# ON THE COSTS OF
# INTERNATIONAL TRADE AND INVESTMENT

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Tran Thi Thu Trang

In some parts of the world today, consumers can shop from home by surfing the internet. After a click to buy, the goods will be delivered to their doors, sometimes within a day. This seamless movement of goods and information is thanks to reduced trade costs. International transportation costs declined by 17 percent between 1995 and 2016.[1] The average tariff rates have decreased from about 15 percent at the beginning of the 1990s to about five percent in the 2000s.[2]

Despite the declining trend, trade costs are still prevalent and prone to political and natural shocks. For example, the rise of the US's protectionism has pushed the weighted average tariff of the US from around 1.6 percent to a record high of 13.8 percent in 2019. During the second half of the COVID-19 pandemic, the price of sending one container from East Asia to the US's west coast rose eight times, causing distress for the global supply chain. Anderson and Van Wincoop (2004) estimates that the total trade costs can be as large as 170 percent tariff equivalent. Among these, transportation costs are about 21 percent tariff equivalent, including freight costs (12 percent) and time costs (9 percent). The border-related trade barriers are about 44 percent tariff equivalent, and local retail and wholesale distribution are about 55 percent tariff equivalent.

While trade costs have been studied extensively in the trade literature (Anderson and Van Wincoop, 2004), there are still many areas for more exploration. In particular, this dissertation tries to answer three questions. First, how much is the

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[1] Author's calculation based on OECD's International Transport and Insurance Costs of Merchandise Trade database.

[2] World Bank's estimates.

consumer's value of timeliness? Second, how often do sellers send their shipments to the buyer? Third, where do multinational firms locate their subsidiaries? The first two questions focus on the relationship between transportation costs and trade flows, while the third question focuses on the role of information costs on Foreign Direct Investment (FDI).

### The Value of Time in International Container Trade

The literature is started from the works of Hummels (2007) and Hummels and Schaur (2013). They utilized the variation of exporters to the US in choosing between air or ocean transport to estimate the time premium of air transport over ocean transport. Because goods transported by air and ocean are potentially different in quality and finding an appropriate instrument is not easy, these estimates can be improved by considering one mode of transportation. Utilizing fuel price spikes during the first ten years of the 2000s, this study provides a new estimate for the value of timeliness in international container trade.

In the theoretical model, the consumer's value of timeliness is modeled into the Armington-Anderson trade model,[3] and shipping companies choose the optimal delivery time in response to a change in fuel prices. The theoretical framework explains the mechanism for high prices to affect trade through the adjustment of shipping speed in the shipping sector ("slow steaming"). When fuel prices increase, the ship can adjust delivery days and freight costs. The change in delivery days affects consumers as if there is a decrease in the quality of goods.

The model is then tested using data on ship movement. Estimates of the elasticity of delivery days with respect to fuel prices were shown to depend on ship sizes. The average elasticity at the sample means $4,437$ TEU is 0.5. On average, a ten percent increase in fuel prices increases delivery days by five percent. This translates to a delay of one day on the trade route between East Asia and North America (with an average delivery time of 20 days).

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[3]Anderson and Van Wincoop (2003)

The value of timeliness is estimated by using the Instrumental Variable (IV) method. The IV considers the response of ships to high fuel prices and the composition of ship sizes for different trade routes. The trade elasticity of delivery days is estimated to be about $-0.0814$. A one percent delay in delivery is equivalent to an additional one percent tariff. On the East Asia - North America trade route (with an average delivery time of 20 days), one delayed day adds a five percent tariff. Between 2010 and 2011, fuel prices increased by 36 percent. This causes delays of 22 percent on average.

The study also shows geographical differences in ships' responses to high fuel prices. Slow steaming does not happen in regional trade routes because it's easier to adjust schedules to respond to high fuel prices due to shorter distances. Among inter-regional trade routes, the slow steaming effects in the North-South group are twice as high as in the East-West group. It is because ship sizes on the East-West route are slightly bigger than that of the North-South, and the fuel consumption coefficient is higher for larger ships.

Changing functional forms of delivery days from constant to variable elasticity shows slightly different results. The trade elasticity of delivery days is $-0.0087Day$. On the East Asia - North America trade route, the elasticity becomes $-0.175$. In general, the time value estimates are smaller than in the literature. This is because previous literature measures the premium between air and ocean transportation, whereas this study measures the variation within the container shipping sector. This result by no means discredits the importance of time costs in international trade. On the contrary, it shows that time costs are present even after controlling for the quality of goods. Consumers are very sensitive to delivery time.

The study contributes to the literature in several ways. First, it is the first study to discuss a different channel for fuel prices to affect container trade: that is, through speed adjustment in the shipping sector. Second, it is the first study to provide a credible instrument variable to control for the quality elements in delivery days. Third, it shows the potential of using new types of data (ship movement data)

in exploring the patterns of trade costs in international trade.

## Trade Costs and Different Margins of Trade

This chapter explores the value of timeliness for final producers. Unlike final consumers, producers buy intermediate goods not to consume but to produce and sell them to the customers. This involves decisions on how much input to stock, how much to produce, and which buyers to sell to. The time costs for these producers are related to the cost of storing intermediate inputs and the associated opportunity costs of idle capital. If the costs per shipment for these intermediate inputs are minimal, they can have them shipped continuously to eliminate storage costs and reduce opportunity costs. While some multinational firms have succeeded in doing so by integrating the logistics system into their business models, most firms still have to pay shipment costs and balance shipment frequency and shipment size.

Studies on shipment frequency and shipment size have been explored by many authors, including Hornok and Koren (2015) and Kropf and Sauré (2014). These models share a similar concept that consumers value the timeliness of shipment, but each shipment incurs a fixed cost. The optimal frequency ultimately depends on the trade-off between this fixed cost and the cost of holding inventory. On the other hand, trade literature also emphasizes the importance of firms' heterogeneity in shaping trade patterns (Melitz, 2003; Chaney, 2008; Bernard, Moxnes, and Ulltveit-Moe, 2018). The natural extension is to investigate how buyers' heterogeneity affects the decision of sellers on shipment frequency and shipment size in responding to the change in trade barriers.

This study models time preference[4] in the profit function of intermediates heterogeneous buyers.[5] The results show that iceberg trade costs affect trade directly through sales and indirectly through shipment frequency and the number of buyers. Shipment cost effects are only through the adjustment of shipment frequency. Sellers with a small number of shipments may reduce shipment size even when iceberg

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[4]Kropf and Sauré (2014)

[5]Bernard, Moxnes, and Ulltveit-Moe (2018)

trade costs decrease. This happens if the adjustment through shipment frequency dominates the sales effects. The theoretical models also provide testable hypotheses, which are examined using the Bill of Lading dataset.

The empirical analysis is carried out by estimating the gravity-like equation for the seller level and the buyer-seller level. The empirical results confirm that trade barriers reduce firms' trade volume and shipment frequency, and the number of buyers. Shipment costs may increase the average shipment size of a seller when the number of shipments is low, as predicted from the theoretical model.

The results also highlight the importance of buyer margins. While the effects of trade barriers on trade volume are mainly from an increase in shipment frequency rather than shipment size, more than half of an increase in shipment frequency is from an increase in the number of buyers. This is a new insight that has not been explored in the literature on shipment frequency.

The study contributes to the literature in several ways. First, it is the first study to examine the role of buyer heterogeneity in the decision of shipment frequency and size. Second, it shows the potential of using the bill of lading dataset in examining the relationship between exporters and importers at the firm level.

### Trade Costs and Multinational Firms' Location Decision

This chapter departs from transportation costs to investigate information costs[6] in the location decision of multinational firms. Recent literature has pointed out the importance of multinational firms in shaping trade patterns through foreign affiliates, it is crucial to study the impact of trade costs not only on trade but also on investments. There has been a vast body of literature studying the role of trade costs in FDI's location decision (Alfaro and Chen, 2018). Trade costs generally decrease the flow of investment,[7] except for horizontal FDI.[8] The FDI literature

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[6] Anderson and Van Wincoop (2004) categorizes this information cost barrier as a part of the border-related trade barrier, which is about six percent tariff equivalent.

[7] These includes vertical FDI (Helpman, 1984) complex FDI (Yeaple, 2003), export platform FDI (Ekholm, Forslid, and Markusen, 2007), merger and acquisitions (Head and Ries, 2008).

[8] Markusen (1984) is one of the first studies.

distinguishes itself from the trade literature in the role of knowledge capital. The traditional assumption is that multinationals' advantage in the unrestricted use of this joint input among subsidiaries is the motivation to invest instead of export. Recent studies by Keller and Yeaple (2013), however, show that FDI's knowledge content does follow the law of gravity. Proximity is crucial for sharing knowledge.

While there have been many papers examining the benefit of proximity in the context of manufacturing plants not many papers have examined the effects on wholesale subsidiaries. The fourth chapter applies this idea to examine the relative locations between manufacturing plants and wholesale subsidiaries.

The analysis framework highlights the importance of "information sharing" not only in manufacturing plants but also in wholesale subsidiaries. The hypothesis is that regional information costs can be reduced if more service firms connect these regions. This concept is examined through the decision on the location of manufacturing plants and wholesale subsidiaries of Japanese firms in the EU. The results show that Japanese firms tend to locate their wholesale subsidiaries in a region with many other Japanese service firms, even after controlling for industry and financial group agglomeration index. Manufacturing plant locations, however, do not always follow the same patterns. This shows that information is particularly important for wholesale subsidiaries, possibly to reach potential customers through other Japanese service firms.

The study contributes to the literature in several ways. First, it confirmed the importance of "information sharing" in the location decision of Japanese multination firms (Blonigen, Ellis, and Fausten, 2005). Second, it highlights the difference in location patterns between manufacturing plants and wholesale subsidiaries.

In conclusion, this dissertation examined the role of trade costs in international trade and investment. While there has been extensive literature on this topic, the availability of microdata brought insights into these matters. Many improvements can be made for future analysis. In chapter two, the availability of data on freight costs can improve the accuracy of the estimation. In chapter three, more detailed

data on the relationship between buyers and sellers could shed light on different patterns of shipments. In chapter four, a global firm dataset could show different behaviors due to firms' nationalities and regional characteristics. Furthermore, data on intra-firm trade could be useful for examining the interaction between firms' subsidiaries.

## Referernces

Alfaro, Laura and Maggie Xiaoyang Chen (2018). "Transportation cost and the geography of foreign investment". In: *Handbook of International Trade and Transportation*. Edward Elgar Publishing, pp. 369–406.

Anderson, James E. and Eric Van Wincoop (2003). "Gravity with Gravitas: A Solution to the Border Puzzle". In: *American Economic Review* 93.1, pp. 170–192.

— (2004). "Trade Costs". In: *Journal of Economic Literature* 42.3, pp. 691–751.

Bernard, Andrew B., Andreas Moxnes, and Karen Helene Ulltveit-Moe (2018). "Two-Sided Heterogeneity and Trade". In: *Review of Economics and Statistics* 100.3, pp. 424–439.

Blonigen, Bruce A., Christopher J. Ellis, and Dietrich Fausten (2005). "Industrial groupings and strategic FDI". In: *Japan and the World Economy* 17.2, pp. 125–150.

Chaney, Thomas (2008). "Distorted gravity: The intensive and extensive margins of international trade". In: *American Economic Review* 98.4, pp. 1707–1721.

Ekholm, Karolina, Rikard Forslid, and James R. Markusen (2007). "Export-Platform Foreign Direct Investment". In: *Journal of the European Economic Association* 5.4, pp. 776–795.

Head, Keith and John Ries (2008). "FDI as an outcome of the market for corporate control: Theory and evidence". In: *Journal of International Economics* 74.1, pp. 2–20.

Helpman, Elhanan (1984). "A Simple Theory of International Trade with Multinational Corporations". In: *Journal of Political Economy* 92.3, pp. 451–471.

Hornok, Cecília and Miklós Koren (2015). "Administrative barriers to trade". In: *Journal of International Economics* 96.1, pp. 110–122.

Hummels, David (2007). "Transportation Costs and International Trade in the Second Era of Globalization". In: *Journal of Economic Perspectives* 21.3, pp. 131–154.

Hummels, David and Georg Schaur (2013). "Time as a Trade Barrier". In: *American Economic Review* 103.7, pp. 2935–2959.

Keller, Wolfgang and Stephen Ross Yeaple (2013). "The Gravity of Knowledge". In: *American Economic Review* 103.4.

Kropf, Andreas and Philip Sauré (2014). "Fixed costs per shipment". In: *Journal of International Economics* 92.1, pp. 166–184.

Markusen, James R. (1984). "Multinationals, multi-plant economies, and the gains from trade". In: *Journal of International Economics* 16.3-4, pp. 205–226.

Melitz, Marc J. (2003). "The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity". In: *Econometrica* 71.6, pp. 1695–1725.

Yeaple, Stephen Ross (2003). "The complex integration strategies of multinationals and cross country dependencies in the structure of foreign direct investment". In: *Journal of International Economics* 60.2, pp. 293–314.