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IDE DISCUSSION PAPER No. 756

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March 2019

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JEL classification: F15, F53

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Transportation Costs in Archipelagos: Evidence from Indonesia

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Abstract: In this paper, we empirically examine the effects of domestic transportation costs on product prices in an archipelagic country, namely, Indonesia. Specifically, we investigate the province-level price of televisions. Our analysis reveals that maritime transportation is more costly than land transportation. For example, a 1% increase in distance in maritime and land transportation increases a product price by 0.08% and 0.02%, respectively. This result implies that the geographical concentration or agglomeration of industries is much costlier in archipelagic countries. In other words, enjoying agglomeration effects is more difficult for archipelagic countries compared with single-island countries; in this sense, archipelagic countries have a topographical disadvantage.

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1. Introduction

Transportation costs are a significant burden for firms. For countries considered archipelagos, in particular, even domestic transactions result significant transportation costs. When a country trades with foreign countries, domestic transportation costs are incurred for transportation to a port followed by international transportation costs for the ocean and air transportation between the two countries. At the port, the transshipment of products from trucks to containers is also a significant burden for firms. These costs have been a major impediment in international trade compared with domestic transactions. Notably, this case is applicable to cases other than international trade. For an archipelagic country, costs similar to international transportation costs are incurred. As a result, in archipelagic countries, transportation costs occupy a significant fraction of total costs, even for domestic transactions.

* We thank the seminar participants at the Institute of Developing Economies for their invaluable comments.

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In this paper, we empirically examined the effects of domestic transportation costs on product prices in an archipelagic country. Because transportation costs affect product prices, we expected to observe wide differences in product prices across islands within a country. Specifically, we investigated the province-level price of televisions in Indonesia. Indonesia is the best country for this investigation because the nation has the most islands of any archipelagic country in the world (i.e., greater than ten thousand). The regions of Indonesia are divided into seven large islands. Thus, this nation requires land, sea, and air transportation to complete cross-island transactions. We focus on the price of televisions because all televisions produced in Indonesia are produced on one island. Therefore, if individuals residing on the other islands want to consume domestically produced televisions, the product must be transported by sea or air. Because this focus enabled us to fix the origin in transportation, the television price in each province is dependent on the transportation costs from that origin to each province.

We examined measures to assess distance from a production location to each province. The first measure used was direct distance, which is a standard measure to examine the effect of transportation costs between an origin and destination. For the second measure, we decomposed the distance from a production location to a major port of each province and the distance from that port to a representative city of the province. This decomposition was critical to differentiate between maritime transportation and land transportation in the context of archipelagic countries. The third measure used was actual route distance. This analysis allowed us to consider land transportation and, in particular, the availability and quality of roads. Finally, we set a representative city of the province as the capital city of the province and a center of gravity regarding population to consider the population distribution in each province.

Our analysis revealed that maritime transportation was more costly than land transportation. For example, a 1% increase in distance in maritime and land transportation increases the product price by 0.08% and 0.02%, respectively. The geographical concentration or agglomeration of industries within a country can allow that country to enjoy a scale economy and other agglomeration effects such as knowledge spillover while it yields larger costs to transport products to consumers. Our result implied that such a concentration becomes much more costly in terms of transportation costs and, in particular, for archipelagic countries. In other words, enjoying the agglomeration effects is difficult for archipelagic countries compared with single-island countries.

The content of this study relates to at least two strands in the literature. The first strand has investigated various impediments in domestic transactions (i.e., intra-national trade). Wolf (2000) presented a pioneering study in this first strand, and more recent examples include Agnosteva, Anderson, and Yotov (2019), Albrecht and Tombe (2016), Donaldson (2018), Yilmazkuday (2012), and Wrona (2018). The study in this strand of the literature that most closely resembles this study is Donaldson (2018), who conducted four types of analyses to evaluate the infrastructure in colonial India. Among those four analyses, the first was to investigate the price of salt. Similar to the case of televisions in this study, the production of salt was geographically concentrated in colonial India. By using the variation in the salt price across regions, Donaldson inferred domestic transportation costs. In this study, we followed this method to provide additional details on domestic transportation costs in the case of an archipelago.

The second strand of literature related to this study includes the study of law of one price (LOP). There are many studies that investigate the price deviation and convergence across countries or across cities within a country. The examples include Engel and Rogers (2001), Goldberg and Verboven (2005), Huang et al. (2012), Giri (2012), Hegwood and Nath (2013), Crucini et al. (2010, 2015), and Elberg (2016). By employing the macro-econometrics techniques, most of the studies in this literature examined whether prices converged or diverged, i.e., the existence of price convergence, and how fast the prices react to external shocks. Although we did not examine the long-run change in prices, because of our short sample period (3 years), our results suggested that a dramatic reduction in maritime transportation costs is necessary for price convergence across regions in the case of archipelagic countries.

The remainder of this paper is organized as follows. Section 2 is an overview of transportation in Indonesia. Section 3 presents our empirical framework. Section 4 provides the details of our investigation into the effects of various distance measures on regional prices, and Section 5 concludes.

2. Geography and Transportation in Indonesia

In Indonesia, the economy and population are unevenly distributed. Of the more than ten thousand islands of Indonesia, the Java and Sumatra islands have approximately 80% of the GDP and population share. In particular, the geographical area of Java is only 6.8% of Indonesia, but the island is home to 58% of the national population. Additionally, Java and Bali combined have 25% of the national road network, and Sumatra has 34% (World Bank, 2012). Because the area of Sumatra is three times greater than Java, Sumatra's road length per acre is 0.36 times longer. Similarly, compared with Java, the road length per acre is 0.49 times in Sulawesi, 0.11 times in Kalimantan, and 0.13 times in the sum of provinces of Maluku, East Nusa Tenggara (NTT), West Nusa Tenggara (NTB), and Western New Guinea. The share of four or more wheels in Indonesia is 61.4% for Java and Bali, and 18.2% for Sumatra. Therefore, Java has 4.6 times as many cars as Sumatra per kilometer.

Compared with Java, road conditions on other islands are not well developed. The percentage of unstable roads is 26.2% for Java and Bali, 37.6% for Sumatra, 37.0% for Kalimantan, 42.3% for Sulawesi, and 47.5% for provinces of Maluku, NTT, NTB, and Western New Guinea (World Bank, 2012). Thus far, tollways have mainly been built on Java.

As of June 15, 2015, 948 km of tollway was under operation: 878 km on Java, 43 km on Sumatra, 18 km on Sulawesi, and 10 km on Bali (Pamboedi, 2015). Kalimantan has no expressways. According to the national plan that provides guidelines until 2025, a tollway network of 2,865 km in Sumatra, 2,815 km in Java, 229 km in Bali, 107 km in Sulawesi, and 99 km in Kalimantan will be completed. There are no expressways and no plans to construct expressways on Western New Guinea or the other islands.

Indonesia has approximately 30 main ports, 200 collector ports, and 1,000 feeder ports. Table 1 presents the top 10 ports in terms of cargo throughputs. Bontang, Tanjung Bara, and Taboneo in Kalimantan, which are mainly engaged in exporting resources, are included in these top 10 ports. The other ports are Tanjung Priok and Tanjung Perak in Java, which are involved in domestic and international transactions; Samarinda in Kalimantan and Dumai in Sumatra, which export mainly resources and timber; and Pontianak in Kalimantan and Perawang in Sumatra, which are involved in mainly domestic transactions). As shown in Table 2, the container handling volume is concentrated in Tanjung Priok (Jakarta, Java), Tanjung Perak (Surabaya, Java), Belawan (gateway port for Medan, Sumatra), Tanjung Emas (Semarang, Java), and Panjang (Bandar Lampung, Sumatra). Because the ports of Singapore and Malaysia are Indonesia's main partners in terms of container transportation, the international transaction ratio is high in those ports. Additionally, Tanjung Priok, Tanjung Perak, and Belawan engage in domestic container transactions with each other and other ports such as Makassar (Sulawesi), Banjarmasin (Kalimantan), and Pontianak (Kalimantan). In summary, the ports of each Java, Sumatra, Kalimantan, and Sulawesi are listed in these two tables, and the volume handled by ports on the other islands is much smaller.

=== Tables 1 & 2 ===

Logistics within Indonesia have a high cost because of the uneven distribution of domestic economic activities, insufficient competition, and regulations. For example, the transportation cost for a 40-foot container from Padang in West Sumatra to Jakarta is USD 600, which is more than three times higher than the shipping cost between Singapore and Jakarta, despite the shorter distance; similarly, the costs to Jakarta are USD 650 from Banjarmasin and USD 1,000 from Jayapura (Sandee, 2017). Regarding international freight transportation in the Mekong region, the duration of land transportation is shorter, but the transportation fee is higher, and marine transportation is cheapest but the most time-consuming. Domestic transportation in Indonesia presents an opposite situation. For example, from Jakarta to Medan on Sumatra Island, road transportation required 4.7 days and cost USD 320, and maritime transportation cost USD 500 and required 1.9 days (Malisan, 2013). This opposite relation in Indonesia is because the quality of the roads is not uniform, leading a longer shipping time.

Furthermore, marine transportation is time-consuming because of the turnaround time at the ports. Before arrival at the port, ships must wait near the ports because of congestion, inefficiency in the allocation system, and poor pilotage services. After arrival, lower labor productivity at the port results in ships remaining at the port for long durations. In Sorong and Jayapura, this turnaround was 50–89 and 72–96 hours, respectively. Furthermore, this turnaround time is unstable and consignors, ship operators, and consignees cannot foresee the exact delivery time. Thus, ship operators must prepare more ships to manage the delay because of the turnaround time. Indeed, a correlation has been observed between total shipping time and this turnaround time and implies that turnaround extends shipping time, or the ports located far from Jakarta have relatively lower labor productivity and thus turnaround time becomes longer (World Bank, 2015).

In summary, Java and Sumatra account for most of the maritime transportation except for resource-related transactions. Each port in Indonesia is a destination within a network of Singapore and Malaysian ports, and the number of domestic transactions remains small. In particular, on distant, remote islands, demand is smaller, ship size is smaller, and shipping time is longer and more unstable; therefore, transportation costs tend to be considerably high. In addition, the main modes of cargo transportation differ by island. According to the Survey of Origin-destination of National Transport in 2006, 95.7%, 90.7%, and 93.5% of cargo transportation was carried by road in Java, Sumatra and Bali/NTB/NTT, respectively. By contrast, the road share was 11.0% in Kalimantan and 0.4% in Maluku and Papua (Malisan, 2013). Additionally, the share of maritime transportation is 88.5% in Kalimantan, 60.0% in Sulawesi, and 98.9% in Maluku/Papua. These differences are reflected in the different road quality on each island.

3. Empirical Framework

This section presents our empirical framework to examine the role of transportation costs in consumer prices. To simplify the combination of a production site, namely, the location of the factory, and consumer, we focused on a product produced only in a specific domestic region. Consumers purchase either that domestic product or an imported product. Their respective consumer prices in region r at time t are denoted by p_{rt}^{P} and p_{t}^{I}. We assume that the consumer price of the imported product is given by its (production location-specific) producer price (p_t^I) multiplied by a market-specific price shifter (m_{rt}) and the transportation cost from foreign countries to region r. While the former shifter includes, for example, demand sizes in region r, the latter cost, which is denoted by φ_t, is assumed to be indifferent across domestic regions. As a result, the consumer price of the import product becomes $p_t^I = \varphi_t m_{rt} p_t^I$. Similarly, the consumer price of the domestic product is given by its (production location-specific) producer price (p_t^P) multiplied by the market-specific price shifter and the transportation costs from the production site to region r, which are denoted by T_{rt}. As a result, the consumer price of the domestic product becomes $p_{rt}^P = T_{rt} m_{rt} p_t^P$.

We assume that the composite of consumer price of this product in region r at time t (p_{rt}^C) is given by the following equation:

$$p_{rt}^C = (p_{rt}^P)^\alpha (p_t^I)^{1-\alpha}, \qquad 0 < \alpha < 1. \tag{1}$$

Thus, by using the above respective prices, equation (1) can be written as follows:

$$p_{rt}^C = (T_{rt})^\alpha m_{rt} k_t, \tag{2}$$

where $k_t \equiv (p_t^P)^\alpha (\varphi_t p_t^I)^{1-\alpha}$. The transportation costs are simply assumed to be a function of the geographical distance from the domestic production site to region r (d_r) in addition to a time-variant component, which is common across regions (θ_t).

$$T_{rt} = \theta_t (d_r)^\beta, \;\; \beta > 0 \tag{3}$$

Substituting this equation into equation (2), we obtain

$$p_{rt}^C = v_t (d_r)^{\alpha\beta} m_{rt}, \tag{4}$$

where $v_t \equiv (\theta_t)^\alpha k_t$. By taking a log, replacing region-invariant elements with time fixed effects (u_t), and adding a disturbance term (ϵ_{rt}), we obtain our estimation equation:

$$\ln p_{rt}^C = \gamma \ln d_r + \ln m_{rt} + \mathrm{u}_t + \epsilon_{rt}. \tag{5}$$

In equation (5), $\gamma \equiv \alpha\beta > 0$ and $\mathrm{u}_t \equiv \ln v_t$. Equation (5) was derived from a simple model that describes why the product price in provinces farther from the production location increases. Finally, we assume that a market-specific price shifter is related to the income ($Capita_{rt}$) and the number of population ($Population_{rt}$) in region r. The income is proxied by gross regional product per capita. As a result, our estimation equation is given by the following.

$$\ln p_{rt}^C = \gamma_1 \ln d_r + \gamma_2 \ln Capita_{rt} + \gamma_3 \ln Population_{rt} + \mathrm{u}_t + \epsilon_{rt}. \tag{6}$$

In this study, our main data source was the Rural Consumer Price Statistics: Non-Food Groups by the Central Bureau of Statistics. This source provided the average monthly rural consumer price for many products at a province level through statistics collected by administering a questionnaire and conducting direct interviews with the retailers in the rural market. Specifically, the price information was collected from three or four traders in several sub-districts of each province, and then the geometric mean was taken. We focused on the price in the rural area is because this price depends more heavily on the availability and quality of the transportation infrastructure in each province. Furthermore, we may ignore the effect of the competition among sellers (e.g., retailers) in the market. In this paper, we focused on the price of a television because televisions produced in Indonesia are manufactured in only Jakarta and its two neighboring provinces (i.e., Banten and West Java) on the same large island, Java.[1] We measured the average price of a television by Indonesian rupiah per unit. As a result, our sample included the monthly price of a television from 2008–2010 in 31 provinces. We included 36 time points, for which we defined time fixed effects.

[1] This is confirmed by employing Indonesian manufacturing surveys from 2008–2010 by the BPS, which covers all manufacturing plants with 20 or more workers.

In our empirical analysis, we used various measures for the geographical distance from a production location to each province. In the baseline analysis, we set Jakarta as a production location and a capital city at the representative point of each province. In the later analysis, we also decomposed this distance measure into the distance measure from Jakarta to a major port in each province and the distance measure from that port to a capital city of each province. These provinces, capital cities, and major ports are presented in Figure 1. Most of the major ports are in the capital city of each province. Furthermore, we also attempt to set a city nearest to a center of gravity in terms of population at a representative point of each province.[2] The annual data on income and population are obtained from the CEIC database.

=== Figure 1 ===

4. Empirical Results

The estimation result for equation (5) is reported in column (I) in Table 3 and naturally shows that transportation costs increased with the distance. A 1% increase in distance from the production site increased the consumer price by 0.067%. The coefficients for income and population are significantly estimated to be positive and negative, respectively. Namely, the consumer price is higher in the regions with higher average income or with the smaller population. We further estimated some extended models. The transportation to provinces within Java qualitatively differs from the transportation to the other provinces because the former may only be carried by land. To control for this difference in transportation mode, we simply added a dummy variable that takes a value of one for provinces in islands apart from Java and zero otherwise, denoted by *Non-Java dummy*. The result is presented in column (II); again, the distance variable was a significantly positive coefficient. The coefficient for the new dummy variable was insignificantly estimated.

=== Table 3 ===

In column (III), we also introduced the interaction term of *Non-Java dummy* with the distance variable. The result shows a clear contrast in the distance coefficient between Java and non-Java provinces, which we estimated to be negative for the Java provinces and positive for the non-Java provinces. This result indicates that the longer distance from the production site is not associated with the higher price within the island where the production site is located; however, it is related to the higher price off that island. In addition, when controlling for this interaction term by using the distance variable, the coefficient for

[2] The basic statistics for our estimation are provided in the Appendix.

Non-Java dummy is negative, that is, the main reason for high consumer prices outside of Java is the long distance from the production site.

We further investigated the difference in the distance coefficient among the non-Java islands. Specifically, we introduced the interaction terms of dummy variables on islands with the distance variable. The estimation results are presented in Table 4. The base island in these interaction terms is Java, that is, the island with the production site. In column (II), we also added *Non-Java dummy*. All the coefficients for the interaction terms were significantly positive, and this was consistent with the result in column (III) in Table 3. The absolute magnitude was relatively large in Western New Guinea and relatively small in Sulawesi. The large magnitude in Western New Guinea implied that even when the transportation distance was the same, the transportation to Western New Guinea was perhaps more costly because of the worse quality of infrastructure.

=== Table 4 ===

Next, we decomposed the distance from Jakarta to each province according to transportation modes. In this analysis, we excluded the provinces of Java because only land transportation is used for transportation to those provinces. The distance from Jakarta to each province is decomposed into the sea-route distance from Jakarta to the major port in each province and the direct distance from that port to a capital city of the province; the former distance was obtained from Ports.com. These two distances are denoted by "Distance from origin to port" and "Distance from port to destination," respectively. The results are presented in column (I) in Table 5. Although the coefficient for the distance from Jakarta to the nearest port was estimated to be significantly positive, the distance from the port to the provinces has a significantly negative coefficient. These results imply that maritime transportation costs from the production site to the major port are more significant than land transportation costs from the port to provinces.

=== Table 5 ===

The negative coefficient for the distance from the port to the provinces is an unnatural result. As a robustness check, we use the road distance from the major port to a capital city of the province instead of the direct distance. The minimum road distance is calculated by using the road network data in MapFan Southeast Asia Map compiled by Increment P Corp. The result is reported in column (II) in Table 5 but shows a result similar to the results in column (I). Thus, the difference between direct distance and road distance is not a major source to understand the negative coefficient for the distance from the port to provinces.

Another source of the negative coefficient might that most of the major ports are in capital cities (Figure 1). Namely, when we set a capita city as a destination point, "Distance from port to destination" is small and does not capture the intra-province transportation well. To improve this measure, as a destination point, we set the capital city of the regency nearest to the center of gravity in terms of population in each province, i.e., the weighted average of the latitudes and longitudes of all capital cities of the regencies that belong to the province. The data on population in 2010 are used in this computation. Then, we measure the direct distance and road distance from the major port to that city. The results are reported in columns (III) and (IV) and show the positive coefficients for intra-province distance, and these results were consistent with our expectations. For example, column (IV) indicates that a 1% increase in the sea route increases prices by 0.08% and that of the land route results in a 0.02% increase. These results imply that the longer route is four times more costly over sea than over land.[3] This finding is consistent with our discussion in Section 2: For domestic transactions in Indonesia, the transportation fee is higher for maritime transportation than land transportation.

Finally, to further investigate the negative coefficient, we examined the role of distance from the nearest ports to the provinces according to islands. Specifically, we introduced the interaction terms of distance variables to island dummy variables. The base category was Western New Guinea, the farthest island from Java. The results are reported in Table 6 and show that all interaction terms have significantly negative coefficients, whereas the distance variable has a significantly positive coefficient. These results indicate that the intraisland transportation costs are of importance only in Western New Guinea. In particular, except for the Lesser Sunda Islands, the sum of the coefficients for each island dummy and the distance variable is almost equal to zero. The result for Western New Guinea is consistent with our discussion: Papua, and some other provinces, have no expressways.

=== Table 6 ===

5. Concluding Remarks

In this paper, we empirically examined the effects of domestic transportation costs on product prices in an archipelagic country, namely, Indonesia. Our analysis revealed that maritime transportation is more costly than land transportation. For example, a 1% increase in the distance in maritime and land transportation increased the product price by 0.08% and 0.02%, respectively. This result implies that the geographical concentration and agglomeration of industries is much costlier regarding transportation costs and, in particular, for archipelagic countries. In other words, agglomeration effects are more

[3] Notice that this assertion is based on the distance elasticity of prices. Indeed, as found in the Appendix, the sample average is three times higher in the sea-route distance than in the land-route distance. Therefore, the margin effect of (non-logged) distance might not be so different between these two distances.

difficult to enjoy for archipelagic countries compared with single-island countries; in this sense, archipelagic countries have a topographical disadvantage. In conclusion, we assert that a drastic reduction of maritime transportation costs is necessary to exploit benefits from industry agglomeration in the case of archipelagic countries.

References

Agnosteva, D., Anderson, J., and Yotov, Y., 2019, Intra-national Trade Costs: Assaying Regional Frictions, *European Economic Review*, 112: 32-50.

Albrecht, L. and Tombe, T., 2016, Internal Trade, Productivity, and Interconnected Industries: A Quantitative Analysis, *Canadian Journal of Economics*, 49(1): 237-263.

Crucini, M., Shintani, M., and Tsuruga, T., 2010, The Law of One Price without the Border: the Role of Distance versus Sticky Prices, *Economic Journal*, 120: 462-480

Crucini, M., Shintani, M., and Tsuruga, T., 2015, Noisy Information, Distance and Law of One Price Dynamics across US Cities, *Journal of Monetary Economics*, 74: 52-66.

Engel, C. and Rogers, J., 2001, Violating the Law of One Price: Should We Make a Federal Case Out of It?, *Journal of Money, Credit and Banking*, 33(1): 1-15.

Elberg, A., 2016, Sticky Prices and Deviations from the Law of One Price: Evidence from Mexican Micro-price Data, *Journal of International Economics*, 98: 191-203.

Giri, R., 2012, Local Costs of Distribution, International Trade Costs and Micro Evidence on the Law of One Price, *Journal of International Economics*, 86(1): 82-100.

Goldberg, P. and Verboven F., 2005, Market Integration and Convergence to the Law of One Price: Evidence from the European Car Market, *Journal of International Economics*, 65: 49-73.

Hegwood, N. and Nath, H., 2013, Structural Breaks and Relative Price Convergence among US Cities, *Journal of Macroeconomics*, 36: 150-160.

Holmes, M., Otero, J., and Panagiotidis, T., 2011, Investigating Regional House Price Convergence in the United States: Evidence from a Pair-wise Approach, *Economic Modelling*, 28(6): 2369-2376.

Huang, H., Liu, W., and Yeh, C., 2012, Convergence in Price Levels across US Cities, *Economics Letters*, 114(3): 245-248.

Donaldson, D., 2018, Railroads of the Raj: Estimating the Impact of Transportation Infrastructure, *American Economic Review*, 108(4-5): 899-934.

Malisan, J., 2013, Intermodal integration in Indonesia, PowerPoint material for the Seventh Regional EST Forum in Asia, http://www.uncrd.or.jp/content/documents/7EST-P3-3.pdf

OECD, 2012, OECD Reviews of Regulatory Reform INDONESIA, Regulatory and Competition Issues in Ports, rail and Shipping, OECD.

Pamboedi, K., 2015, Toll Road Investment Opportunities, Presentation material on the International Symposium Japan Road Congress, Tokyo, https://www.road.or.jp/international/pdf/31_2.pdf

Sandee, H., 2017, Behind the Border Logistics Challenges and Measures in Indonesia, Presentation Material for Asia-Pacific Trade Facilitation Forum 2017.

Yilmazkuday, H., 2012, Understanding Interstate Trade Patterns, *Journal of International Economics*, 86(1), 158–66

Wolf, H., 2000, Intra-National Home Bias in Trade, *Review of Economics and Statistics*, 82(4): 555-563.

World Bank, 2012, Investing in Indonesia's Roads. Improving Efficiency and Closing the Financing Gap, World Bank.

World Bank, 2015, Improving Indonesia's Freight Logistics System: A Plan of Action, World Bank.

Wrona, J., 2018, Border Effects without Borders: What Divides Japan's Internal Trade?, *International Economic Review*, 59(3): 1209-1262.

Table 1. Top 10 Indonesian Ports in Throughput (1,000 tons, 2009)

		Province	Island	International		Domestic		Export share
				Import (a)	Export (b)	Unloading (c)	Loading (d)	(b)/(a+b+c+d)
1	Samarinda	East Kalimantan	Kalimantan	260	52,875	6,193	12,911	0.73
2	Tanjung Priok	Jakarta	Java	23,060	20,930	10,840	12,272	0.31
3	Tanjung Perak	East Java	Java	13,410	7243	18,856	19,269	0.12
4	Bontang	East Kalimantan	Kalimantan	678	46,764	300	566	0.97
5	Pontianak	West Kalimantan	Kalimantan	52	250	13,175	33,371	0.01
6	Tanjung Bara	East Kalimantan	Kalimantan	221	41,179	0	0	1.00
7	Perawang	Riau	Sumatra	113	534	29,443	8,142	0.01
8	Taboneo	South Kalimantan	Kalimantan	103	36,043	213	224	0.99
9	Kendawangan	West Kalimantan	Kalimantan	0	340	15,632	15,632	0.01
10	Dumai	Riau	Sumatra	857	18,604	6,415	868	0.70

Source: OECD (2012)

Table 2 Container Throughputs (1,000 TEU)

				International		Domestic		Intl transaction
				Import	Export	Unloading	Loading	Share
		Province	Island	(a)	(b)	(c)	(d)	(a+b)/(a+b+c+d)
1	Tanjung Priok	Jakarta	Java	1,605	1485	328	505	0.79
2	Tanjung Perak	East Java	Java	630	576	256	282	0.69
3	Belawan	North Sumatra	Sumatra	302	309	180	98	0.69
4	Tanjung Emas	Central Java	Java	291	253	17	15	0.94
5	Panjang	Lampung	Sumatra	137	139	14	11	0.92
6	Makassar	South Sulawesi	Sulawesi	2	0	144	104	0.01
7	Banjarmasin	South Kalimantan	Kalimantan	0	0	61	57	0.00
8	Pontianak	West Kalimantan	Kalimantan	0	0	70	29	0.00
9	Samarinda	East Kalimantan	Kalimantan	0	0	50	45	0.00
10	Pekanbaru	Riau	Sumatra	11	32	16	13	0.60

Source: OECD (2012)

Table 3. Baseline Results

	(I)	(II)	(III)
ln Distance	0.067***	0.065***	-0.110***
	[0.006]	[0.006]	[0.005]
* Non-Java dummy			0.211***
			[0.008]
Non-Java dummy		0.012	-1.166***
		[0.017]	[0.050]
ln Capita	0.028***	0.027***	0.027***
	[0.005]	[0.006]	[0.005]
ln Population	-0.012**	-0.011*	-0.008*
	[0.005]	[0.006]	[0.005]
Number of observations	1,116	1,116	1,116
R-squared	0.2632	0.2637	0.4134

Notes: The dependent variable is a log of the consumer price for a television. We estimate our model by using OLS. ***, **, and * represent significance at the 1%, 5%, and 10% statistical levels, respectively. Parentheses contain the heteroscedasticity-consistent standard error. In all specifications, we include year-month fixed effects. "Distance" is a direct distance from Jakarta to a capital city of each province. *Non-Java dummy* takes the value of one if provinces are located on islands other than Java and zero otherwise.

Table 4. Estimation Results by Island

	(I)	(II)
ln Distance	0.003	-0.115***
	[0.008]	[0.005]
* Kalimantan	0.016***	0.211***
	[0.002]	[0.010]
* Lesser Sunda Islands	0.033***	0.223***
	[0.003]	[0.010]
* Maluku Islands	0.029***	0.209***
	[0.003]	[0.009]
* Sulawesi	0.015***	0.202***
	[0.003]	[0.009]
* Sumatra	0.017***	0.215***
	[0.002]	[0.010]
* Western New Guinea	0.044***	0.226***
	[0.003]	[0.009]
Non-Java dummy		-1.176***
		[0.066]
ln Capita	0.027***	0.006
	[0.006]	[0.006]
ln Population	-0.001	-0.014***
	[0.004]	[0.004]
Number of observations	1,116	1,116
R-squared	0.4506	0.5497

Notes: The dependent variable is a log of the consumer price for a television. We estimate our model by using OLS. ***, **, and * represent significance at the 1%, 5%, and 10% statistical levels, respectively. Parentheses contain the heteroscedasticity-consistent standard error. "Distance" is a direct distance from Jakarta to a capital city of each province. *Non-Java dummy* takes the value of one if provinces are located on islands other than Java and zero otherwise. The base island in the dummy on islands is Java, i.e., the island with the production site. In all specifications, we include year-month fixed effects.

Table 5. Decomposition of Distance from Origin to Destination

	(I)	(II)	(III)	(IV)
ln SDistance from origin to port	0.063***	0.062***	0.077***	0.077***
	[0.004]	[0.004]	[0.004]	[0.004]
ln DDistance from port to destination	-0.006***		0.026***	
	[0.002]		[0.004]	
ln RDistance from port to destination		-0.008***		0.024***
		[0.002]		[0.004]
ln Capita	0.024***	0.025***	0.020***	0.018***
	[0.006]	[0.005]	[0.005]	[0.005]
ln Population	-0.014**	-0.016***	-0.021***	-0.021***
	[0.006]	[0.006]	[0.006]	[0.006]
Destination point	Capital	Capital	Center	Center
Number of observations	972	972	972	972
R-squared	0.2623	0.2676	0.2966	0.2963

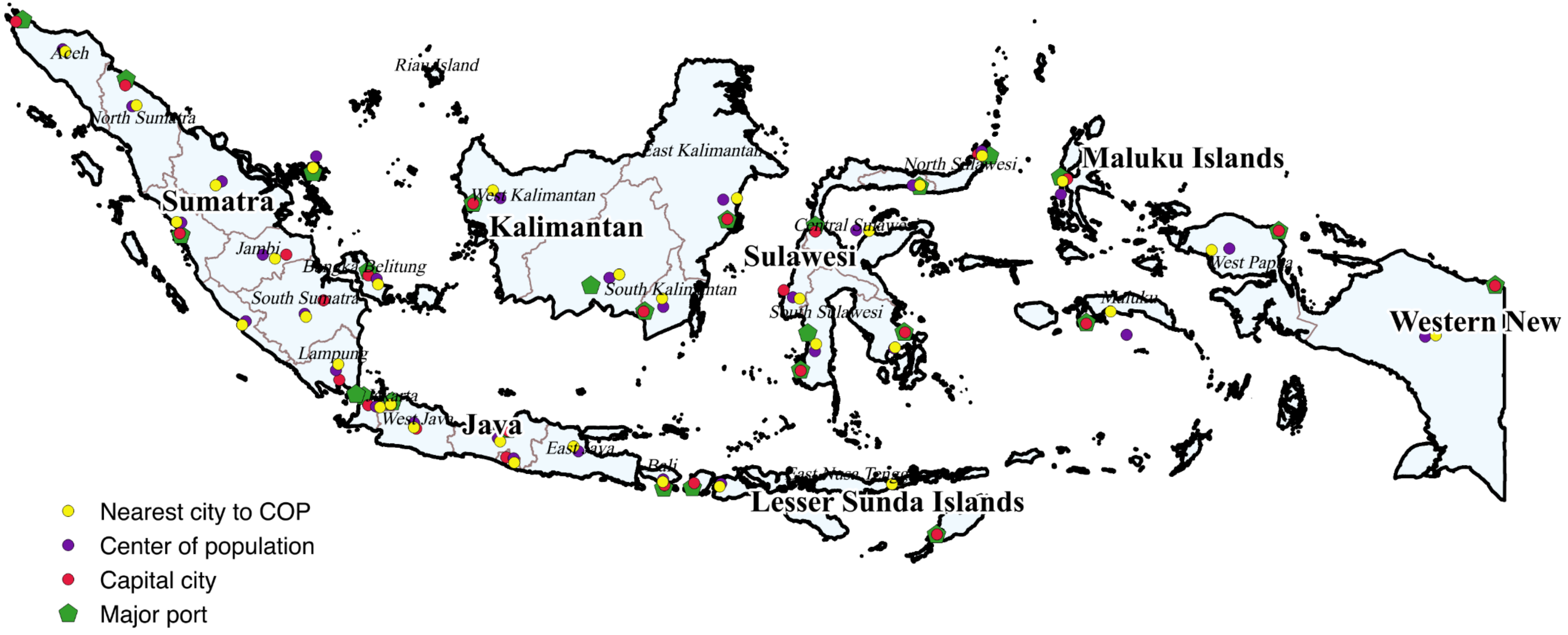
Notes: The dependent variable is a log of the consumer price for a television. We estimate our model by using OLS. ***, **, and * represent significance at the 1%, 5%, and 10% statistical levels, respectively. Parentheses contain the heteroscedasticity-consistent standard error. In all specifications, we include year-month fixed effects. "SDistance from origin to port" is a sea-route distance from Jakarta to a major port of each province. "DDistance from port to destination" ("RDistance from port to destination") is a direct (road) distance from that port to a destination point of each province. The destination point is a capital city in column "Capital" and a center of gravity in terms of population in column "Center."

Table 6. Decomposition of Distance from Origin to Destination by Islands

	(I)	(II)	(III)	(IV)
ln SDistance from origin to port	0.060***	0.078***	0.063***	0.063***
	[0.006]	[0.006]	[0.006]	[0.006]
ln DDistance from port to destination	0.318***		0.033***	
	[0.043]		[0.004]	
ln RDistance from port to destination		0.019*		0.032***
		[0.010]		[0.004]
* Kalimantan	-0.331***	-0.031***	-0.027***	-0.027***
	[0.043]	[0.009]	[0.004]	[0.003]
* Lesser Sunda Islands	-0.304***	-0.012	-0.002	-0.004
	[0.044]	[0.011]	[0.004]	[0.003]
* Maluku Islands	-0.305***	-0.033***	-0.027***	-0.027***
	[0.042]	[0.009]	[0.004]	[0.003]
* Sulawesi	-0.331***	-0.041***	-0.039***	-0.039***
	[0.043]	[0.009]	[0.003]	[0.003]
* Sumatra	-0.316***	-0.017*	-0.022***	-0.022***
	[0.043]	[0.010]	[0.004]	[0.003]
ln Capita	0.015**	0.013*	0.013**	0.009*
	[0.006]	[0.007]	[0.005]	[0.005]
ln Population	-0.012**	-0.031***	-0.019***	-0.017***
	[0.006]	[0.007]	[0.005]	[0.005]
Destination point	Capital	Capital	Center	Center
Number of observations	972	972	972	972
R-squared	0.3501	0.3222	0.4702	0.4843

Notes: The dependent variable is a log of the consumer price for a television. We estimate our model by using OLS. ***, **, and * represent significance at the 1%, 5%, and 10% statistical levels, respectively. Parentheses contain the heteroscedasticity-consistent standard error. "SDistance from origin to port" is a sea-route distance from Jakarta to a major port of each province. "DDistance from port to destination" ("RDistance from port to destination") is a direct (road) distance from that port to a destination point of each province. The destination point is a capital city in column "Capital" and a center of gravity in terms of population in column "Center." The base category is Western New Guinea, which is the farthest island from Java. In all specifications, we include year-month fixed effects.

Figure 1. Provinces, Cities, and Ports in Indonesia



Source: Authors' compilation

Appendix. Basic Statistics

		Obs	Mean	S.D.	Min	Max
All provinces						
ln Price		1,116	14.070	0.135	13.807	14.457
ln Distance		1,116	6.833	0.890	4.349	8.238
ln Distance * Non-Java dummy		1,116	6.149	2.445	0	8.238
Non-Java dummy		1,116	0.871	0.335	0	1
ln Capita		1,116	16.501	0.638	15.173	18.370
ln Population		1,116	8.156	0.943	6.593	10.670
Provinces in non-Java island						
ln Price		972	14.089	0.130	13.807	14.457
ln SDistance from origin to port		972	7.256	0.849	5.333	8.531
ln DDistance from port to destination	(Capital)	972	2.729	1.859	-0.506	6.118
ln RDistance from port to destination	(Capital)	972	3.073	2.018	-2.063	6.508
ln DDistance from port to destination	(Center)	972	4.472	1.065	1.423	6.118
ln RDistance from port to destination	(Center)	972	4.865	1.136	1.844	6.508
ln Capita		972	16.510	0.681	15.173	18.370
ln Population		972	7.942	0.721	6.593	9.492

Source: Authors' computation

Notes: "Distance" is a direct distance from Jakarta to a capital city of each province. *Non-Java dummy* takes the value of one if provinces are located on islands other than Java and zero otherwise. "SDistance from origin to port" is a sea-route distance from Jakarta to a major port of each province. "DDistance from port to destination" ("RDistance from port to destination") is a direct (road) distance from that port to a destination point of each province. The destination point is a capital city in column "Capital" and a center of gravity in terms of population in column "Center."