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Barriers to Trade in the Second Era of Globalisation: Empirical Evidence from Korea*

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Korea has been witnessing a sharp rise in merchandise trade and showing greater trade interdependence on a large variety of goods. At the same time, rising transportation costs continue to impede Korea's merchandise trade. This paper provides sufficient evidence to ascertain that variations in ad-valorem transportation costs strongly influence trade flows in Korea. The analysis carried out in this paper indicates that a 10% fall in ad-valorem transportation cost would likely to increase Korea's trade by 12%. One of the conclusions of this paper is that transportation cost is relatively more important than tariff in enhancing Korea's trade. Reduction in transportation costs should therefore get utmost priority while formulating policy for Korea's infrastructure development and trade facilitation since the fall in transportation costs, as an outcome of improved infrastructure and trade facilitation, will stimulate trade.

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Keywords: Trade, Transport Cost, Tariffs, Korea, Globalisation

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1. INTRODUCTION

The last few decades have seen significant changes in economic integration. A growing number of researchers have started to reveal a long list of trade barriers that affect economic integration.[1] These barriers, as listed by Anderson and van Wincoop, broadly are

"The 170% of 'representative' trade costs in industrialized countries breaks down into 21% transportation costs, 44% border related trade barriers and 55% retail and wholesale distribution costs." (Anderson and van Wincoop, 2004)

On the other, a good number of studies have indicated that the benefits of trade liberalisation have been so far remained limited, since a large part of developing world and least developed countries (LDCs) have failed to reduce the rising trade transportation costs, both inland and international (Helble *et al*., 2007; Wilson *et al*., 2005). Another set of theoretical and empirical literature has shown that poor infrastructure and narrow trade facilitation measures have negatively affected country's trade and income.[2] This set of studies show that infrastructure development can increase exports at the intensive margin (deepening existing shipment levels) and the extensive margin (new products or destinations).[3]

About 23% of world trade by value occurs between countries that share a land border and this proportion has been nearly constant over recent decades, though it varies significantly across continents (Hummels, 2007). For trade with nonadjacent partners, nearly all merchandise trade moves by ocean and air modes. Bulk commodities like oil and petroleum products, minerals and

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[1] Refer, for example, Anderson and van Wincoop (2004), Hummels (2007).
[2] See, Limao and Veneables (2001), Wilson *et al*., (2003), Nordås and Piermartini (2004), Francois and Manchin (2006), De (2008), Brooks and Hummels (2009), to mention a few.
[3] For example, expansion through new, small shipments from small firms at the extensive margin requires different transportation infrastructure than deepening existing trade flows (Brooks and Hummels, 2009).

grains are shipped almost exclusively through ocean. Bulk cargoes constitute the majority of international trade when measured in terms of weight, but are a much smaller and shrinking share of trade when measured in value terms (Hummels, 2007). Manufactured goods are the largest and most rapidly growing portion of world trade.

This vast literature has formed the basis for much of the policy advice offered to developing countries and LDCs on trade facilitation. Its thrust has been on trade and transport facilitation steps, which are needed in order to reduce transportation costs in general, and to eliminate border delays, enhance trade efficiency, effect technological upgradation at borders and train human resources for dealing with external trade in particular. What appears is that in a highly competitive world economy, transportation cost is a significant determinant of country's trade competitiveness.

The reasons for making this study of trade costs in case of Korea relevant for trade policy makers include: on one hand, Korea's import is growing at increasing rate, where higher trade costs escalate the landed price of imports, ceteris paribus, and, on the other, Korea's trade covers an increasingly large volume of intermediate goods and finished products, where expensive imports, resulting from higher trade costs, escalate the cost of production. Therefore, understanding the trade transportation costs will help evaluate the required transportation services and trade facilitation.

One of the objectives of this paper is therefore to understand the magnitude of trade transportation costs of Korea's merchandise trade. Two important objectives are: i) to estimate the ad-valorem transportation costs for Korea's trade; and ii) to assess its impact on trade flows at a large cross-section pooled data for the years 1996 and 2006.

How is Korea doing in reducing trade costs? Which barriers matter most — tariffs or transport costs? By estimating the trade transportation costs for Korea's merchandise trade with its major trading partners at commodity levels and by using some direct and indirect evidences on trade barriers, this paper provides empirical evidence to show that an important impediment for trade expansion in Korea is high trade transportation costs. We report

evidence that the lower transportation cost is not only crucial for expanding Korea's trade but also a decisive instrument in integrating the economies engaged in international trade. The remaining part of the paper is organised as follows. Section 2 provides the model, data and methodology. Section 3 provides an illustration of composition of transportation costs in Korea. The aforesaid discussion is finally wrapped up with a formal assessment of the relationship between trade costs elements and trade flows in section 4. We attempt to measure the impact of trade costs on trade flow in a comparative static framework. Econometric results are presented and discussed in this section, followed by conclusions in section 5.

2. DEFINITION, DATA AND METHODOLOGY

In broad terms, trade costs include all costs incurred in getting a merchandise to a final user other than the cost of producing it, such as transportation costs (both freight costs and time costs), policy barriers (tariffs and non-tariff barriers), information costs, contract enforcement costs, costs associated with the use of different currencies, legal and regulatory costs, local distribution costs (wholesale and retail) and so forth.[4] This means two things. First, trade cost is measured as a mark-up between export and import prices, where this mark-up roughly indicates the relative costs of transfer of goods from one country to another. Second, trade costs are reported in terms of their ad-valorem tax equivalent.

Trade costs are generally quite large, even aside from trade policy barriers and even between apparently highly integrated economies. In explaining trade costs, Anderson and van Wincoop (2004) cited the example of Mattel's Barbie doll, as discussed in Feenstra (1998). Feenstra indicated that the production costs for the doll were US$ 1, while it sold for about US$ 10 in the United States. The cost of transportation, marketing, wholesaling and retailing represent an ad-valorem tax equivalent of 900%. Anderson and van

[4] See, Anderson and van Wincoop (2004) for a detailed discussion on trade costs.

Wincoop (2004) commented: "Tax equivalent of representative trade costs for rich countries is 170%. This includes all transport, border-related and local distribution costs from foreign producer to final user in the domestic country. Trade costs are richly linked to economic policy. Direct policy instruments (tariffs, the tariff equivalents of quotas and trade barriers associated with the exchange rate system) are less important than other policies (transport infrastructure investment, law enforcement and related property rights institutions, informational institutions, regulation, language)."

Direct evidence on border costs shows that tariff barriers are now low in most countries, on average (trade-weighted) less than 5% for rich countries, and with a few exceptions are on average between 10% and 20% for developing countries.[5] While the world has witnessed a drastic fall in tariffs over the last two decades, a whole lot of barriers remain which penalise trade. Some among them are termed as 'soft' barriers and others as 'hard' barriers. One set of such 'soft' barriers are dealt with trade and business facilitation measures, and the 'hard' set of barriers, which are often cited as physical or infrastructure barriers, are dealt with transport facilitation measures. For our understanding, the costs appearing from barriers may be termed as trade costs.

High trade costs are an obstacle to trade and impede the realization of gains from trade liberalisation.[6] Most of the studies on trade costs show that integration is the result of reduced costs of transportation in particular and other infrastructure services in general. The supply constraints are the primary factors that have limited the ability of many developing countries and LDCs to exploit trade opportunities arising from trade liberalisation. Realization of optimal gain from trade, therefore, depends not only on tariff liberalisation but also on the quality of infrastructure and related services associated with trading across borders.

The cost of international transportation is a crucial determinant of a

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[5] Based on WTO (2006a, 2007).

[6] A growing literature in this regard has documented the impact of trade costs on the volume of trade. Some seminal studies carried out on this topic in recent years are Hummels (1999, 2007), Limao and Venables (2001), Anderson and van Wincoop (2004), and Nandasiri (2008).

country's trade competitiveness. Doubling of a country's transportation costs leads to a drop in its trade by 80% or even more (Limao and Veneables, 2001). Shipping costs, the major element of transportation costs, represent a greater burden than tariffs.[7] The effective rate of protection provided by the international transport costs in many cases was found to be higher than that provided by tariffs.[8] Therefore, shipping costs represent a more binding constraint to greater participation in international trade than tariffs. Complimentary trade policies focusing inland and international transport costs have, therefore, gained immense importance in enhancing international trade and integration.

In this paper, we attempt to assess the impact of trade costs (barriers to trade) on trade flows. We are interested to understand how changes in major trade costs components affect changes in Korea's import demand. Therefore, we first estimate the impact of transport costs and other barriers to trade flows, controlling for other variables. We deal with only those barriers (components of trade costs), which are imposed by policy (e.g. transportation costs and tariff rates). To attain this objective, we first aggregate the freight rates by partner countries, which help us to estimate the ad-valorem transportation cost.

2.1. Aggregated Freight Rates

The cost of transportation of merchandise from one country to another is a combination of two major components: inland and international transportation costs. Understanding the unit freight rate in two legs of the journey — inland and international — will help us to know the variation in cost of transportation across commodities in Korea.

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[7] For a shipment of goods across border, transport costs refer to two major elements — international transport costs, which count costs associated with the shipment of goods from one country and to another, and the inland (domestic) transport costs, which consider costs of inland transportation of merchandise in both exporting and importing countries.

[8] For example, according to World Bank (2001), 168 out of 216 US trading partner, transport costs barriers outweighed tariff barriers. For the majority of Sub-Saharan African countries, Latin America and Caribbean, and a large part of Asia, transport cost incidence for exports is five times higher than tariff cost incidence.

We first derive the freight rate, which is a weighted average of all commodity groups across Korea's major trading partners for both international and inland shipments of a container from abroad to Korea. We use equations (1) and (2) to estimate the country-wise freight rate (weighted average) per container for both inland and international shipment.

$$F_{ij} = \frac{\sum_k Q_{ij}^k f_{ij}^k}{\sum_k Q_{ij}^k}, \tag{1}$$

$$F_i = \frac{1}{n}(F_{ij}), \tag{2}$$

where F_i represents the weighted average freight rate per container of country i (Korea), which is averaged over all commodity groups across all trading partners of country i, F_{ij} denotes the weighted average freight rate per container for country i for import of commodity k from country j, Q_{ij}^k stands for import of commodity k in TEU by country i from country j, f_{ij}^k represents freight rate per TEU of import of commodity k by country i from country j, k is the commodity group traded (at 4-digit HS) between partners i and j, and n is number of bilateral trading partners of i. We collect f_{ij}^k for inland and international shipment separately. F_i is estimated from 4-digit HS for imports of country i from its partner for the years 1996 and 2006.[9)]

2.2. Estimated Ad-valorem Transportation Costs

We attempt to measure the ad-valorem transportation cost for a shipment of a container from partner countries to Korea.[10)] The ad-valorem (trade-

[9)] In general, COMTRADE does not provide trade weight at 2-digit HS. It comes from 4-digit HS only. So, we have to classify the commodity groups at 4-digit HS. This classification of commodity groups follows WTO's classification, which was reported in its Annual Report 2006. See, for example, WTO (2006).

[10)] Given the formula applied here, this nomenclature is also used interchangeably as ad-valorem freight in literature.

weighted) transportation costs provide us US$ transport cost per US$ of import. We use equation (3) to estimate commodity distribution of ad-valorem transportation cost (*AdvTC*) for import of country *i* (Korea) from country *j*.

$$AdvTC_i^k = \frac{\sum_l Q_{ij}^k f_{ij}^k}{\sum_l M_{ij}^k} \times 100, \quad (3)$$

where $AdvTC_i^k$ represent ad-valorem transportation costs respectively for country *i* (Korea) for commodity *k*, Q_{ij}^k stands for import of commodity group *k* in weight (here, in TEU) by country *i* from country *j*, f_{ij}^k represents inland freight rate per TEU for import of commodity *k* by country *i* from country *j*, M_{ij}^k stands for import of commodity group *k* in value (here, in US$) by country *i* from country *j*, *k* is the commodity group traded at 4-digit HS. The transport costs are estimated for *k* commodity group for imports of country *i* from its partner for the years 1996 and 2006. Here, the ad-valorem transportation cost is estimated as percentage of total import.

2.3. Weight-Value Ratio

To evaluate the transportation needs, it is useful to compare the trade growth in relation to transport cost. We calculate weight-value ratio of Korea for its international trade with the help of equation (4).[11)]

$$w_{it} = \sum_k S_{ikt} w_k, \quad (4)$$

where w_k is the median weight/value ratio for each HS 4 digit commodity *k* in imports (exports) for the year 2006, S_{ikt} is the share of product *k* in the trade bundle of country *i* at time *t*, and w_{it} is the aggregate weight-value ratio for country *i*'s imports for the year *t*. We report the weight-value ratio

[11)] Here, methodology follows Brooks and Hummels (2009).

(measured in kg per 100 US$) for Korea's imports.

Commodity-wise fright rates for inland and international shipment were collected from Maersk Sealand (2008),[12] whereas country's imports at 4-digit HS were collected from COMTRADE (UN, 2008).[13]

2.4. The Model

In order to explore the impact of trade costs on trade flows, the following constant elasticity of substitution (CES) equation is considered.

$$U_i = \left(\sum_j \lambda_j x^{\frac{1}{\theta}} \right)^{\theta}, \tag{5}$$

where i and j are importing and exporting countries, respectively, $\theta = \sigma / (1-\sigma)$. We treat λ is a quality shifter specific to exporter j, or, in other words, it represents the number of unique varieties being produced by exporter j. We write the import demand for a product is as follows.

$$q_{ij} = E_i \left(\frac{\lambda_j}{p_j} \right)^{\sigma} t_{ij}^{-\sigma}, \tag{6}$$

where q_{ij} is value of import of i from j, t is trade cost component, E is real expenditures on a product (expenditures divided by the price level), which

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[12] The usual caveat is that the freight rates offered in Mearsk Sealand (2007), which we have considered in this paper, are the gross rates and not the negotiated rates that the shipping line entered into. Negotiated rates are happened to be lower than the gross rates.

[13] Systematic data on Asia's import by origin and commodity are not available. The problem becomes more acute when one searches trade in weight in TEUs. As a result, we had to rely on Maersk Sealand for freight rates of commodities at bilateral level. Since COMTRADE does not provide trade in TEU, we had to convert the weight in kg into weight in TEU. This was done based on author's personal communication with International Navigation Association (PIANC), Brussels. The conversion rate we used here was 12,000kg ≅ 1TEU to get a loaded 20' container (popularly known as FCL), sourced from PIANC.

we do not observe but proxy it by country's GDP.[14] Similarly, λ / p are not observable due to poor quality of measures of *p*, and also contaminated by quality differences.[15] We want prices net of quality differences and quality itself, but we cannot observe those. We want to control for a demand shifter that is exporter specific — Korea is different from China, certainly in its size and probably in the quality of the products it makes so we want to keep that out. Therefore, we have to omit those things we can not observe. We take care this in following ways.

First, we take a log and use a vector of importer and exporter fixed effects. We get equation (7).

$$\ln q_{ij} = \ln E_i + \sigma \ln\left(\frac{\lambda_j}{p_j}\right) - \sigma \ln t_{ij}. \tag{7}$$

Second, we replace t_{ij} by ad-valorem transportation cost. We write the trade cost vector as follows.

$$t_{ij} = TAR_{ij}\, f_{ij} = TAR_{ij}(F_{ij} / V_{ij}), \tag{8}$$

where f_{ij} is the ad-valorem equivalent of the transport cost, F_{ij} is the freight cost in TEU and V_{ij} is the import value per TEU. Since our purpose is to assess the impact of trade cost components on trade over time, we consider two cross-section years, namely, 1996 and 2006. We rewrite the equation (6) as follows.

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[14] The reason is that if all goods are consumed as a constant fraction of GDP and price levels do not vary, but we do not see the expenditure shares or the price levels. In particular, the main way that international production sharing shows up here is that *E* varies a lot across countries as a function of what they are producing — a country makes lot of cars it demands an unusually large amount of car parts and components.

[15] For example, a high price for a product may reflect higher production costs, or it may just reflect quality differences.

$$\frac{q_{ij2006}}{q_{ij1996}} = \frac{E_{i2006}\left(\frac{\lambda_{j2006}}{p_{j2006}}\right)^{\sigma} t_{ij2006}^{-\sigma}}{E_{i1996}\left(\frac{\lambda_{j1996}}{p_{j1996}}\right)^{\sigma} t_{ij1996}^{-\sigma}}. \tag{9}$$

By taking log, we get

$$\ln\frac{q_{ij2006}}{q_{ij1996}} = \ln\left(\frac{E_{i2006}}{E_{i1996}}\right) + \sigma\ln\left(\frac{\frac{\lambda_{j2006}}{p_{j2006}}}{\frac{\lambda_{j1996}}{p_{j1996}}}\right) - \sigma\ln\left(\frac{t_{ij2006}}{t_{ij1996}}\right). \tag{10}$$

We incorporate exporter fixed effects to take care expenditures or the quality or the price parameters, and rewrite it as follows.

$$\ln\frac{q_{ij2006}}{q_{ij1996}} = \alpha + A_j - \sigma\ln\left(\frac{t_{ij2006}}{t_{ij1996}}\right). \tag{11}$$

Now, we substitute the trade costs elements by tariff (TAR_{ij}) and transport cost (TC_{ij}), and rewrite the equation (10) as follows.

$$\ln\frac{q_{ij2006}}{q_{ij1996}} = \alpha + A_j - \sigma\ln\left(\frac{TAR_{ij2006}}{TAR_{ij1996}}\right) - \sigma\ln\left(\frac{TC_{ij2006}}{TC_{ij1996}}\right) + \varepsilon_{ij}, \tag{12}$$

where i and j are importing (Korea) and exporting countries. Tariff represents weighted applied rate whereas transport cost is taken at ad-valorem equivalent. The parameters to be estimated are denoted by α, σ, and ε_{ij} is the error term.

The model considered here uses data for the years 1996 and 2006 at 4-digit HS for Korea's imports from her 30 major trade partners. The model

considers data at the bilateral level for all the variables for their individual partners. By taking tariffs and transport costs, we cover a major portion of trade costs. Bilateral trade, transport costs, and tariffs are estimated from 4-digit HS for the years 1996 and 2006. While bilateral trade was collected from COMTRADE, tariff was sourced from WITS (World Bank, 2008).

3. IMPORTANCE OF TRANSPORTATION COSTS

Here we examine the level and variation of freight rates at disaggregated commodity levels. We deal with this analysis as follows: first, we aggregate the freight rates and its composition, and second, we estimate the transportation costs in order to understand its relative importance in trade flows.

In general, the trade volume in Korea has been rising very rapidly. A majority of Korea's import in goods is intermediate goods, feeding the country's production or import demand when variations in trade costs could be crucial for the country's international competitiveness in manufactures. Reduction in trade costs is therefore likely to help Korea get its goods to markets more quickly and cheaply.

However, the problem gets multiplied when one attempts to measure 'price' and 'non-price' barriers to trade.[16] Hummels (1999) commented: "Beginning with tariffs and proceeding to international and domestic transportation costs, time, and information, it is not difficult to understand a credible impact of trade costs on international trade. However, the difficulty lies in directly measuring acceptable indicators of cross-country differentials in 'price' and 'non-price' factors in general, which are traditionally seen as two major determinants of cross-country variations in trade costs." Absence of compatible quantitative information on elements of trade costs restricts

[16] In literature, 'non-price' term was also used as infrastructure variable to facilitate the understanding of the importance of trade costs or the scope of trade costs.

researchers from venturing into trade and transportation costs study for the continent. Korea does not compile information on import and export by transport modes and commodity groups as is done in the US.[17] As a result, researchers rely on proxy of transport costs, and sometime on indirectly measured non-price factors while assessing barriers to trade flows.

3.1. Aggregated Freight Rates

The cost of transportation of merchandise from one country to another is a combination of two major components: inland and international transportation costs. Understanding the unit freight rate will help us to know the variation in cost of transportation across Korea's trade partners.

We first derive country-wise freight rate, which is a weighted average of all commodity groups across all trading partners for both international and inland shipments of a container to Korea. We use equation (1) to aggregate the country-wise import freight rate (weighted average) per container for ocean shipment. Table 1 provides aggregated freight (F_i) per container for the year 2006.[18] Following observations are worth noting.

First, the aggregated import freight rate varies across countries. Table 1 and figures (1a, 1b) show that cost of inland freight is much higher in Korea, compared to international freight.

Second, the variation in ocean freight across countries and commodities presumably has much to do with terminal handling charges (THC) and auxiliary shipping charges. On an average, auxiliary shipping charges are much higher than THC across commodities and countries. They are

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[17] For example, US Census Bureau provides periodically US imports data at 10-digit HS level by origin countries. US Department of Transportation supplies US imports by HS, transport modes and origin countries and destination provinces, besides the information on value and volume of imports.

[18] The rates are spot rates and collected for shipment of a 20' container (TEU) between the major container ports of origin and destination countries from the historical freight rate database. Rates are quarterly averaged for the years 2000 and 2005, and include container handling charges, documentation fees, government taxes and levies, etc. of both the trading partners. For details of ocean freight components, please refer De (2007).

Table 1 Estimated Freight Rates in 2005

Importer	Exporter	Total Freight Rate (US$ /TEU)	Inland Freight		International Freight	
			Rate (US$ /TEU)	Share# (%)	Rate (US$ / TEU)	Share# (%)
Korea	China	1475	879	60	596	40
	India	3420	1866	55	1554	45
	Indonesia	1862	1162	62	700	38
	Japan	1247	369	30	878	70
	Malaysia	1594	1063	67	531	33
	Thailand	1534	955	62	579	38
	Total*	1855	1049	57	806	43

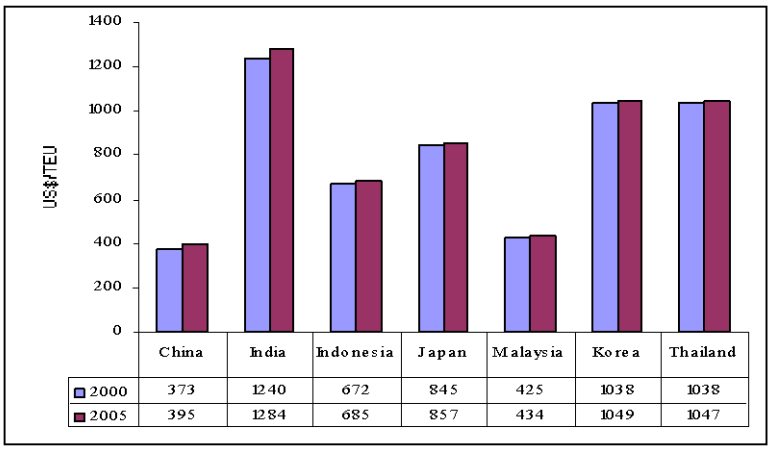
Notes: * Weighted average over all partners. # Share in total freight.

exceptionally high in Korea (table 2). Quite naturally, imports of manufactures like electronics, and office and telecom equipment, which come in containers and have relatively high shares in total imports, cost more in Korea than the traditional commodities. Why the international freight per container is so expensive in case of Korea? Perhaps, it is due to high auxiliary shipping charges, US$ 511 per TEU, [19] at Korean ports.

Third, the aggregated inland freight rates in Korea are comparatively higher than their comparable international freight rates. However, the most of the Asian countries (excluding Thailand) show an opposite scenario: their international freight rate is higher than their inland freight rate. Taking the total transportation leg, the cost of inland transportation takes the major

[19] Auxiliary shipping charges represent several explicit and implicit fees. For example, it covers all shipping charges other than basic ocean freight such as peak season surcharge, congestion surcharge, Bunker Adjustment Factor (BAF), Yen Appreciation Surcharge (YAS), Fuel Adjustment Factor (FAF), and delivery order, etc., which often make the shipping between the countries costlier (De, 2007).

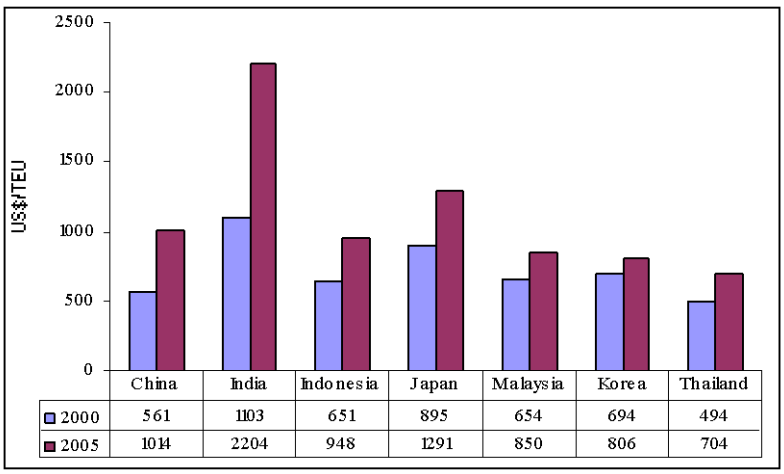
Figure 1a Inland Freight (Weighted Average) per Container



	China	India	Indonesia	Japan	Malaysia	Korea	Thailand
2000	373	1240	672	845	425	1038	1038
2005	395	1284	685	857	434	1049	1047

Note: Weighted average over all partners.

Figure 1b International Freight (Weighted Average) per Container



	China	India	Indonesia	Japan	Malaysia	Korea	Thailand
2000	561	1103	651	895	654	694	494
2005	1014	2204	948	1291	850	806	704

Note: Weighted average over all partners.

shares in Thailand and Korea, compared to other Asian countries. For others, it is the international freight which matters most.

Four, the combined incidence of THC and auxiliary shipping charges is higher in case of high-value manufactures such as electronic integrated circuits, office and telecom equipment, and electrical and electronics items

Table 2 Terminal Handling Charge (Weighted Average) and Auxiliary Shipping Charges (Weighted Average) in 2005

Terminal Handling Charge		Auxiliary Shipping Charges	
Commodity Groups	Korea (US$ /TEU)	Commodity Groups	Korea (US$/TEU)
Electronic Integrated Circuits	252	Electronic Integrated Circuits	466
Office and Telecom Equipment	251	Office and Telecom Equipment	530
Fuels, Mining and Forest Products	316	Electrical and Electronics	537
Food Products	363	Fuels, Mining and Forest Products	518
Electrical and Electronics	247	Food Products	573
Chemicals	249	Textile and Clothing	545
Textile and Clothing	264	Leather	565
Paper and Pulp	327	Pharmaceuticals	458
Pharmaceuticals	243	Chemicals	485
Leather	255	Metal	558
Rubber and Plastics	270	Machinery and Mechanical Appliances	491
Metal	251	Automobiles and Components	497
Automobiles and Components	244	Rubber and Plastics	474
Machinery and Mechanical Appliances	238	Iron and Steel	478
Iron and Steel	235	Paper and Pulp	477
Transport Equipment	225	Transport Equipment	460
Country Total (WA)	295	Country Total (WA)	511

Note: WA stands for weighted average.

than traditional commodities and mining and forest products. These are the items which crucially determine Korea's export competitiveness.

3.2. Estimated Ad-valorem Transportation Costs

Transportation cost in ad-valorem terms is the cost of shipping relative to the value of the good. This is equivalent to the percentage change in the delivered price as a result of paying for transportation. Here, we measure the ad-valorem transportation cost for import of a container to Korea using the

Table 3 Ad-valorem Transportation Costs (Trade Weighted) in 2006

Commodity Groups	Korea (% of Import Value)
Transport Equipment	11.80
Automobiles and Components	6.70
Chemicals	10.80
Electrical and Electronics	6.60
Electronic Integrated Circuits	8.24
Food Products	17.90
Fuels, Mining and Forest Products	40.21
Iron and Steel	12.50
Leather	2.20
Machinery and Mechanical Appliances	8.30
Metal	12.00
Office and Telecom Equipment	6.40
Paper and Pulp	13.90
Pharmaceuticals	7.00
Rubber and Plastics	4.30
Textile and Clothing	2.90
Country Total	14.90

Note: Weighted average for Korea's 30 bilateral trade partners.

equation (3).[20] Table 3 provides evidence on the level and distribution of ad-valorem transportation costs by commodity for the year 2006. Following broad features appear.

First, the ad-valorem transportation costs vary across commodities. The ad-valorem transportation cost for import of all goods is about 14.90% of import value.

Second, cost of shipping (relative to the value of the good) is comparatively lower in case of Korea's import from adjacent countries.

Third, transportation costs are lower for manufactured goods, than for traditional commodities. Fuels, mining and forest products incur the highest transportation costs, due mainly to higher weights.

Fourth, the transportation costs for imports of high-end manufactures such as electrical and electronics, office and telecom equipment, and electronic integrated circuits in Korea is comparatively low.

3.3. The Weight to Value Ratio of Trade and Transport Cost

The changing composition of Korea's trade has become an important issue. The weight-value ratio of a product is the major determinant of the transportation expenses a country faces (Hummels and Skiba, 2004).[21] For example, the cost of transportation of heavier goods would certainly be higher than lighter goods. If a country (or a region) is a net importer of weights, it will be having a net deficit in transportation costs.[22] Since Korea's major import partners are nonadjacent, it would be worthwhile to understand the relationship between transport cost and weight-value ratio, which will help us evaluate the transportation needs in Korea more prominently. We estimate the weight-value (measured in kg per 100 US$) for Korea's import and export with the help of equation 4. The results are reported in tables 4 and 5. Followings are some important observations.

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[20] Given the formula applied here, this nomenclature is also used interchangeably as ad-valorem freight in literature.

[21] For example, Hummels and Skiba (2004) commented that a 10% increase in product weight-value leads to a 4% increase in ad-valorem shipping cost.

[22] This is ideally true if the trade is undertaken at cost, insurance and freight (*cif*) price.

Table 4 Estimated Weight-Value Ratio (kg/100 US$)*

Commodity Groups	Import		Export	
	1996	2006	1996	2006
Agriculture and Food Products	16.47	9.08	1.23	0.56
Chemicals	6.69	4.42	5.52	5.45
Electrical and Electronics	0.39	0.44	1.64	1.04
Iron and Steel	13.67	10.07	8.32	6.08
Leather	0.31	0.12	0.23	0.05
Machinery and Mechanical Appliances	0.73	0.52	0.83	1.04
Metal	1.81	2.33	0.55	0.82
Paper and Pulp	2.99	1.50	1.16	0.98
Rubber and Plastics	0.80	0.69	3.97	3.42
Textile and Clothing	0.43	0.32	2.01	0.77
Transport	1.03	0.52	14.03	4.35

Note: * Trade weighted over Korea's 25 major trading partners.

Korea's imports are comparatively heavy in agriculture and food product, and iron and steel, which are basically heavier raw materials and intermediate products used as inputs for production. In other words, Korea is importer of weights in semi-finished goods and raw materials. Weights for imports of most of the commodities, except metal and electrical and electronics, have been reduced over time, while we found a similar trend in case of export, except machinery and mechanical appliances. Therefore, what emerges from the product classification is that Korea's merchandise trade by and large is shifting from heavier goods to lighter goods.

However, there is a clear variation in W-V ratio across Korea's trade partners (table 5). While Korea's imports from Australia are bulky and heavier products thereby costing good amount towards transportation, exports to its partners are relatively less bulky and heavier. Tally between total import and export of W-V ratio clearly shows that, in relative terms, Korean imports are associated with larger weights, implying high transport congestion and subsequently high ad-valorem transportation costs.

Table 5 Estimated Weight-Value Ratio by Partner (kg/US$) in 2006*

Partner	Import	Partner	Export
Australia	0.227	China	0.102
China	0.181	USA	0.048
Saudi Arabia	0.139	Japan	0.047
Indonesia	0.107	Hong Kong	0.015
UAE	0.083	Indonesia	0.012
Japan	0.079	Singapore	0.012
USA	0.060	Australia	0.008
Kuwait	0.058	India	0.008
Brazil	0.053	Thailand	0.007
Qatar	0.044	Viet Nam	0.007
Russia	0.038	Malaysia	0.007
Iran	0.037	Philippines	0.005
Malaysia	0.034	Russia	0.004
Oman	0.033	Chile	0.004
Canada	0.026	Liberia	0.004
India	0.023	Iran	0.004
New Zealand	0.011	Germany	0.004
Thailand	0.009	Netherlands	0.004
Brunei	0.009	Mexico	0.004
Chile	0.008	Saudi Arabia	0.004
South Africa	0.007	Greece	0.003
Iraq	0.007	Canada	0.003
Congo	0.005	South Africa	0.003
Viet Nam	0.005	UAE	0.003
Peru	0.005	Panama	0.003
Mexico	0.004	Nigeria	0.003
Nigeria	0.004	Bangladesh	0.003
Egypt	0.004	Italy	0.002
Cameroon	0.003	Turkey	0.002
Algeria	0.003	UK	0.002
Argentina	0.003	Belgium	0.002
Singapore	0.003	Cyprus	0.002
Germany	0.003	Brazil	0.002
Yemen	0.003	Spain	0.002
Philippines	0.003	New Zealan	0.001

UK	0.002	France	0.001
Ukraine	0.002	Guam	0.001
France	0.002	Pakistan	0.001
Netherlands	0.001	Kenya	0.001
Sudan	0.001	Bahamas	0.001
Bahrain	0.001	Egypt	0.001
Bolivia	0.001	Qatar	0.001
Angola	0.001	Kuwait	0.001
Venezuela	0.001	Malta	0.001
Pakistan	0.001	Colombia	0.001
Italy	0.001	Ukraine	0.001
Kazakhstan	0.001	Norway	0.001
Spain	0.001	Poland	0.001
Belgium	0.001	Ghana	0.001
Jordan	0.001	Ecuador	0.001
Morocco	0.001	Peru	0.001
Poland	0.001	Venezuela	0.001
Sweden	0.001	Israel	0.001
Total Import	1.358	Total Export	0.391

Notes: * Trade weighted, ** All partners.

4. ASSESSING BARRIERS TO TRADE IN KOREA

The model considered here uses bilateral import data for the years 1996 and 2006. By taking transportation costs and tariff, we cover a major portion of trade costs. Before estimating the models, we obtained a matrix of correlation coefficients to rule out any possibility of multicollinearity problems.[24] The log-linear type equation has been estimated using both OLS and GLS regressions. The random effect has turned out to be the proper model fitting for the data, as per the Hausman (1978) specification test.[25]

[24] We avoid placing partial correlation coefficients of the variables due to lack of space. The same would be made available to interested readers on request.

[25] The Hausman test tests the null hypothesis that the coefficients estimated by the efficient random effects estimator are the same as the ones estimated by the consistent fixed effects estimator. If they are (insignificant *P*-value, Prob.>chi 2 larger than 0.05) then it is safe to use random effects. We have used Stata 10.

Table 6 Non-linear Least Squares Estimates of Import Demand

	OLS[1)]		GLS[2)]	
	Model 1	Model 2	Model 3	Model 4
Transport Cost (ad-valorem equivalent)	–1.008 (–4.774)*	–1.028 (–5.310)*	–1.214 (–4.940)*	–1.230 (–5.250)*
Tariff (weighted applied)	–0.112 (–0.740)		–0.153 (–0.689)	
R^2	0.719	0.756	0.771	0.759
Wald χ^2			26.72	26.50
Prob>χ^2			0.00	0.00
No. of Observations	30	30	30	30

Notes: 1) Fixed effect.
2) Random effect.
* Significant at 1% level. Here, *t*-values are given in first bracket, whereas *z*-values are given in third bracket. Country fixed effects are included in the model.

Table 6 reports OLS and GLS estimates of equation (12). We expect that the tariff and ad-valorem transport cost variables are negatively correlated with the volume of imports. Variables being in natural logarithms, estimated coefficients show CES elasticity. The elasticity is useful both as an indicator of the effect of trade barriers on trade volumes. The model performs well as most of the variables do have expected signs.

The econometric evidence seems to strengthen the existing linkage of trade costs and trade flows: higher the transportation costs between each pair of partners, less they trade. In our case, it is seen that a 10% fall in transportation costs has the effect of increasing Korea's import by about 12% (in models 3 and 4). Although as per the specification tests, random effect turned out to be the appropriate model, we have run the fixed effects estimation as well and compared between the OLS and GLS R^2. We could see that a marginal improvement in overall goodness of fit of the GLS estimation (77.1% in model 3), compared to OLS (71.9% in model 1). The REMs report values of Wald χ^2. The reported χ^2 value of 26.72 in model 3 is

highly significant with the probability>χ^2 (=0.0000). Taken jointly, our model shows almost a perfect fit.

The estimated model explains about 77% of the variations in direction of trade flows. The most interesting result is the strong influence that changes in ad-valorem transportation cost had on changes in trade: higher the transportation cost between each pair of partners, less they trade. In other words, the estimated elasticity indicates that a 10% rise in ad-valorem transportation cost lowers trade by 12% in Korea.

The estimated models also indicate that tariff does not influence the trade flow since all its estimated coefficients have appeared as statistically insignificant. Perhaps, there were not much significant changes in applied tariffs between 1996 and 2006. The insignificance of tariff is of the fact that both transportation cost and tariff work in same direction with trade flow and hence tariff has been overshadowed by transportation cost in the regression models. Omitted variable bias could be the plausible reasons for insignificance of transit time.

From the estimated elasticities and their significance level, it can be concluded that transportation cost is more important than tariff, ceteris paribus, in enhancing Korea's trade. This also directly indicates that there is a huge infrastructure bottleneck inside Korea in general. This calls for immediate attention in order to enhance Korea's trade flows.

The estimates also seem to show that the size of the effects does not vary widely. The usual caveat is that R^2 reported in the table 6 indicate that the equation (12) explain only 1/3rd of the variation in trade flows. Perhaps the omitted variable bias could be the plausible reasons for such a fit.

5. CONCLUSIONS AND POLICY IMPLICATIONS

The analysis carried out in this paper provides sufficient evidence to emphasize that variations in transportation costs have significant influence on Korea's trade. There are two major advancement of this study: First, we

introduce bilateral ocean freight that we believe have an impact on trade. Second, we introduce ad-valorem transportation costs at bilateral level, which are largely ignored in the empirical literature in the context of Korea. One of the conclusions of this paper is that transportation cost is more important than tariff, ceteris paribus, in enhancing Korea's import.

Trade transaction costs have an equally strong catalytic role in enhancing Korea's trade. Korea need to take serious measures aimed at reducing "behind the border" and "at the border" costs of exports, which can be expected to have significant impact on the country's trade. Trade facilitation is an essential measure to decrease the cost and time required for trade across borders. A surge in trade transaction barriers could take a very long time to clean up and would adversely affect Korea's trade for years to come.

Reduction in transportation costs should therefore get priority attention while formulating policy for Korea's infrastructure development and trade facilitation. The challenge for Korea is thus to identify improvements in trade facilitation, logistics services and related infrastructure that can be achieved in the short-to-medium term and that would have a significant impact on trade competitiveness of Korea.

The future research agenda should be carried out to understand how trade has moved in Korea in the second era of globalisation. Hummels (2007) noted: "a dollar of traded merchandise weighs much less today than in previous years". In other words, a fall in the weight/value ratio of trade leads to more air transport. It would be useful to study whether or not Korea trades more in lighter goods with nonadjacent partners which travel via air.

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