value)	0.681***	0.899***	0.626***			
	[0.144]	[0.146]	[0.154]			
Distance (log value)	-0.790***	-0.928***	-0.703***	-0.792***	-0.925***	-0.707***
	[0.125]	[0.114]	[0.131]	[0.122]	[0.111]	[0.127]
RTA dummy	1.512	2.476***	0.851	1.513	2.428***	0.872
	[1.042]	[0.933]	[1.079]	[1.006]	[0.905]	[1.047]
Common official language dummy	0.309***	0.364***	0.283**	0.313***	0.358***	0.290**
	[0.114]	[0.133]	[0.124]	[0.113]	[0.133]	[0.122]
Contiguity dummy	-0.388*	-0.651***	-0.224	-0.392**	-0.637***	-0.231
	[0.203]	[0.187]	[0.213]	[0.198]	[0.179]	[0.208]
Number of observations	610	610	610	610	610	610
R-squared	0.99605	0.99597	0.99503	0.99993	0.99975	0.99994
Intranational trade	Yes	Yes	Yes	Yes	Yes	Yes
Fixed effects						
Year	Yes	Yes	Yes	No	No	No
Origin and destination	Yes	Yes	Yes	No	No	No
Origin-year and destination-year	No	No	No	Yes	Yes	Yes

Notes: We employ PPML to estimate the gravity model. ***, **, and * indicate statistically significant at 1%, 5% and 10% levels, respectively. Figures in brackets are standard errors, clustered by country pairs. R-squared is computed as the correlation between actual and fitted values. Common currency dummy is not included because none of the country is applicable.

Table A7. Regression Results: Manufacturing and Factory Asia, Dropping Japan and Adding China

	(1)	(2)	(3)	(4)	(5)	(6)
	All goods	Final goods	Inter-mediate inputs	All goods	Final goods	Inter-mediate inputs
Origin country's GDP (log value)	0.472***	0.432***	0.485***			
	[0.091]	[0.111]	[0.091]			
Destination country's GDP (log value)	0.581***	0.557***	0.586***			
	[0.095]	[0.116]	[0.096]			
Distance (log value)	-0.592***	-0.582***	-0.592***	-0.595***	-0.590***	-0.595***
	[0.018]	[0.022]	[0.017]	[0.019]	[0.023]	[0.018]
RTA dummy	0.674***	0.802***	0.648***	0.727***	0.868***	0.710***
	[0.080]	[0.076]	[0.088]	[0.064]	[0.042]	[0.073]
Common official language dummy	0.435***	0.469***	0.411**	0.414***	0.484***	0.382**
	[0.158]	[0.179]	[0.161]	[0.147]	[0.166]	[0.148]
Contiguity dummy	0.138	-0.002	0.184	0.123	-0.032	0.163
	[0.135]	[0.174]	[0.125]	[0.128]	[0.164]	[0.117]
Number of observations	831	831	831	831	831	831
R-squared	0.99955	0.99922	0.99951	0.99998	0.99994	0.99998
Intranational trade	Yes	Yes	Yes	Yes	Yes	Yes
Fixed effects						
Year	Yes	Yes	Yes	No	No	No
Origin and destination	Yes	Yes	Yes	No	No	No
Origin-year and destination-year	No	No	No	Yes	Yes	Yes

Notes: We employ PPML to estimate the gravity model. ***, **, and * indicate statistically significant at 1%, 5% and 10% levels, respectively. Figures in brackets are standard errors, clustered by country pairs. R-squared is computed as the correlation between actual and fitted values. Common currency dummy is not included because none of the country is applicable.