Container Cabotage Policy and its Impact on Western Canadian Pulse Exports: A Gravity Model Approach

BY

Erica Vido

A Thesis/Practicum submitted to the Faculty of Graduate Studies of The University of Manitoba in partial fulfillment of the requirements of the degree

of

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Acknowledgements

Completing this thesis was one of the most significant accomplishments of my life to date. Looking back I recognize that my thesis has benefited from the intellectual guidance, unselfish efforts and personal and financial support of many individuals.

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To my parents, Blaza and Rudy, in addition to your patience and guidance, your financial support has made this thesis possible. Thank you for being such great parents. To Marc and Marcy, my two best friends, thanks for your patience and encouragement. Finally, I would be remiss if I failed to acknowledge the contribution of my best friend and life partner, Andrea. Your confidence, patience and encouragement have been of immeasurable importance.

Abstract

Containerized shipping of specialty agricultural products from western Canada is hampered by the high costs of obtaining empty equipment. An avoidable barrier to cost-effective container shipping is the out-dated Customs regulations on container cabotage. These regulations, originally intended to protect domestic industry, provide for strict use requirements for internationally owned containers in Canada and require many shippers and carriers to reposition empty equipment. This negatively impacts the costs of container transportation for specialty agricultural products.

A series of in-depth interviews were conducted with various industry stakeholders. This was followed up by a self-administered, faxed-out questionnaire to gather more detailed information. Following this, a gravity model for the eastbound lentils export market was developed with the aim of quantifying the freight rate elasticity. The information obtained from the survey process was used to quantify the effects of container cabotage policy on lentils export volumes.

Canadian lentils exports are highly elastic to freight rates and suggest that reducing freight rates for this market could have great appeal to shippers and carriers. A 5% reduction in freight rates, which could arise from deregulating the cabotage market, could induce lentil exports to increase by about 10%. This translates into an expected increase of about $10 million in improved export sales.

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Chapter 1:

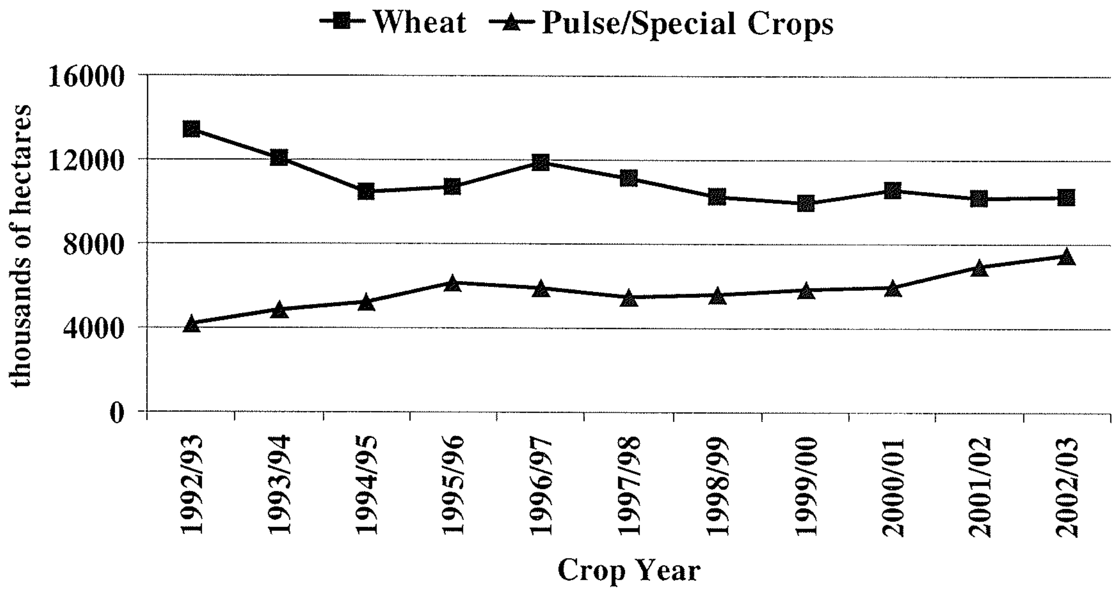
Problem Statement and Thesis Hypothesis

1.0 Introduction

Ending the *Western Grain Transportation* Act (WGTA) in 1995 eliminated $750 million in transport subsidies and launched a new reality for western Canadian farmers. No longer can they afford to produce low-valued grains destined for highly subsidized and volatile global commodity markets. Increasing global agricultural development, freer trade, coupled with costly agricultural policies in the United States and European Union have made commodity markets a losing proposition for Canadian farmers. The future of Canadian agriculture depends on its ability to adapt to these disparate forces.

In response, the landscape of prairie agriculture has changed. As shown in Figure 1.1, pulses, special crops and forages have replaced a significant amount of Prairie acreage previously allocated to wheat. The Prairies have also seen a dramatic increase in livestock and potato production. Over 80% of these value-added products are exported in containers.

Figure 1.1.
Seeded Area by Crop Type
Western Canada



Canadian grain handling and transportation has responded to global market conditions by tinkering with the bulk system in the hopes of reducing inland transport costs. Rationalization of the prairie elevator system, and closure of high cost branch lines have extracted incremental efficiencies, but the industry now faces a new challenge in handling value-added production and Identity Preserved (IP) products. IP grains and special crops are a promising avenue for increasing producers' incomes.

Catering to niche markets is an answer for some producers struggling to survive in the tough global agricultural climate. Identity preservation, Just-In-Time inventory techniques and attribute specific input sourcing are becoming increasingly important for producers and processors. A practical way to ship these products is in containers. Perhaps improving access to and the efficiency of Canada's intermodal system could provide a more profitable alternative to producers of specialty products.

An avoidable barrier to cost-effective container shipping in Canada is the out-dated Customs regulations on container cabotage. In general, cabotage refers to the carriage of domestic cargo on sovereign territory by a foreign conveyance. These regulations, originally intended to protect domestic industry, provide for strict use requirements for internationally owned containers in Canada. The implicit hypothesis of this thesis is that Canadian container cabotage restrictions, which require many shippers and carriers to reposition empty equipment, negatively impacts the costs container transportation for specialty agricultural products.

Ocean carriers spend an estimated US$1.6 billion annually to reposition empty equipment.[1] The tight restrictions placed on foreign-owned containers are a source of economic inefficiency that cannot be discounted. This policy causes containers to accumulate at the ports and to move empty, taking up rail capacity, burning fuel and costing shippers if repositioned. Carriers charge (build in their rates) the cost of these empty repositioning moves. The higher cost of operating container equipment in Canada relative to the more liberal U.S. regulations makes it less desirable for the shipping lines to position equipment in the Canadian interior.

[1] Bangsberg, P.T. "Carriers urged to embrace e-logistics." *JoC Online*, February 2001.

This thesis focuses on this regulatory barrier faced by shippers of intermodal freight. Cabotage restrictions reduce the flexibility of carriers to position equipment in demand areas, creating unnecessarily high costs for container services. Reduced transport costs would make Prairie exports more attractive to importers and more profitable to farmers. The objective of this research is to calculate the economic impact this barrier has on Canadian transport operations and on pulse exports. Lentils are used as a test commodity to model this market.

1.1 Objectives

By making Canadian regulations more consistent with the U.S. container regulatory system, it is hypothesized that the costs of container service on the Prairies will decline, creating opportunities for export growth. A gravity model is used to test the sensitivity of pulse crop exports to freight rates. As a test commodity, the change in lentil export volumes owing to lower transport costs arising from a revised regulatory environment provides an estimate of the economic impact.

The specific objectives of this thesis are:

1. To research and analyze Canada's cabotage restrictions on international containers,
2. To assess the sensitivity of shipping lines to relaxing cabotage restrictions, with respect to container availability and cost,

3. To measure the resultant impact on freight rates and volume of pulse crop exports from Western Canada with the aid of a gravity model.

1.2 Scope and Methodology

Many specialty agricultural products have unique logistical requirements that cannot be satisfied by the status quo bulk handling system. Pulses are more prone to product degradation and require gentler handling than the major grains and oilseeds. For that reason, containers are the dominant mode of transport for many pulse exports. Reducing transportation costs and improving access to intermodal equipment is a key to expanding exports to an elastic global market. Improving access to containers for these shippers could aid in developing new markets and in strengthening existing ones.

Shippers always prefer to source-load containers because they can avoid the transhipment costs (stuffing) and be certain of quality and count. The unfavourable cost trade off of having the empty container repositioned inland means that a significant amount of containerized Prairie exports are stuffed at the ports after arriving by other means. Transhipping adds to the handling costs and complexity of tracing, and also increases the risks of product damage. This thesis attempts to quantify the transport cost savings that could be obtained if Canadian cabotage restrictions on international containers were relaxed to the equivalent of U.S. cabotage restrictions. Lentils are used as a test commodity because the market is well established and geographically diverse.

A gravity model is employed to estimate the change in lentil exports from reduced transport costs arising from a deregulated container market. Gravity models have a long history in the analysis of commodity flows and market penetration. A gravity model can estimate sensitivities to freight rate changes, and identify market opportunities.

1.3 Organization of the Study

This thesis begins with a review of the literature on gravity models in Chapter 2. The chapter also lays down the theoretical framework for this evaluation of cabotage policy.

A review of Canadian and U.S. container cabotage regulations is presented in Chapter 3. The similarities and the differences in cabotage restrictions in both countries are highlighted with reference to U.S. and Canadian customs legislation.

Chapter 4 discusses the 2002 container cabotage survey undertaken for this thesis. Some of the issues discussed include: the problems identified by carriers and other stakeholders from the cabotage restrictions, the estimated repositioning cost reduction from liberalizing the regulations and global competitiveness issues faced by Canadian shippers.

In Chapter 5, the gravity model for lentils exports is developed and the estimate results analyzed. The model produces quantitative estimates of the sensitivity of lentils export volumes to changes in freight costs, or the freight rate elasticity.

In Chapter 6, the impact on lentil exports is determined. The elasticities derived from the gravity model are applied to the calculated transport cost savings as anticipated in a deregulated cabotage environment. The change in export volumes associated with a transport cost reduction can be used as a proxy for all pulse crops.

Finally, a summary of the findings, the major conclusions and recommendations for further research are discussed in Chapter 7.

Chapter 2:

The Theory of Trade and Transport Costs - A Gravity Model Analysis

2.0. Introduction

Economic gravity models can be used to examine the role played by transportation costs in determining the volume of commodity flows in international trade. Although inspired by the laws of gravity, economic gravity models assume that the Law of One Price applies. Specifically, trade between two regions depends on the economic distance between them, and their relative sizes. Under the Law of One Price, markets are at equilibrium when price differences are equal to or greater than the cost of moving goods between them.

Information data requirements are less burdensome for gravity models. Traditional trade equilibrium models require commodity prices in different regions that represent the appropriate market level (wholesale or retail) and similar value-added quality. Economic gravity models require only an accurate measure of commodity flows and transportation costs between origins and destinations. This is a significant advantage for quantitative analysis.

This chapter reviews the literature on the micro-foundations and estimation issues in gravity model analysis. In addition, it introduces the theoretical foundations of the impact of transport costs on trade. The empirical model is developed later in Chapter 5.

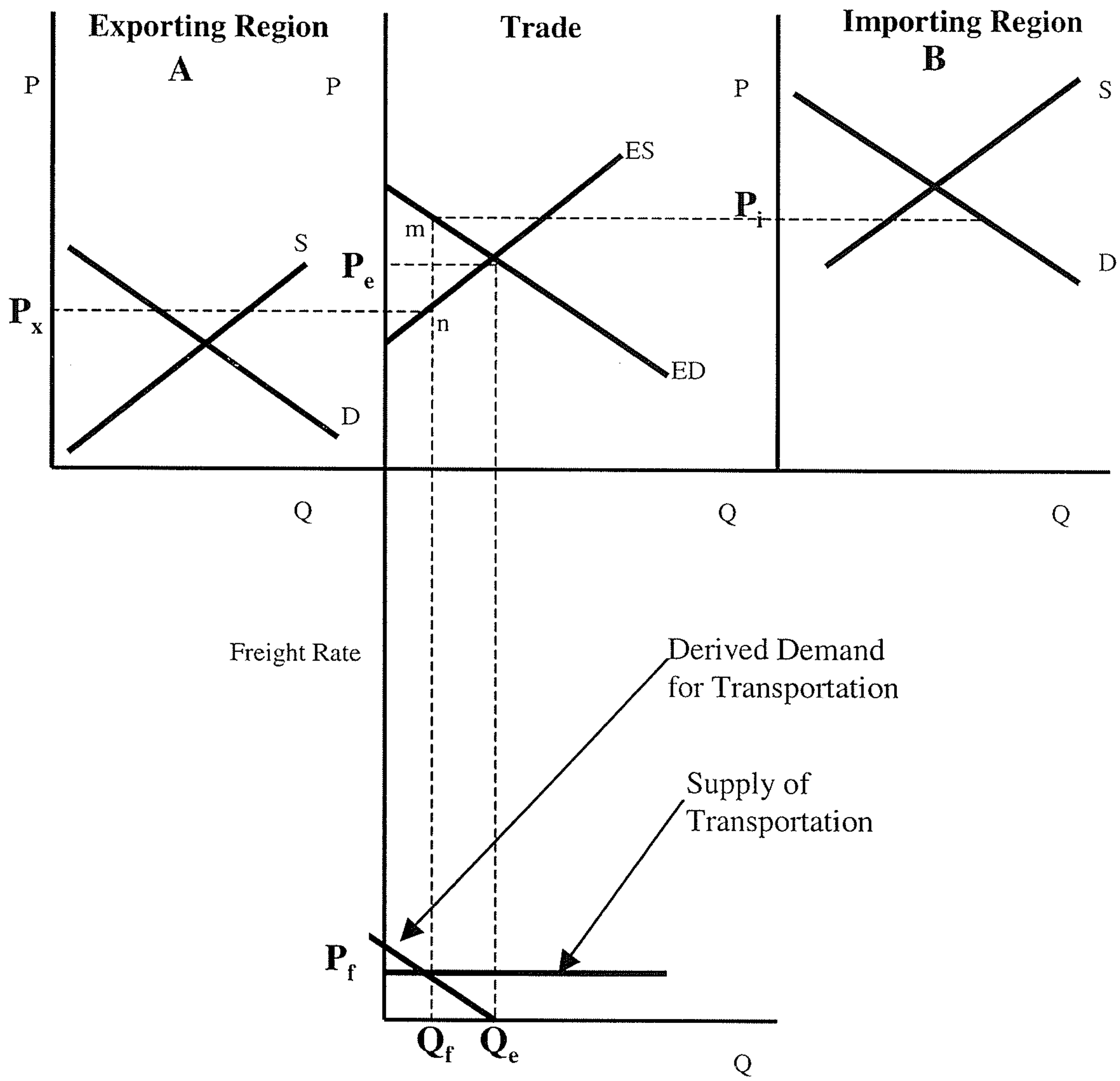
2.1. Micro Foundations of the Gravity Model

Gravity Models were first applied to international trade by Tinbergen (1962), Poyhonen (1963) and Linneman (1966) who proposed that the volume of trade is an increasing function of the national incomes of the trading partners, and a decreasing function of the distance between them. The empirical success of gravity models was hard to deny but they were criticized by economists because they seemed to lack theoretical foundations. These foundations were subsequently developed by, among others, Anderson (1979) and Bergstrand (1985), who derived gravity models from models of monopolistic competition, and Deardorff (1998), who demonstrated that the gravity model could be derived within Ricardian and Heckscher-Ohlin frameworks.

Prentice *et al* (1998) and Urbina (1996) use the Law of One Price as a theoretical base for the gravity model. In a world of one commodity and two regions where price differences exist in the absence of trade, this difference would give rise to potential trade flows from where price is low to where price is high. Assuming that exchange rates are fixed and that free trade is negotiated between the two regions, the Law of One Price dictates that trade flows would increase until the prices differed exactly by the transportation and logistics costs associated with transfer. The gravity model represents the derived demand for transportation from the low price market to the high price market.

Figure 2.1.

Derivation of Transport Demand Schedule



The upper panel in the interregional trade model shown in Figure 2.1, illustrates a two-nation case where Nation A, the Exporting Region, enjoys a comparative advantage over

Nation B, the Importing Region, in producing pulse crops. The international price for pulse crops is higher than the available domestic price in the Exporting Region. Sellers in this region will wish to earn the higher international price and will divert supplies to the world market. This will reduce the domestic demand in the Exporting Region, driving domestic prices up toward the international price. This surplus production at the prevailing international price creates an excess supply, which is derived from the horizontal difference between the supply and demand functions. The excess supply function is depicted in the central panel of Figure 2.1.

In the Importing Region, the international price is lower than the domestic price, encouraging cheaper imports to enter the market. The influx of cheap imports will put pressure on domestic prices to fall, creating an excess demand for pulse crops in the Importing Region. The excess demand function depicted in the central panel of Figure 2.1 is derived from the horizontal difference of the demand and supply functions. The excess demand and excess supply functions depend on all properties and parameters that lie behind the domestic demand and supply schedules in the respective regions. Superimposing the importing region's excess demand curve over the exporting region's excess supply curve, at zero transport costs, an equilibrium trade flow, (Q_e) is determined at P_e.

Now, let us relax the assumption of zero transport costs and assume that the costs of transfer are equal to the value *mn*. The domestic prices in the two nations in equilibrium will then differ by this amount. The price in the Exporting Region (P_x) is *mn* units lower than the price in the Importing Region (P_i). Thus, $P_x + mn = P_i$. The trade volume at which the difference in the two prices is exactly equal to *mn* is Q_f.

Vertically subtracting the excess supply curve from the excess demand curve creates a derived demand for transportation services, and is depicted in the lower portion of Figure 2.1. The derived demand for transportation captures the relationship between transport costs and quantities of transport services demanded. If supply of transportation is assumed to be perfectly elastic at P_f, the trade will equal Q_f. Commodity prices in the importing (P_i) and exporting (P_x) regions will differ by the transport cost (P_i-P_x=P_f). Observation reveals that the derived demand for transport is essentially a gravity model, $Q_e = f(P_f)$.

The significance of this observation is important. The gravity model gives trade economists a new method for studying interregional commodity flows. The gravity model can be used to estimate the demand for interregional trade of commodities. In essence, it is the reduced form equivalent of the interregional trade models excess supply and excess demand curves (Prentice *et al* (1998), Urbina (1996)).

2.2. The Role of Transport Costs in Trade

The previous section explored the micro-foundations of gravity models and introduced the concept of transport costs. This section takes a closer look at transport costs and more closely explores the impact that these costs have on trade.

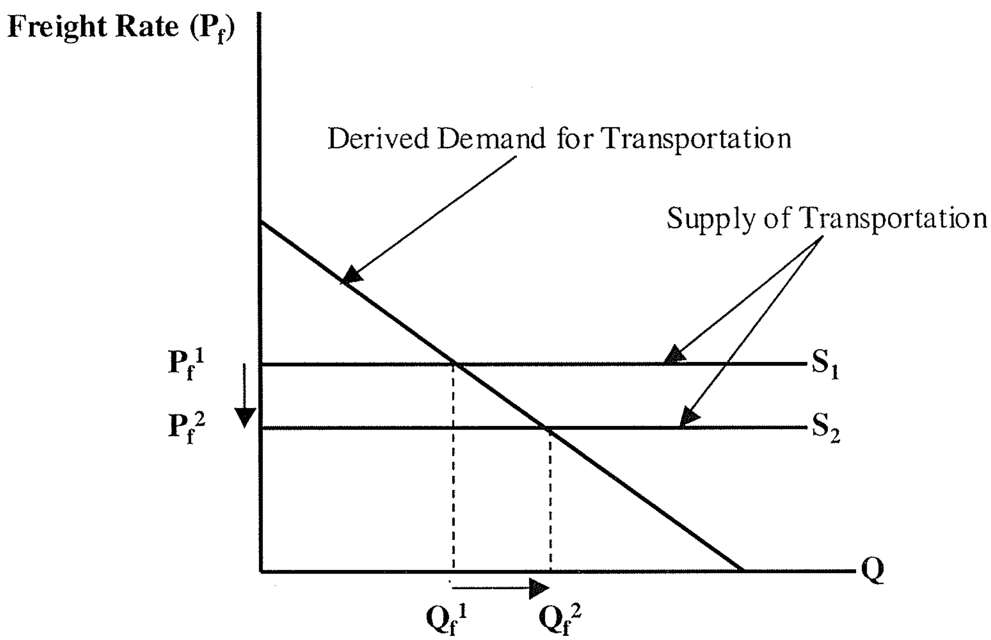
This thesis uses freight rates as an estimate of the costs of transfer in international trade. However, freight rates are only what shippers see. They are a complex structure of costs composed of such components as fuel, labour and the regulatory environment. Regulations that impose costs on service providers can include a variety of factors like cabotage restrictions, excessive administrative requirements, tariff and non-tariff trade barriers, etc.

Historically, transportation markets have been heavily regulated, and as discussed, this impacts the costs faced by transportation providers. These market conditions determine the quantity of services that firms can supply to the market. The transportation supply schedule is the relation between the market price and the amount of services that transportation companies could supply, given the costs they face.

Figure 2.2 illustrates the derived demand and supply of transportation as depicted in the lower panel of Figure 2.1. In this example, the supply of transport function (S_1) is assumed to be perfectly elastic at freight rate of P_f^1 per unit (container). The supply function reflects the market conditions in which companies operate. The price of imports in the importing region (P_i in Figure 2.1) and the price of exports in the exporting region (P_x in Figure 2.1) differ by the freight rate, P_f^1. The intersection of the derived demand and supply functions at P_f^1 results in a shipment of Q_f^1 containers.

Figure 2.2.

The Market for Transportation Services



Now, suppose there is a change in the transportation industry that reduces costs for carriers. An example of such a change could be a relaxation of the cabotage restrictions on international containers. This new regulatory environment allows foreign liner companies to compete for domestic traffic in the Canadian interior. By relaxing these restrictions, the cost faced by carriers at every level of services they provide is reduced. This puts pressure on the transportation supply function to shift downward to S_2. This new supply function places downward pressure on the price of transportation services and freight rates decrease to P_f^2.

At P_f^2 shippers will demand more freight services as the costs of transport become more affordable. The volume increase is determined at the intersection of the derived demand for transportation schedule and the new supply of transportation schedule, Q_f^2. The level of Q_f^2 as the supply schedule shifts will depend on the slope of the derived demand for transportation schedule, or the freight rate elasticity. With an elastic demand for transport, the volume of transportation services will increase in larger proportion than the decrease in freight rates. The opposite holds true in inelastic markets.

2.3. Estimation Issues of the Gravity Model

A significant advantage of the gravity model is that its data requirements are easy to obtain. Gravity models require only an accurate measure of commodity flows and transportation costs between origins and destinations. Nevertheless, data on transport costs are often unavailable or difficult to obtain. Consequently, distance has been used as a proxy in previous studies.

Gravity models do not require market prices, but do require a consistent measure of the commodity flows. Both the volume of goods traded or the value of goods traded could be used as the dependant variable. However, volume data is likely to be more independent of transport costs, to the extent that carriers are known to try to extract higher freight rates when commodity prices rise, and vice versa.

The remainder of this chapter discusses gravity model specification issues as it relates to the quality of data.

2.3.1. Impedance Factor Specification

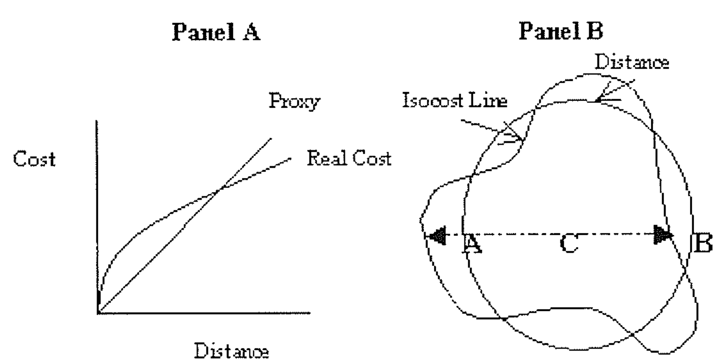
Linneman (1966) uses distance between trading countries as a proxy variable for the total natural trade impediments, in their widest sense. It embodies three elements; transport costs, transport time and psychic distance, constituting together the obstacles to trade due to the existence of space. Over the years, many other economists have adhered to this method.

Several problems exist when using distance as a proxy for transport costs. First, no distance may be representative for countries that share long borders with goods moving across many entry points. Second, problems arise when allowing for variation in the cost of alternative means of transport. Land transport is more expensive than ocean transport and air transport is more expensive than land transport. Distance measures cannot account for these cost differences. Third, improvements in transportation technology affects the cost of producing these services and consumer demand for goods through the level of services provided (Bandyopadhay, 1999). A fall in transportation costs because of a more efficient distribution sector will lower the final prices of goods and increase their quantities demanded. Finally, an elasticity with regard to distance is difficult, if not impossible to interpret.

Geraci and Prewo (1977) and Ferguson (1972) observe other reasons that make distance measures a poor proxy for transport costs. First, freight rates are influenced by factors other than distance, such as the value, weight and bulk of the commodity being transported, as well as the mode of transportation used. Second, the use of distance assumes that freight rates are the same in either direction. In many trade lanes there is a front haul and a back haul, with higher rates on front haul moves.

Figure 2.3 illustrates the relationship between transport cost and distance. In panel A, the proxy variable (distance) is assumed to exhibit a linear relationship. The real transport cost, on the other hand, does not lend itself to such simplicity. In this specific example, transportation costs are greater for shorter distances and begin to taper off as the distance increases. For shorter routes, the proxy variable underestimates the effect of transfer costs on export flows and the opposite holds true for longer routes. Only on mid-range routes would the proxy variable accurately reflect the impact of transfer costs on export flows.

Figure 2.3. The Relationship Between Transport Cost and Distance



Source: Vido and Prentice, 2003

Panel B outlines this same relationship, but includes other factors such as the level of infrastructure and the direction of travel. The smooth circle represents distance and every point on the circle is equidistant from the center, point C. The warped circle represents an isocost line where the transportation costs from point C to any point on the isocost line are equal. Let us assume that a shipper at point C has goods to deliver to points A and B, both of which are equidistant from point C. The route to point B is through a mountainous region where the road twists and turns and travel speed is slow. On the other hand, the route to point A is through a plain where the road is generally flat and straight and travel speed is fast. For a given level of costs (the isocost line) the distances travelled toward points A and B are different. In this example, the route toward point B is more costly than the route toward point A. Again; a proxy variable like distance would not distinguish between these cost differences.

Distance measures fail to account for currency exchange rates and do not reflect technological advances that impact the shippers' decisions about mode choice. Mode choice, in turn, depends on the particular trade corridors used, the availability of equipment and infrastructure, freight rates, and the volumes and types of commodities being shipped. Finally, the estimated relationships between trade flows and static variables such as distance are not very helpful in predicting future trade levels or for policy analysis (Geraci and Prewo, 1977).

Wall (1999) attempted to overcome the problems associated with using distance as a proxy for transport costs by using a fixed-effects method to allow for country specific intercepts. According to Wall, the fixed-effects method controls for omitted variables that are unobservable or difficult to measure such as historical links, cultural similarities, etc. With this approach "fixed economic distance variables are subsumed into the trading-pair intercept, instead of being proxied for by geographic distance." A major disadvantage of this approach is that the results do not provide any information on the sensitivity of exports to transport costs.

The primary reason for the use of distance as a proxy in previous studies is that reliable data on transport costs are unavailable or difficult to obtain. Beckerman (1956) suggests using the difference between the F.O.B. and C.I.F.[2] values as a proxy for transportation costs. However, this procedure is subject to limitations. For instance, the time period used in recording trade statistics may not be the same for both the importing and exporting country. Product classification may differ across countries and weight changes during transit may affect the accuracy of data. Furthermore, goods that move in transit through another country may be officially counted as imported and subsequently exported, putting further doubt on the reliability of the data.

Alcaly (1967) estimated a gravity model using travel cost as the impedance factor instead of distance. The inclusion of cost tends to make the equations somewhat more specific to each mode of transport and more like traditional demand equations. Depending on the research objectives, different specifications of the model may be appropriate. Aggregate models with distance as the impedance factor help to explain aggregate trade flows as a

[2] F.O.B. (free on board) value excludes international transportation and insurance costs. C.I.F. (cost, insurance and freight) is the value at the importers customs frontier and includes international transportation and insurance costs.