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The role of insurance in international shipping costs

Adrian Wolanski

Department of Economics, Indiana University, United States

HIGHLIGHTS

- Define and estimate a model of insurance costs in international shipping.
- Results show distance is not a parameter of insurance costs.
- Transportation costs are per-unit rather than ad-valorem.
- GDP per capita is a weak instrumental variable in transportation cost models.

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ABSTRACT

We estimate insurance costs for international shipments, and determine that distance does not affect insurance costs. This corroborates empirical observations of the Alchian–Allen effect. We also show that GDP per capita is endogenously related to unit value through insurance costs.

1. Introduction

A recent focus of international trade research has been on modeling transportation costs. While there has been substantial work on transportation costs as a whole, the various subcomponents have not received as much attention. Specifically, there has been very little investigation into determinants of insurance costs and their role in total transportation costs. Since Hummels (2001) demonstrates that explicitly measured costs make up the majority of transportation costs, it is important to develop a better understanding of these explicit factors–including insurance costs. The likely reason so little work has been done is due to a lack of data. Firms typically report insurance costs and freight costs together, and there is no established methodology for assigning shares of total transportation costs to the separate components of transportation costs. According to Hummels et al. (2009), the only real information available about shipping insurance is that insurance cost is highly related (elasticity coefficient of 0.88) to the price of the object being shipped. We use Chilean import data from 2007, which reports freight and insurance separately, to gain information about the determinants of insurance costs. In particular, we find that insurance costs are distance insensitive (nearly distance invariant). In addition, our results show that insurance declines as a share of total transportation cost as distance increases, which indicates that freight costs are per unit rather than iceberg. This corroborates Hummels and Skiba (2004), who find empirical evidence supporting the theorem proposed by Alchian and Allen (1964). We also find endogeneity problems between price and GDP per capita (a commonly used instrument for price), which validates growing concerns about the empirical utility of instrumental variable estimation.

2. Materials

We investigate Chilean imports for 2007 using the variables insurance, unit value, quantity, weight, importer, product, distance, and GDP per capita. One unique feature of this data set is that Chile has a somewhat special place in economic geography–rich trade partners like the United States, Europe, and Japan, are far away while neighboring trade partners tend to be much poorer. In Section 5, we consider the effects that this might have on transportation and insurance costs. The main feature of this data set is the insurance variable, which distinguishes insurance costs from freight costs. However, there is a problem with the way that the data set reports insurance costs. The data set reports costs by item, even though the data was recorded by shipment. Therefore, in shipments containing more than one item, the items were simply

E-mail address: adwolans@indiana.edu.

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Table 1
Full sample data summary.

Variable name	All methods	Maritime shipments only	Air shipments only
Imports (USD, Millions)	39,000	28,400	4,990
Freight Cost (USD, Millions)	2,730	1,990	292
Total Insurance Cost (USD, Millions)	116	61.8	33.5
Number of Importers	31,366	13,802	18,100
Number of Shipments	811,020	287,162	363,658
Number of Entries	2,500,725	1,020,650	979,969
HTS Code Observations	6,508	5,903	5,372

assigned an insurance cost proportional to the value share of the item in the shipment. Since there is so little information available about the determinants of insurance cost, we treat insurance as a black box instead of assuming that insurance costs for shipments are linear combinations of the items in the shipments. We therefore aggregate the data back to the shipment level for our analysis. There are some problems with this method; namely, we cannot include product-specific fixed effects on shipments that contain multiple products. We compensate by first considering the shipments that contain only one observation in the overall data set, and then compare these results to the entire data set. We first provide some descriptive statistics of the total data set in Table 1.

The most important thing to note is that freight costs are about 7 percent of total import value, and that insurance costs are about 0.2 percent of total import value. It is also important to note that these numbers are explicit freight and insurance costs only, which is why they are much smaller than the estimate by Anderson and van Wincoop (2004) of total transportation costs at 170 percent of import values. Since the subset of shipments containing only one item is heavily used throughout our analysis, we have included some descriptive statistics of that subsample in Table 2.

As table two shows, this subset comprises just over half of the total number of shipments and about 64 percent of the total import value for Chile in 2007. In addition, about 80 percent of importers and about 90 percent of product classifications present in the main data set are also present in this subset. Since there is also a similar distribution of value and shipments across transportation methods, this subset provides reasonable coverage of the main data set despite not being representative due to a lack of composite shipments.

3. Model specification

The theory behind this model is similar to equation 10 in Hummels and Skiba (2004), which provides a model for estimating freight cost as a function of distance. We replace unit freight cost with ad-valorem insurance cost to produce Eq. (1):

$$\begin{aligned} log(insurance_v) = {} & \alpha_1 + \alpha_2 + log(distance) * \beta_1 \\ & + log(unit\, value) * \beta_2 \\ & + log(unit\, weight) * \beta_3 + \epsilon. \end{aligned} \tag{1}$$

Where $insurance_v$ is the insurance cost as a proportion of unit value, α_1 is fixed effects for importers, α_2 is fixed effects for product and importer combinations, and ϵ is an error term. At most one fixed effect at a time will be used when estimating an equation, so the regression tables in the next section will indicate which fixed effects are being used in which regressions.

We then define Eq. (2) with the same right hand side variables, but the dependent variable is insurance cost as a percentage of explicit freight costs, rather than as a percentage of value.

$$\begin{aligned} log(insurance_c) = {} & \alpha_1 + \alpha_2 + log(distance) * \beta_1 \\ & + log(unit\, value) * \beta_2 \\ & + log(unit\, weight) * \beta_3 + \epsilon. \end{aligned} \tag{2}$$

Where $insurance_c$ is insurance as a percentage of explicit freight costs, and all other variables are the same as above.

We estimate both equations first on the set of shipments containing only one item in the main data set, and then repeat the specifications on the full data set. We estimate all models using both OLS and IV regression with GDP per capita of the exporting country as an instrument for price. We also report estimates for all transportation methods together, as well as separately for maritime and air transportation. Finally, we include importer–product and importer fixed effects for the partial sample, and importer fixed effects for the whole set.

4. Results

In Table 3, we provide the regression results of Eq. (1). The OLS estimates show that increases in distance have a slight positive effect on insurance cost, but that the inclusion of product-specific fixed effects reduces the magnitude of distance effects and makes the results statistically insignificant for all transportation methods together and also for just maritime transport. The results from the IV regression generally agree with the OLS results when including importer–product fixed effects, and are generally statistically insignificant. Therefore, the results from Table 3 indicate that insurance cost is not a function of distance.

In Table 4, we estimate Eq. (2) and find that insurance cost declines as a portion of total freight cost as distance increases. While this shows that freight cost is more sensitive to distance than insurance cost, the previous result that insurance cost is generally unaffected by distance indicates that the relationship captured by this model could simply be caused by the increase in freight cost over distance.

We then repeat the specifications on Eqs. (1) and (2) using the full data set. The results from the full samples are similar to the partial sample results, with Table 5 showing that insurance costs are not a function of distance and Table 6 showing that insurance declines as a share of total explicit freight costs as distance increases.

While this provides direct information on the behavior of insurance costs, these results also link to other debates in international trade. Specifically, the results corroborate previous research that freight costs are primarily per unit, rather than iceberg. One of the justifications for iceberg freight cost models is that more expensive goods require more insurance to ship, so freight cost should be strongly proportional to price. We showed earlier, however, that insurance makes up less than 10 percent of freight costs. Additionally, the large negative parameter estimates from Tables 4 and 6 demonstrate that insurance is significantly less sensitive to changes in distance than total transportation costs. We therefore conclude that insurance costs are not the main factor governing transportation costs, which corroborates the results in Hummels and Skiba (2004) that freight cost is per unit rather than iceberg.

5. Robustness checks

To support our results, we provide a series of robustness checks. First, all regressions in this paper are done with heteroscedasticity–robust standard errors that are also clustered by fixed effects.