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A Search Cost Perspective on Duration of Trade

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Abstract

More than half of all US import relationships begin with less than $10,000 annually. The median relationship is observed to last just one year. The incidence and duration of these relationships are consistent with a matching model of international trade. The preponderance of small starting relationships reveals uncertainty present in formation of trade relationships. Initial size, reliability, and search costs matter and play an important role. Larger initial purchase results in longer relationships. Higher reliability and lower search costs lead to larger initial purchases and longer relationships.

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1 Introduction

Much effort has been invested by trade economists to explain root causes of international trade. Many explanations have been proposed, including Ricardian comparative advantage, Heckscher-Ohlin factor endowments, and Helpman and Krugman monopolistic competition. The majority of existing models explain why countries trade in the aggregate. However, there are few models that examine formation of trade at the product level. The main goal of this paper is to provide an empirical analysis of formation of trade relationships at the product level.

Formation of relationships is modeled following Rauch and Watson (2003) who examine how a developed country buyer searches for an appropriate supplier from a developing country. Given the uncertainty present in international markets they find buyers elect to start some relationships with small purchases to test the supplier, while they start others with large purchases. Relationships that start with large purchases are more likely to be long lasting. This paper provides evidence a search model of trade formation is consistent with observed data and is not limited to case studies presented by Rauch and Watson (2003).

The empirical investigation proceeds in several steps. Initially, I examine only relationships that most closely match the Rauch-Watson model, those between the United States and developing countries. After finding support for the model, several exercises establish robustness to potential measurement errors, different definition of size, and aggregation. Finally, I study US import relationships with developed countries to examine whether they fit some or all aspects of the model. Three conclusions

emerge.

First, data support the model. A great majority of US import relationships commence with very small annual purchases with a median value below $10,000.[1] More than ninety percent of US import relationships start under $1,000,000. There is a considerable amount of uncertainty in formation of trade relationships. Most buyers choose to test suppliers via small orders and upgrade them to large orders if they prove capable. The smaller the initial purchase the shorter the relationship. Almost a half of the smallest relationships, those starting under $10,000, last only one year. Only three percent of the largest relationships, those starting over $1,000,000, fail after one year. In addition to initial purchase size duration increases the more reliable the supplier and the smaller the search costs.

Second, implications of the Rauch-Watson model are more widely applicable to all trade relationships, not just to developed country imports from developing countries. All US imports have similar characteristics – the majority of relationships start with small purchases and duration increases with initial purchase and reliability, while it decreases with search costs.

Third, the paper highlights an unexplored phenomenon in international trade. The majority of trade relationships start with low values and are of short length. Highly valued and long lasting relationships are a minority.

This paper contributes to a large body of literature using highly disaggregated trade data. Schott (2004) uses product level US trade data to find international competition in product markets has increased over time. Hummels and Lugovskyy

[1] All trade values are in 1987 US dollars.

(2006) examine whether useful information on transportation costs can be obtained from aggregated data. Using disaggregated data they find aggregation significantly distorts measures of transportation costs. Broda and Weinstein (2006) estimate elasticities of substitution and use them to investigate gains from increases in variety of traded products. Hallak and Schott (2005) estimate cross-country differences in product quality revealing trends not apparent in export prices alone. Blonigen and Wilson (2006) use product level data to investigate the efficiency of US ports.

A different segment of the literature uses plant and firm level data to investigate trade dynamics and export decisions of firms. Roberts and Tybout (1997), Bernard and Jensen (2004), and others as surveyed by Tybout (2003), study disaggregated trade at the firm/plant level and attempt to analyze factors which determine firm participation in international markets. While related to this literature, this paper differs fundamentally by employing import rather than export data. An apparent shortcoming of this paper is its inability to capture cross-firm heterogeneity missing from product level data. As I will argue, this is not a debilitating shortcoming as firm-product level data would only make the results stronger. In addition, product level data highlight the significant dynamics which exist in international trade and are glanced over by firm level data. Besedeš and Prusa (2006a) contain an extensive discussion of differences between the use of product level import and firm level export data.

Besides offering an empirical confirmation of Rauch and Watson (2003), the paper makes a contribution to the literature on duration of trade. Besedeš and Prusa (2006a, b) investigate duration of US import trade. They find trade at the product level to

be very volatile, with the median duration of just four years. They find differentiated products exhibit much longer median duration than do homogeneous products, five versus two years. Although Besedeš and Prusa (2006b) also use the Rauch and Watson model, this paper is more faithful its setup, relates data more closely to the model, and focuses on the initial purchase-duration relationship.

2 Motivation for Empirics

2.1 A Model of Costly Search and Unknown Match Quality

The paper is motivated by Rauch and Watson's (2003) model of a buyer's search for a foreign supplier. They motivate their model by a desire to understand how developed country buyers make their decisions to cooperate with suppliers from less developed countries. While the original model is presented at the firm level, data constraints force me to recast the model at the country-product level. The buyer will be a developed country, the US, searching for a supplier of a product among developing countries.

The buyer's goal is to find a developing country supplier successful in supplying a large order. Suppliers differ in per-period production costs. The buyer must pay a search cost whenever a search is undertaken. After being matched with a supplier, the buyer immediately observes the supplier's per period cost. The supplier's success in fulfilling a large order is initially unknown. If the supplier is successful, a large order generates gross per-period sales for the buyer at the seller's per period cost. If the

supplier is unsuccessful, gross sales are zero. Before a large order can be placed, the buyer must pay a training investment which will enable the foreign supplier to fulfill large orders. The training investment reveals whether the supplier will be successful.

After a match, the buyer has a choice between three options: place a large order, place a small order, or reject the supplier and search anew. If a large order is placed, the buyer pays the training investment, learns the supplier's ability, and positive profit results if the supplier is successful. Alternatively, the buyer can place a small order resulting in zero profit. Over a period of time a series of small orders reveal whether the supplier can successfully supply a large order. If the supplier is revealed to be successful, the buyer will pay the training investment and place a large order. If at any point the supplier is revealed unsuccessful or immediately rejected, the buyer returns to the pool and searches again. A successful relationship with a supplier gives the buyer access to a network of potential suppliers, which costlessly introduces the buyer with some probability to a new supplier. If the buyer decides to switch, it again must decide whether to start small or large.

In equilibrium buyers will place large orders with low cost suppliers. Intermediate cost suppliers will be tested with small orders before being upgraded to large orders. High cost suppliers will be rejected. Rauch and Watson demonstrate two key characteristics of the equilibrium. First, relationships starting with large orders will have longer duration than those starting with small orders. Second, a decrease in search costs and an increase in reliability each increase both the likelihood of a large start and duration.

2.2 Relating the Model to Data

The model describes how small initial purchases and short durations depend upon supplier characteristics. The five key variables — supplier's marginal cost, search cost, supplier reliability, training investment, and probability of being re-matched — are all primarily supplier or product characteristics. The model could be directly estimated by collecting a large amount of firm level import data and examining the evolution of actual buyer-supplier relationships. With enough observations one could identify the effect of these variables on duration. Unfortunately, no such data are readily available.

Extremely disaggregated US import data from 1972 to 2001 are used instead. Import data are used as the model describes how developed countries search for imports from developing countries. Since the model focuses on the role of search costs, only data for differentiated goods are used. Search costs do not play an important role in nondifferentiated goods trade. The US records every product purchased from every supplier in every year which allows the identification of buyer-supplier relationships at the country level. While such data provide no information about individual firms actually buying or supplying, information about the traded product and the characteristics of the supplying country can be used to determine whether data support the model.

US import data are recorded annually using the 7-digit Tariff Schedule of the United States (TS) between 1972 and 1988 and using the 10-digit Harmonized System

(HS) since 1989.[2] Only differentiated goods are used as search costs are of little importance for homogeneous goods as argued by Rauch (1999). Differentiated goods are defined using Rauch (1999). Spells of service are created from annual data. If product i is imported from country c between 1976 and 1980, then the ci^{th} *trade relationship* has a spell length of five. The TS dataset has 548,692 differentiated goods spells with a median (mean) length of 1 (2.7) years; the HS dataset has 701,615 spells with a median (mean) length of 1 (3.1) years. Concordance problems between TS and HS data make it impossible to construct a product level database covering the entire 1972–2001 period. The inability to concord the two classifications is not problematic since trade for over 22,000 different products is observed in each subperiod. Rather, the two datasets present a natural robustness check. The analysis is performed using both TS and HS data finding remarkably similar results.

Two issues necessitate a discussion of censoring in data. The basic censoring issue is the inability to accurately observe either the beginning or ending date for some spells. Since trade relationships before 1972 are not observed, it is not clear whether those observed in 1972 actually start in 1972 or whether they started earlier. Similarly, 1988 is the last year when relationships are observed and it is not clear whether those relationships truly end in 1988 or continue unobserved. All such relationships, those observed in 1972 and/or 1988, are treated as censored. For example, a spell observed from 1972 to 1976 is treated as censored and is said to have a length of at least five

[2]Data were compiled by Feenstra (1996) and then extended by Feenstra, Romalis, and Schott (2002). Data contain information on several different measures of value and quantity, units of quantity, and assessed duty. There is no information on the identity of either the buyer(s) or seller(s) at the firm level. Complete details on the sources of data are included in the appendix.

years. In HS data, spells observed in 1989 and/or 2001 are treated as censored. The other censoring issue is the reclassification of products. US Customs revises product codes on an annual basis. Old codes are discontinued, while new ones are required to better record trade. Since a concordance between new and old codes is unavailable, all such cases are treated as censored.[3] Besedeš and Prusa (2006a, b) have a long discussion of censoring issues in import data.

A shortcoming of product level data is that even as disaggregated as they are (e.g., more than 30 different types of ball bearings) there is no information on individual buyers or sellers. Consequently in some cases one might expect observed data are a result of multiple buyer-seller relationships at the firm level. To be able to observe the actual buyer-seller relationships that underlie the country-product data used, one would have to be able to observe firm-product level interactions, where both the buyer and the seller as well as the product are identifiable. Unfortunately, such data are not readily available. A growing body of literature uses firm level data, such as Roberts and Tybout (1997) and Bernard and Jensen (2004), but those data sets only observe a firm on one side. Roberts and Tybout (1997) observe total exports of Colombian plants without the ability to distinguish neither the country nor the product nor the individual firm buying those exports. Bernard and Jensen (2004) have similar observations for US firms. There are several reasons why the bias introduced by using country-product data is small.

First, the great majority of relationships at the country-product level are observed

[3]Reclassified codes are defined as those observed for the first time after 1972 (1989) and for the last time before 1988 (2001).

for at most a year. The average observed duration is barely 3 years. Hence, given data are reported annually the shortest time one could observe a buyer-seller relationship would be one year. Second, most relationships are observed to start with surprisingly low values, less than $10,000 at the median. Firm level data would reveal even smaller initial values if the country-product data are a result of multiple buyer-supplier relationships at the firm-product level. Third, results using data aggregated to the industry level do not differ significantly from those at the product level. Assuming most firms produce different products within the same industry, one would expect both initial purchases and duration to increase with aggregation. However, at reasonable levels of aggregation duration remains short and initial purchases low. Data disaggregated to the country-firm-product level would result in even shorter duration and smaller initial purchase.

There are several other data issues. Data could be misclassified at the point of entry. First, most data are constructed from forms filed with US Customs. While some effort goes into catching errors for large valued shipments, it is likely errors for small valued shipments will remain. Second, certain small shipments remain unrecorded as smallest shipments do not have to go through all recording steps. Some relationships that involve very small, but regular shipments may go completely unrecorded. The observed duration may be understated (too short) as these small valued, regular, long lasting relationships are ignored. Third, unrecorded small shipments may result in an observed break in a relationship, when the break does not actually occur.

Though difficult to deal with, neither of the first two issues is likely debilitating. If small initial sizes are due to recording errors, given the large number of small initial

purchases, a large proportion of observed relationships would be recorded with an error. For unrecorded shipments to present a large problem there would have to be a vast number of them. Both of these are unlikely as a lot of effort goes into collecting accurate import data for duty collection purposes. In addition, these relationships are most likely very small in value, which would make the results even stronger, as they would increase the number of very small starting relationships.

There are two arguments why the third issue is also unlikely to cause problems. First, since data are recorded annually, for an artificial break to occur due to unrecorded transactions, there would either have to be only one such shipment or every shipment must be very small during the entire year. While possible, it is unlikely that in a long relationship there will be a year when every shipment is below the Customs radar. Second, one robustness exercise involves an assumption of every one year gap being a result of an error. Two spells separated by a year are merged into one longer spell. Results are not significantly affected by this change. Hence, even if relationships are artificially broken due to recording errors results are unaffected.

2.3 Verifiable Implications

The Rauch-Watson model provides an explanation why some trade relationships start small and others start large, why trade relationships may be short-lived, why duration may vary across suppliers, and how duration and starting size are related. It also implies some potential suppliers are rejected by buyers before any transaction takes place. These rejections are unobservable as only data on realized relationships are

available.[4] Five verifiable implications can be identified.

Implication 1 *Some trade relationships will start small and others large. Those that start large should have a longer duration than those that start small.*

Rauch and Watson do not quantify exactly what it means to start small. Different definitions of 'small' will be used for robustness. Empirically lower hazard rates should be observed for relationships with large initial purchases.

Implication 2 *The fraction of trade relationships starting large will be greater the more reliable the supplier. Due to the greater fraction of large starts, relationships involving more reliable suppliers will have longer duration.*

Since there is no available direct measure of reliability, the supplying country's level of development as indicated by its per capita GDP will be used as a proxy. Suppliers with higher per capita GDP should have longer duration.

Implication 3 *Goods with lower search costs will have a larger fraction of relationships that start large and will have a longer duration.*

Given data constraints, country and product characteristics will be used to proxy for search costs.

Implication 4 *The chance of a trade relationship ending will be the highest during the learning stage.*

[4]There is no information on potential suppliers who were rejected by US buyers or even if non-active countries have the ability to supply a particular product.

Empirically, failure rates should be high early in relationships, especially for relationships that start small.

Implication 5 *A small fraction of successful relationships will be ended by buyers switching to a new supplier. The greater the reliability, the greater should the attrition rate be as it is easier/cheaper to switch to another supplier.*

The risk of failure should decline significantly the longer the relationship. The risk of failure need not go to zero as a buyer might opt to start a new relationship with a different supplier. The opt-out possibility is less likely the lower are the costs of the current supplier. I will examine the reliability implication for the attrition rate of successful relationships at the end of the paper.

3 Results

The main focus of discussion is on TS data. All HS results are qualitatively similar and are available on request. I first investigate whether the implications of the Rauch-Watson model hold for developing countries as they postulated. Countries are classified as developing if they are not a member of the OECD.[5]

3.1 A First Pass

I provide a first pass at results by examining implications #1, #4, and #5 non-parametrically. Implications #2 and #3 can only be evaluated jointly with other

[5]Since the main focus is on TS data, countries are defined as OECD members if they were members in 1988.

implications by estimating a hazard model.

3.1.1 Starting small and starting large – Implication #1

Let us begin by examining the extent to which US buyers start relationships with large orders. Table 1 reports several percentiles of the distribution of the value of imports in the first year of each relationship irrespective of eventual duration. The upper panel presents the distribution for TS data, and the lower panel contains the corresponding distribution for HS data.

There is a great number of very small starting relationships. The median traded value in the first year of a relationship is just \$7,941 for TS data and \$8,384 for HS data. For either classification more than three quarters of all relationships begin with less than \$50,000. Half of all trade relationships are based on extremely small annual transactions. These numbers suggest a key motivation and feature of the model — that buyers initially place small orders — is prevalent in data. Results do not imply there are no large initial transactions. To the contrary, the relatively few relationships that are large, are *very* large. The mean value for TS data is \$432,151 and \$603,754 for HS data. The mean roughly corresponds to the 94^{th} percentile in both datasets, which implies the right tail of the distribution is dominated by a small number of very large relationships. However one chooses to define "small," the majority of US import relationships start very small, while a few start very large.

The second part of implication #1 is that the size of a trade relationship in the first year affects its duration. I estimate survival functions for relationships of different first year transactions using the Kaplan-Meier product limit estimator. Trade relationships

are divided into five groups: those starting (i) with less than $10,000, (ii) between $10,000 and $50,000, (iii) between $50,000 and $100,000, (iv) between $100,000 and $1,000,000, and (v) with more than $1,000,000. About 53% of all relationships fall into the smallest group, while about 24%, 7%, 12%, and 4% fall in next groups respectively for both datasets. As depicted in the upper-left panel of Figure 1 estimates are a striking confirmation of the model: the smaller the initial purchase, the lower the probability of survival and the shorter the duration. Differences between estimated survival functions are statistically significant. However one defines a small purchase, relationships that start small will be of short duration.

3.1.2 Hazard rates – Implications #4 and #5

The last two implications concern the conditional probability of failure or the hazard rate. According to Rauch and Watson, early stages of relationships should be characterized by higher hazard rates as buyers determine whether suppliers can successfully deliver the order. Beyond the initial learning stage there should be a small number of failures stemming from re-matching.

Both hypotheses are borne out by data. Table 2 reports estimated hazard rates for both TS and HS data. The probability a relationship will fail is highest at its outset. More than a third of relationships fail in their first year. Beyond the first year the hazard rate declines rapidly. About 25–35% of relationships fail in the next two years. Thereafter, there is little attrition. Between years five and ten no more than 10% of relationships fail. Once relationships last more than ten years, the probability of failure in each subsequent year is around or below one percent. Even when suppliers

prove to be reliable and relationships are long, there is still some possibility of the buyer switching to a different supplier.

The lower-left panel of Figure 1 depicts hazard rates across initial transaction size. Relationships with larger initial transactions experience lower hazard rates at every point. Hazard rates never decline to zero as even the most successful relationships can fail when the buyer decides to switch to a new supplier.

3.2 Hazard Model Estimation

Results presented so far offer generally strong support for the Rauch-Watson search cost model. To evaluate the interplay of potential factors affecting the size-duration relationship, I estimate a stratified Cox proportional hazard model

$$h_s(t, \boldsymbol{x}, \boldsymbol{\beta}) = h_{s0}(t) \exp(\boldsymbol{x}'\boldsymbol{\beta}),$$

where $\boldsymbol{x}$ denotes a vector of explanatory variables and $\boldsymbol{\beta}$ is to be estimated. Explanatory variables capture search costs, supplier reliability, relative costs of trading, and initial purchase size. The baseline hazard, $h_{s0}(t)$, characterizes how hazard changes as a function of time and is different for each strata, s. Estimation is stratified by regions and 1-digit SITC industries.

Distance, common language, contiguity, and the number of potential suppliers are used to capture search costs. Distance may be correlated with costs of finding a foreign supplier. Greater distance is expected to indicate a more difficult search. A common language dummy captures any advantages of English being the primary

language of the supplier. Common language facilitates easier, faster, and cheaper communication and search. Contiguity should capture any advantages of trading with a neighboring country which should make searching there cheaper.

The number of potential suppliers captures the ease with which a buyer can find a good match. This variable is a product level count of the cumulative number of observed suppliers. It counts the number of countries that were observed to have supplied the US market in a particular product. For instance, suppose Canada and France supply a product in 1972 and Canada, Germany, and Brazil supply it in 1973. There are two potential suppliers in 1972 and four in 1973.

Two measures of supplier reliability are used. The first and most direct measure is per capita GDP. It is assumed a supplier's reliability will be closely related to its level of development as proxied by per capita GDP.[6] The other measure, multiple spells, is more indirect and requires some explanation. Some trade relationships are observed for a period of consecutive years (spell 1), followed by a period of no trade, and then again observed for another service spell (spell 2).[7] There is no way to identify whether parties involved in the first spell are the same as those involved in the second spell. If failure is at least partially related to country characteristics then the first failure makes a second failure more likely and indicates lower reliability.[8] Multiple spells are

[6] I considered using other variables to capture the level of development such as education, miles of paved roads, measures of corruption, etc., but these alternatives were not available either for all countries or all years or both.

[7] About one-quarter of trade relationships experience multiple spells of service and about two-thirds of those experience just two spells. Less than one percent of trade relationships have more than three spells.

[8] The use of multiple spells as a measure of reliability is not perfect. It is entirely possible that before switching to another country, the buyer attempts to find another supplier in the same country as the first failed supplier. Since firm level data are not observed, it is impossible to deal with this

treated as independent by using a dummy variable for higher order spells. Alternative approaches toward multiple spells are considered in a robustness exercises.

Larger economies are able to trade more with the US due to their larger production capacity. Suppliers from larger economies are able to commence their relationships with US buyers with larger values, which would result in longer relationships. GDP of the supplier country is included to control for this effect.[9]

To control for cost differences and changes in costs across suppliers percentage change in the relative real exchange rate and ad-valorem transportation costs are used. The change in the relative real exchange rate is constructed by first defining each country's exchange rate so an increase corresponds to a real depreciation. It is then normalized in each year by the average real exchange rate of all currencies relative to the US dollar and annual percentage changes are calculated. This gives a measure of how each country's currency changed relative to its competitors'. An increase in the measure reflects a country's currency has weakened relatively more than its competitors', making its product cheaper and less likely its relationships will be discontinued.

Transportation costs are measured as the cif/fob ratio for US imports as reported in Feenstra (1996) and Feenstra et al. (2002). When calculated at the product level this ratio is a reasonable measure for transportation costs, as suggested by Hummels and Lugovskyy (2003). Following Hummels and Lugovskyy I drop a handful of obser-

issue. This problem declines in importance the longer the duration of the first spell in a series of multiple spells, since the buyer has several years to be rematched with some other supplier in that country and upon failure of the first relationship may decide to switch to another country.

[9]Both GDP and per capita GDP are measured in 1995 US dollars.

vations with unrealistically large transportation costs (i.e., those with transportation costs more than the value of the product being traded).

An agricultural good dummy is included as those goods are highly susceptible to temporary shocks such as weather which may increase the variability in initial purchases and duration of relationships. An intermediate goods dummy is included as there may be some additional peculiarities related to intermediate goods that are not present for final goods. For example, some firms buy intermediate goods only from approved suppliers. The approval process may cost upward of tens of thousands of dollars. For parts which may cost one dollar or less, the fixed cost of approving an additional supplier is extremely high at the margin. In those cases, firms may be forced to buy from a single approved supplier, even though there are other capable suppliers. Other firms may have more liberty to choose suppliers of intermediate goods which can lead to higher variability in duration and greater turnover of suppliers.

Two controls for the initial size of a trade relationship are included. The first and most direct control is the dollar value of imports in the first year. Second, dummies representing the same groups of relationships as in Figure 1 are added to the dollar value of the initial purchase. Dummies are used due to the skewness in the distribution of initial purchase.

3.2.1 Benchmark estimates

Table 3 contains the first set of results. All estimates are expressed in terms of hazard ratios. If the hazard ratio is greater than 1 the variable increases hazard and leads to longer duration. Since most parameter estimates are very similar across specifications

I will focus on the specification with the actual value of first year imports and size group dummies (column 2).

Higher distance from the US increases hazard by a small amount, 0.015% per one thousand kilometers. Indonesian suppliers have a 14% higher hazard than suppliers form the average country which in turn have a 10% higher hazard than Mexican suppliers due to distance. Suppliers from English speaking countries face a 3% lower hazard. Mexico has a 28% lower hazard due to its common border with the US. A one standard deviation increase in the number of potential suppliers, about 16 additional suppliers, lowers the hazard by about 9%. These findings are consistent with the Rauch-Watson model: the easier it is to search the lower the hazard rate.

Both variables measuring reliability support the model. More reliable suppliers have a lower hazard and longer duration. Suppliers from countries with a $1,000 higher per capita GDP face a 1.7% lower hazard. In 1980 per capita GDP of supplier countries ranged between $148 and $12,651,[10] with an average of $3,133. Relative to the average supplier, the least reliable supplier faced a 5% higher hazard, while the most reliable supplier faced an almost 15% lower hazard. Multiple spells are an indicator of lower reliability as expected — having been previously dropped considerably reduces duration of any subsequent spell (a 31% higher hazard).

Cost changes have a sensible effect on duration. Transportation costs have a very small effect: a one standard deviation increase in transportation costs, about 12%, increases the hazard rate by 1.3%. The relative real exchange rate has a larger

[10] Per capita GDP of $12,651 represents the 95^{th} percentile which is used rather than the maximum as it appears to be a clear outlier at $35,398.

effect. If a supplier's currency falls by 10% then the hazard rate falls by 5%; a one standard deviation fall in the exchange rate, about 26%, lowers the hazard rate by 22%. Agricultural goods face an almost 10% lower hazard, while intermediate goods face a 10% higher hazard than final goods.

The initial purchase plays an important role as implied by the model. Relationships that start large experience lower hazard and longer duration. Compared to the smallest transactions relationships that start with $10,000 to $50,000 face about a 36% lower hazard; those starting between $50,000 and $100,000 face an almost 50% lower hazard; those starting between $100,000 and $1,000,000 face a 70% lower hazard, while the largest relationships have a 93% lower hazard. The actual value of the initial purchase has a small effect independent of size dummies, though it is not statistically significant. Without size dummies a $1 million higher initial purchase has an 80% lower hazard (column 1).

Columns (5) and (6) present corresponding results using HS data. The effect of all search cost variables increases, while the effect of reliability variables declines. Larger economies have a smaller advantage and the effect of cost variables declines slightly. The effect of size variables is almost identical. The only significant difference between the two time periods is the change in product type dummies. Intermediate goods reverse in sign, while the estimate for agricultural goods is no longer significant. Results in Table 3 offer strong support for the model: reliability and search costs matter, and size has a tremendously large effect on duration of relationships.

3.2.2 A more flexible alternative

Since the size of the initial purchase has a nonlinear effect, it is possible other exogenous variables have a size specific effect. The pure size effect may be mismeasured by not allowing a size specific effect of every variable. Reliability and search costs may increase in importance for higher valued transactions. The top panel of Table 4 presents results from estimating the following specification

$$h_s(t, \boldsymbol{x}, \boldsymbol{\beta}) = h_{s0}(t) \exp\left(\sum_i D_i \boldsymbol{x}'\boldsymbol{\beta}\right),$$

where D_i denotes the i^{th} size dummy corresponding to the initial transaction cutoffs used above. The reference category are final products with initial purchase below \$10,000. Reading across the columns one can compare the effect for each variable as initial size increases.

Effects of explanatory variables generally do vary by size. The positive effect of distance is the strongest for the smallest starting relationships — hazard increases by almost 2% for each 1,000 kilometers. The effect is smaller for the next two groups and it reverses in sign for the largest two groups. This may signify that for suppliers far away, which are expensive and difficult to search, the buyer does not commit to a supplier unless it is fairly certain the supplier will prove to be successful.

Common language has no effect for the smallest relationships while lowering hazard for larger relationships at an increasing rate, up to 45%. The role of Mexico's border with the US increases with size. Smallest relationships with Mexico have a 17%, while the largest ones have an 82% lower hazard. The effect of the number

of potential suppliers increases for larger relationships, from 0.004% to 3.3% lower hazard. The importance of search costs increases with initial size.

The effect of reliability, as measured by GDP per capita, increases with size, but does not have an effect for the largest starting relationships. Reliability as measured by multiple spells increases with size. Having been dropped once spells a death sentence for the largest starting relationships increasing hazard by more than 700%.

Larger economies face lower hazard the larger the initial transaction, though the range of estimates is small, between 9% and 11%. The effect of the change in the relative real exchange rate increases with size from 4% to 10%, but has no effect for the largest relationships. Ad-valorem transportation costs have a statistically significant effect only for the smallest and largest relationships. The largest relationships are particularly sensitive facing an 18% higher hazard for every 10% increase in transportation costs.

Even after controlling for the size specific effect of every explanatory variable relationships starting with smallest transactions still face the largest risk. Relative to the smallest relationships involving final goods, the largest relationships enjoy a 61% lower hazard. Larger relationships enjoy an inherent advantage over smaller ones.

3.3 Robustness

Several issues might bias the results: (i) measurement errors regarding the end of a spell, (ii) inability to observe the exact starting date for relationships that are active at the beginning of the sample, (iii) definition of size, and (iv) aggregation concerns.

3.3.1 Measurement errors and Multiple spells

There are two issues related to multiple spells. The first involves the possibility of mismeasuring the end of the preceding spell. The second involves the assumption of independence of multiple spells.

A short gap between two spells could be a result of a recording error or transactions too small to be recorded. If time between two spells is sufficiently short, then they may be more appropriately interpreted as one spell. I assume a one year gap between two spells is a result of a recording error and merge the spells creating one longer spell. Gaps longer than a year are assumed to accurately reflect failure. To illustrate suppose a country supplies a product from 1981–1983 and then again from 1985–1987. The benchmark approach treats this as two independent spells, each three years long. The gap-adjusted approach interpret this as one 7-year spell. The second column of Table 5 presents the gap-adjusted estimates. Results are very similar to benchmark estimates, which are reported in the first column for ease of comparison.[11]

Two alternatives are estimated to investigate the independence assumption. Analysis is limited to the first spell of each relationship eliminating every higher order spell. A more restrictive approach analyzing only single spell relationships is also considered. Results are reported in columns 3 and 4 of Table 5. While some estimated coefficients change in magnitude, results do not change qualitatively and are strikingly similar to benchmark estimates.

[11] Transportation cost for the gap year is the average of the two adjoining years. There are fewer subjects due to merging of spells, while there are more observations as the gap year is added.

3.3.2 Starting dates

For relationships active in 1972 it is impossible to ascertain the exact starting date. Benchmark analysis interprets all such spells censored, which may introduce bias since of those spells are already long-lived in 1972. I estimate the model excluding all spells observed in 1972. Results very similar to benchmark results are reported in column 5 of Table 5.

3.3.3 Defining size

One difficulty in empirically investigating the Rauch-Watson model is the appropriate notion of initial size. Due to product heterogeneity it may be more appropriate to use market share instead of dollar value to define size. For some products \$15,000 may be big and for others \$1 million could be small. I calculate market share for each supplier in their first year and divide relationships into five groups so approximately the same fraction of observations fall into each group as under dollar value cutoffs. The chosen market share cutoffs are: 0.4%, 5%, 20%, and 50%.

Estimates presented in column 6 of Table 5 are qualitatively similar to benchmark and other robustness exercises. The estimated effect of size is muted, especially for the largest two groups. The hazard rate for the largest group is 44% lower than for the smallest group. By contrast, the largest group has an 86% lower hazard in the benchmark case.

Two of comments are in order. First, even when using the relative size concept larger initial transactions have lower hazard. Second, results suggest the absolute size

of a transaction has a more pronounced effect on hazard. A supplier may be relatively big even though it may have only a few thousand dollars of sales. All else equal, this supplier is worse off than a relatively small supplier with a million dollars of sales.

3.3.4 Aggregation

In the preceding analysis trade relationships were defined using product level data. The product level might be an overly fine parsing of data. A supplier may sell a variety of products that all fall within the same industry. Product level data would reveal this supplier has very short duration as its sales shift from one product to another. At the industry level, however, one would observe the supplier experiences a long duration. The highly disaggregated nature of trade data might bias results toward short duration. Spells of service at the SITC 5- and 4-digit levels were computed using industry level data compiled by Feenstra (1996) and Feenstra et al. (2002). Industry level estimates are reported in columns 7 and 8 of Table 5. Following Hummmels and Lugovskyy (2003) I exclude transportation costs as the reliability of cif/fob ratios declines with aggregation.

Results are qualitatively similar to the benchmark. Contiguity has a much stronger effect than at the product level, while the effect of multiple spells is reduced significantly. Intermediate goods are no longer different, largely due to imperfect matching of product level characteristics to industries. An industry might contain final and intermediate goods. In such cases the industry was assigned the characteristic of the majority of products within it. General insights that search costs, reliability, and initial transaction size all matter for duration find strong support in industry level

estimates.

Overall robustness exercises show benchmark results are robust to a series of alternative treatments. Relationships starting with lower purchases have higher hazard and shorter duration.

4 What About Developed Countries?

When developed country buyers search for suppliers from developing countries they tend to commence the majority of their relationships with small orders resulting in short relationships. Lower search costs and greater supplier reliability result in larger initial orders and longer duration. Are any of these characteristics present when developed country buyers search for suppliers from developed countries? Although Rauch and Watson (2003) did not have those relationships in mind, it is worthwhile to compare the two environments.

Figure 1 and Tables 1 through 4 contain results for developed country relationships equivalent to those already discussed for developing countries. All results are qualitatively similar and only major differences are discussed here. Developed countries have higher survival and lower hazard than developing countries, but still display the same size-duration relationship. Developed countries have relationships that start with smaller purchases. However, they dominate developing countries in the size of the largest relationships by a factor of two. Although seemingly incongruous with the model's implications, the explanation hinges on reliability implications of the model. I will return to this point shortly.

Table 3 replicates the benchmark estimation for developed countries. Results are qualitatively similar to those for developing countries. Distance actually lowers hazard. Japan and several European countries have longer duration than Canada, the closest country to the US, causing the reversal of the sign. Common language, multiple spells, and transportation costs play a larger role, while the impact of GDP and GDP per capita is smaller for developed countries. Exchange rates have a much larger effect in the earlier period, but have almost no impact in the latter period. Except for the largest relationships, the size of the initial purchase reduces hazard more for developed countries. Estimates from the more flexible specification in Table 4 reveal qualitatively similar results to those for developing countries. Larger relationships have lower hazard rates. Robustness exercises (available on request) again show the relationship between the size of the initial purchase and duration is robust.

4.1 A Final Word on Reliability

Reliability has a dual role in the Rauch-Watson model. More reliable suppliers should receive larger initial orders and have longer duration. However, holding the initial purchase constant, higher reliability may lead to higher hazard and lower duration. With highly reliable suppliers it is easy to switch to a new reliable supplier as there is little uncertainty about its reliability. Comparing developed and developing country trade relationships with the US, one may be able to observe just that — at similar levels of initial transaction developing countries may exhibit lower hazard than developed ones as the cost of switching to a new generally less reliable developing country

supplier is higher. Two pieces of evidence support this implication.

At the lower end of initial purchase distribution, the US commences its relationships with developed countries with lower values than with developing countries. These developed country relationships are also strikingly short. At high levels of reliability it is very easy and cheap to strike up and end relationships. Hence, there is a large number of small and short relationships with developed countries even though they are highly reliable.

I offer Table 6 as the other piece of evidence. It presents estimates from one regression where each variable has a specific effect for developed and developing countries and for each initial size group. Results are presented in a nonstandard format due to the large number of coefficients. The top panel contains estimated coefficients for developed countries. This is the only specification which allows me to evaluate the dual role of reliability. Since most coefficients are qualitatively similar to previous specifications, I will focus only on those illuminating differences in final goods relationships.

The dual role of reliability is supported by data. Within each size group, the more reliable developed countries actually have *higher* hazard rates than do the less reliable developing countries. Comparing across size groups only the largest starting developed country relationships have lower hazard than the smallest starting developing country relationships. For all other initial size groups developed countries have a higher hazard than developing countries. Reliability, as measured by per capita GDP and multiple spells, results in lower hazard for larger relationships within each of the two groups defined by general levels of reliability. This indicates a nonlinear effect of

reliability and a presence of a threshold. Below the threshold switching to another less reliable supplier is expensive — a large initial purchase reveals a more reliable supplier with a greater level of protection from being dropped than a comparable supplier who receives the same initial order in an environment with highly reliable suppliers. Thus, a developing country relationship that starts with a large initial purchase is less likely to be ended than a developed country relationships starting with an equivalent purchase, holding everything else constant.

5 Conclusion

This paper examines formation of trade relationships through the lens of a search model. US import data are used to examine a number of implications of the Rauch-Watson model of searching for a foreign supplier from a developing country. There are three main contributions.

First, there is strong support for all implications. Not only do many trade relationships start small but they are also of shorter duration. Relationships that start large are a clear minority with a decided advantage in expected duration. More reliable suppliers have longer lasting relationships. The ease with which a buyer can find a supplier increases duration. Relationships are more likely to end in their early phases if the supplier is reveled to be unreliable. A small fraction of relationships end even after the supplier has proven to be successful.

Second, results indicate the role of search costs is broader than Rauch and Watson suggest. They motivate their model by describing a number of case studies of

a developed country establishing a relationship with suppliers from less developed countries. They point out it is common for these relationships to begin with small orders and are gradually deepened if the buyer is satisfied with the supplier. Not only does this paper go well beyond case study anecdotes, it demonstrates such behavior is not limited to less developed country suppliers. There is overwhelming evidence US buyers start a great majority of relationships with foreign suppliers with small orders whether they are from developed or developing countries. Within the set of highly reliable developed country suppliers, most relationships exhibit higher hazard rates since it is easier and cheaper to end old and establish new relationships when the pool of available suppliers is composed of only highly reliable suppliers.

Third, results highlight an important phenomenon — many trade relationships begin with small initial values and are often very short lived. Future research should explore implications of this finding for international trade both theoretically and empirically. Almost all empirical work uses more aggregated data and as a result does not observe much of the underlying dynamics unearthed here. Results using aggregated data will be driven by the relatively few, but very large observations. While these trade weighted studies accurately measure general patterns and relationships, there is a lot of economic activity they do not capture. Three-quarters of trade relationships begin with less than $50,000. This is an important point from a policy point of view. If only relationships that start with large purchases can be successful (long lasting and of high value), should policy makers invest any effort to help smaller businesses unable to start their relationships at large levels?

The goal of this paper was to highlight the extent of dynamics that exist at a

disaggregated level. Aggregate trade data are appropriate to investigate issues such as why countries trade. In order to understand how countries establish trade relationships and what factors are important disaggregated data must be used. Studies at the disaggregated level allow firms to properly evaluate costs and benefits of participating in international markets. Such studies will enable policy makers to construct better policies to help firms tap international markets. Results of this paper should help on both of those fronts. While this paper certainly should not be the last word on these issues, it provides a strong push and motivation to delve deeper into these issues.

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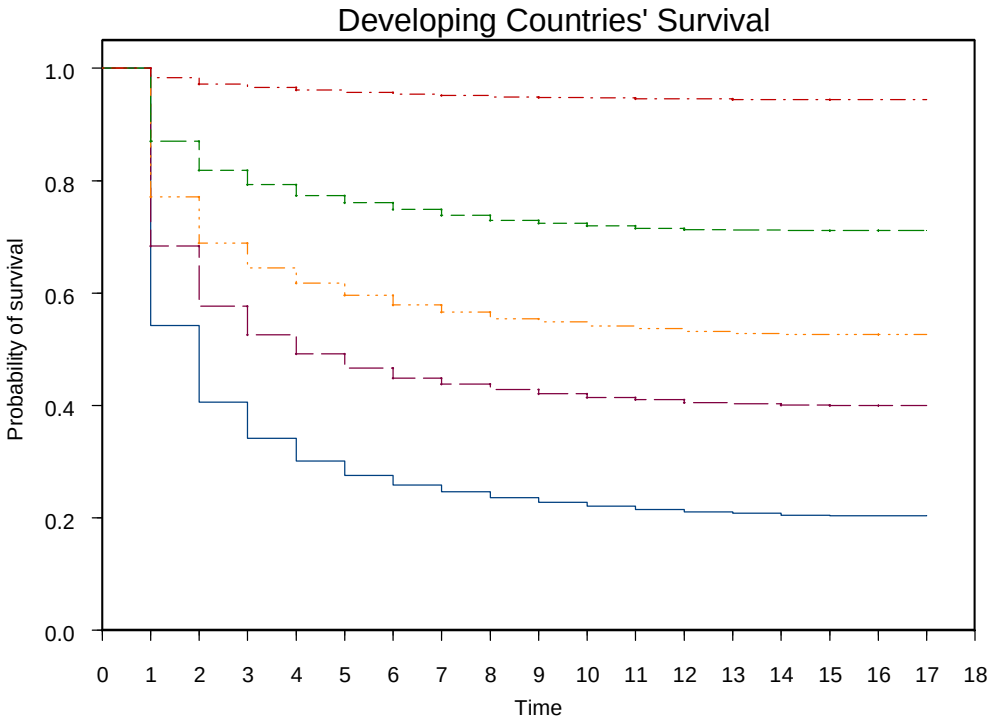
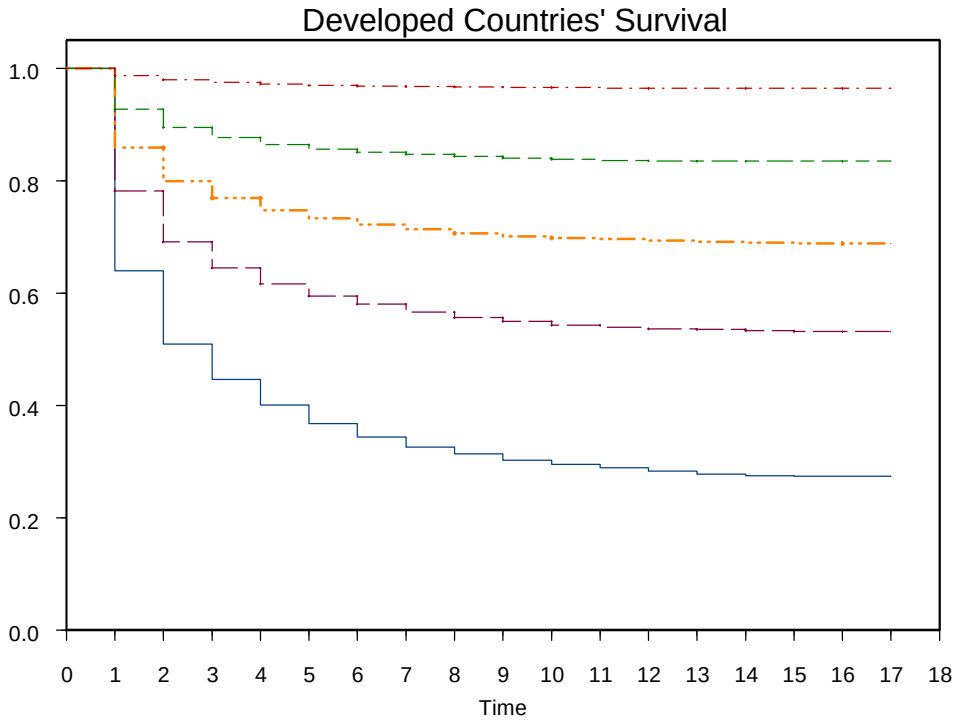
A Data Appendix

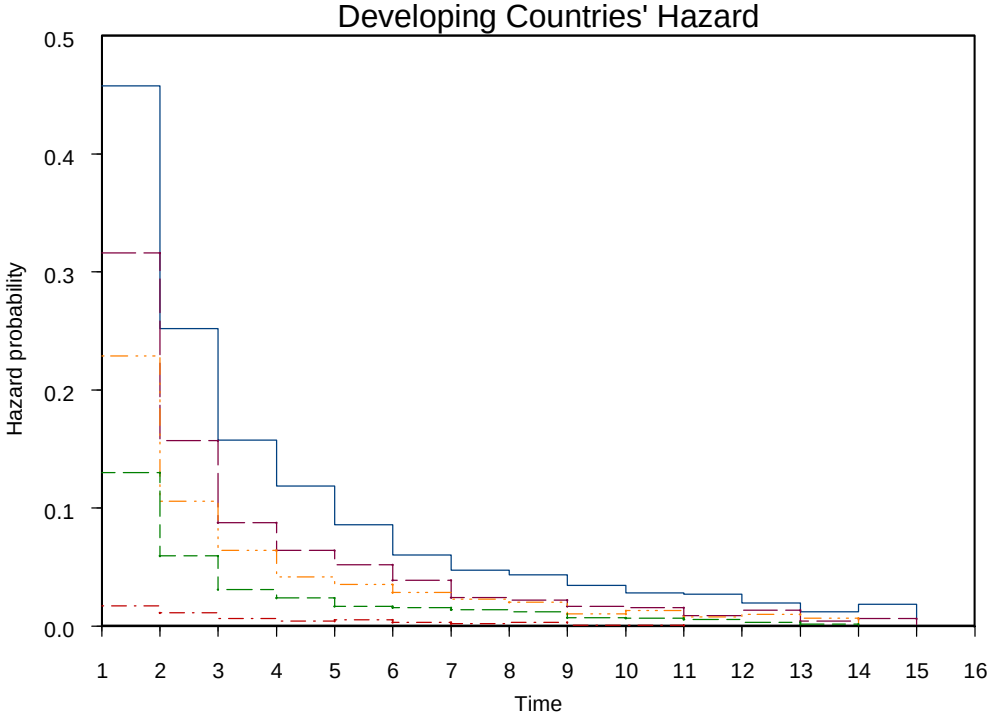
All data are available from public sources.

Variable	**Source**
7-digit TS and 10-digit HS Import Data	Robert Feenstra's online data collection at http://data.econ.ucdavis.edu/international/
5- and 4-digit SITC Import Data	http://data.econ.ucdavis.edu/international/
Consumer Price Index	Bureau of Labor Statistics at http://www.bls.gov/cpi/
Language, Contiguity, Distance	Jon Haveman's online international trade data at http://www.haveman.org/
Real Exchange Rates	US Department of Agriculture's Economic Research Service at http://www.ers.usda.gov/Data/exchangerates/
Ad Valorem Transportation Costs	Calculated from the product level import data from http://data.econ.ucdavis.edu/international/
GDP and GDP per capita	World Bank

Figure 1 - Survival and Hazard by Initial Purchase, 7-digit TS data







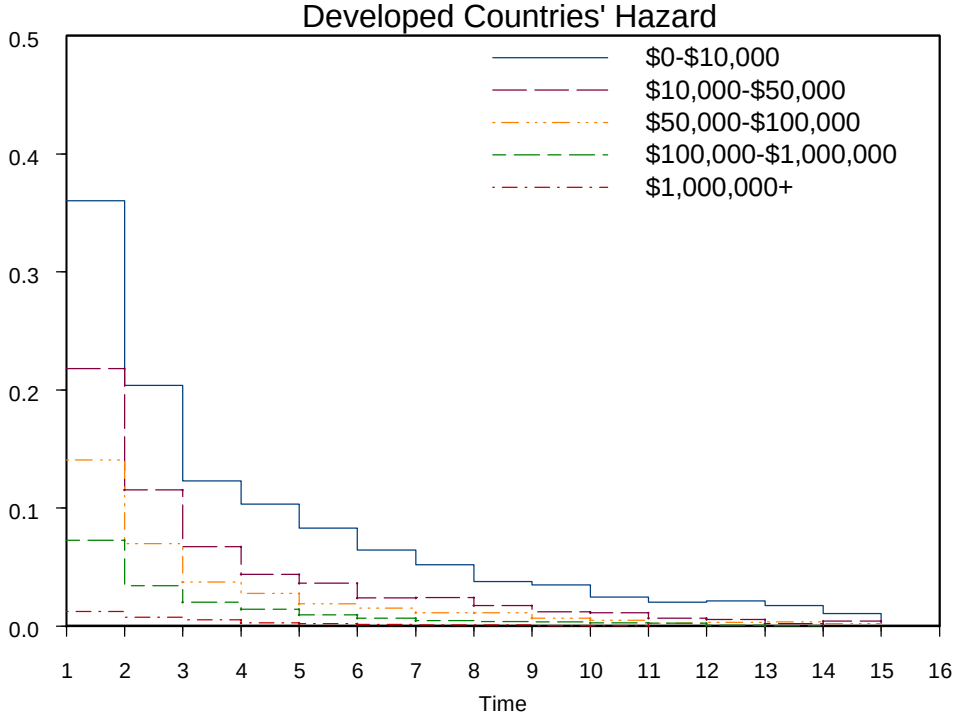


Table 1 - Distribution of First-Year Trade Values ($1987)

		Developing Countries	Developed Countries	All Countries
7-digit TSUSA data, 1972-1988	Relationships	294,075	254,617	548,692
	Mean	$432,151	$1,020,295	$705,076
	5th percentile	$503	$469	$487
	25th precentile	$1,818	$1,634	$1,729
	Median	$7,941	$6,752	$7,376
	75th percentile	$42,100	$44,456	$43,076
	95th percentile	$710,457	$1,335,901	$970,647
10-digit HS data, 1989-2001	Relationships	402,400	299,215	701,615
	Mean	$603,754	$1,232,676	$871,967
	5th percentile	$382	$357	$369
	25th precentile	$2,118	$1,939	$2,041
	Median	$8,384	$8,129	$8,281
	75th percentile	$42,348	$57,282	$47,413
	95th percentile	$823,324	$1,672,886	$1,162,163

Table 2 - Estimated Hazard Rates

	7-digit TS data, 1972-1988			10-digit HS data, 1989-2001		
Year	Developing Countries	Developed Countries	All Countries	Developing Countries	Developed Countries	All Countries
1	0.352	0.264	0.311	0.372	0.287	0.336
2	0.160	0.124	0.141	0.176	0.138	0.158
3	0.088	0.067	0.076	0.098	0.077	0.087
4	0.062	0.047	0.053	0.059	0.045	0.052
5	0.048	0.034	0.039	0.038	0.030	0.034
6	0.034	0.024	0.028	0.027	0.019	0.023
7	0.026	0.020	0.022	0.018	0.014	0.016
8	0.023	0.014	0.017	0.015	0.010	0.012
9	0.016	0.011	0.013	0.009	0.007	0.008
10	0.015	0.008	0.010	0.006	0.004	0.005
11	0.012	0.006	0.008	0.002	0.002	0.002

Note: Hazard rates for only the first 11 years are presented

Table 3 - Cox Proportional Hazard Estimates

	7-digit TSUSA data, 1972-1988				10-digit HS data, 1989-2001			
	Developing Countries		Developed Countries		Developing Countries		Developed Countries	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Distance	1.01484	1.01544	0.96687	0.96387	1.01950	1.02217	0.98615	0.99295
(unit = 1,000 kilometers)								0.077
Language dummy	0.98883	0.97041	0.81755	0.81075	0.95094	0.93572	0.88705	0.89014
	0.110							
Contiguous with USA	0.72116	0.71854			0.65827	0.66416		
Number of potential product suppliers	0.99430	0.99420	0.98457	0.98596	0.99411	0.99386	0.98904	0.98948
GDP per capita	0.98090	0.98314	0.99377	0.99237	0.99853	0.99823	0.99961	0.99883
(1995 US$, unit = $1000)							0.177	
Multiple spell dummy	1.37014	1.31431	1.98109	1.84074	1.36521	1.30997	2.01939	1.79162
GDP	0.90147	0.91068	0.94943	0.95277	0.95113	0.95422	0.96389	0.96727
(1995$, unit = $100bil)								
%Δ relative real exchange rate	0.95083	0.95176	0.83247	0.82894	0.97989	0.97943	0.99179	0.98958
(unit = 10%)							0.021	
Ad-valorem transportation cost	1.03860	1.01082	1.06793	1.03786	1.03351	1.00584	1.06532	1.02835
(unit = 10%)								
Intermediate goods	1.14115	1.10819	0.99325	1.00052	0.96659	0.95213	0.82990	0.84273
			0.522	0.961				
Agricultural goods	0.91297	0.89516	1.03370	1.03001	1.01288	1.02064	1.10605	1.12119
			0.154	0.213	0.528	0.315		
First year imports	0.21691	0.94332	0.32716	0.96885	0.14758	0.85773	0.25480	0.93436
(millions $1987)		0.153		0.090				0.022
First year imports between $10,000 and $50,000		0.69239		0.63645		0.70188		0.59061
First year imports between $50,000 and $100,000		0.51279		0.44359		0.50203		0.39555
First year imports between $100,000 and $1,000,000		0.29219		0.26740		0.27685		0.23145
First year imports above $1,000,000		0.07808		0.08064		0.09009		0.08351
Observations	440,852	440,852	705,022	705,022	839,119	839,119	1,076,172	1,076,172
No. Subjects	193,855	193,855	230,382	230,382	286,709	286,709	293,380	293,380

Notes: Only p-values greater than 0.01 are reported below the estimated hazard ratios
Stratified by regions and 1-digit SITC industries

Table 4 - Cox Proportional Hazard Estimates with Group Varying Coefficients, 1972-1988 7-digit TSUSA data

Developing Countries	Relationships with first year trade value				
	<$10,000	≥$10,000 & <$50,000	≥$50,000 & <$100,000	≥$100,000 & <$1,000,000	≥$1,000,000
Distance	1.01996	1.00814	1.00914	0.97672	0.89148
			0.017		
Language dummy	1.00128	0.96393	0.90327	0.78559	0.55526
	0.870	0.014			
Contiguous with USA	0.82995	0.65311	0.54312	0.35141	0.17382
Number of potential product suppliers	0.99609	0.99260	0.98988	0.98560	0.96714
GDP	0.91530	0.90621	0.89643	0.88178	0.89446
Multiple spell dummy	1.19051	1.40432	1.62944	2.51149	7.16317
GDP per capita	0.98639	0.98219	0.97085	0.97242	1.00543
					0.766
%Δ relative real exchange rate	0.96294	0.92950	0.91061	0.90473	1.00129
					0.971
Ad-valorem transportation cost	1.01324	1.00617	0.97770	0.99684	1.18437
		0.277	0.189	0.878	0.016
Final goods	1	0.86629	0.73984	0.62082	0.38717
Intermediate goods	1.09610	1.15036	1.13328	1.15271	0.99122
					0.967
Agricultural goods	0.83314	0.98174	1.09429	1.14334	0.57067
		0.646	0.276	0.149	0.204
Observations			440,852		
No. Subjects			193,855		

Developed Countries	Relationships with first year trade value				
	<$10,000	≥$10,000 & <$50,000	≥$50,000 & <$100,000	≥$100,000 & <$1,000,000	≥$1,000,000
Distance	0.95803	0.98388	0.99091	1.01294	1.05951
			0.244	0.097	0.032
Language dummy	0.85154	0.77365	0.75184	0.67740	0.42651
Number of potential product suppliers	0.99021	0.98138	0.97529	0.96640	0.95287
GDP	0.95893	0.95056	0.93989	0.92541	0.90303
Multiple spell dummy	1.51883	2.32063	3.43892	5.82499	16.01357
GDP per capita	0.99310	0.99005	0.99098	0.99321	0.98688
					0.036
%Δ relative real exchange rate	0.84064	0.80976	0.79553	0.80125	0.80008
Ad-valorem transportation cost	1.03876	1.04728	1.05931	1.03151	1.08238
				0.126	0.250
Final goods	1	0.59582	0.41247	0.25087	0.08715
Intermediate goods	1.07519	0.99288	0.75588	0.71211	0.84386
		0.770			0.401
Agricultural goods	0.96366	1.04947	1.19565	1.39979	1.84693
	0.165	0.265	0.060		0.020
Observations			705,022		
No. Subjects			230,382		

Notes: Only p-values greater than 0.01 are reported below the estimated hazard ratios
Stratified by regions and 1-digit SITC industries

Table 5 - Robustness Regressions, 1972-1988, Developing Countries

	Product level data						Industry level data	
	(1) Benchmark	(2) Gap-Adjusted	(3) First Spell	(4) Single Spell	(5) No 1972 Spells	(6) Market Share	(7) 5-digit	(8) 4-digit
Distance	1.01544	1.01919	1.01329	1.01597	1.01540	1.01233	1.00840	1.00486
								0.035
Language dummy	0.97041	0.96759	0.94821	0.97796	0.98159	1.00235	0.96511	0.94616
				0.041		0.739		
Contiguous with USA	0.71854	0.63693	0.68162	0.57669	0.74733	0.66166	0.55076	0.49122
Number of potential product suppliers	0.99420	0.99384	0.99562	0.99417	0.99416	0.98948	0.99687	0.99738
GDP per capita	0.98314	0.98126	0.98146	0.97885	0.98231	0.97855	0.98591	0.98658
Multiple spell dummy	1.31431	1.31983			1.26992	1.47309	1.05268	1.07556
GDP	0.91068	0.89662	0.91470	0.88801	0.90697	0.89700	0.88558	0.83430
%Δ relative real exchange rate	0.95176	0.94587	0.95957	0.95263	0.95076	0.95209	0.97372	0.98072
Ad-valorem transportation cost	1.01082	1.00779	1.00792	1.00455	1.01288	1.04203		
				0.108				
Intermediate goods	1.10819	1.10201	1.14561	1.11214	1.11588	1.15110	0.99310	0.99185
							0.625	0.670
Agricultural goods	0.89516	0.90399	0.83758	0.86972	0.89285	0.93153	0.90755	0.89767
								0.011
First year value	0.94332	0.95315	0.88850	0.89608	0.94387	1.00168	0.98809	0.99011
	0.153	0.252	0.058	0.203	0.146	0.069	0.142	0.201
Group 2	0.69239	0.69678	0.67907	0.68159	0.69864	0.68523	0.73834	0.73231
Group 3	0.51279	0.51667	0.49503	0.49411	0.51900	0.53671	0.56854	0.56380
Group 4	0.29219	0.28690	0.26135	0.24631	0.29911	0.51470	0.40437	0.40071
Group 5	0.07808	0.07241	0.06993	0.05686	0.08064	0.56350	0.15299	0.14892
Observations	440,852	467,291	330,325	279,733	391,537	440,852	164,274	110,292
No. Subjects	193,855	170,863	142,371	113,404	186,341	193,855	47,810	29,271

Notes: Only p-values greater than 0.01 are reported below the estimated hazard ratios

Stratified by regions and 1-digit SITC industries

For specifications (1)-(5) and (7)-(8) 'First year value' denotes the dollar value of imports (millions) and Groups 2-5 are defined as in Table 4.

For specification (6) 'First year value' denotes import market share (%) and Groups 2-5 are defined as follows:

Group 2	First year market share between 0.4% and 5%
Group 3	First year market share between 5% and 20%
Group 4	First year market share between 20% and 50%
Group 5	First year market share above 50%

Table 6 - Reliability and value specific estimates for 1972-1988 7-digit TSUSA data

Developed Countries	Relationships with first year trade value				
	<$10,000	≥$10,000 & <$50,000	≥$50,000 & <$100,000	≥$100,000 & <$1,000,000	≥$1,000,000
Distance	0.92691	0.95214	0.95913	0.97991	1.02550
				0.008	0.347
Language dummy	0.80299	0.72981	0.71260	0.64171	0.40347
Number of potential product suppliers	0.99045	0.98168	0.97551	0.96661	0.95327
GDP per capita	0.99295	0.98999	0.99098	0.99328	0.98648
				0.002	0.032
Multiple spell dummy	1.51537	2.31277	3.41588	5.79069	15.92781
GDP	0.96299	0.95480	0.94375	0.92864	0.90397
%Δ relative real exchange rate	0.84093	0.81073	0.79649	0.80217	0.80189
Ad-valorem transportation cost	1.03870	1.04715	1.06039	1.03329	1.08861
			0.001	0.105	0.213
Final goods	1	0.59226	0.41019	0.25071	0.08825
Intermediate goods	1.07324	0.99173	0.75541	0.70992	0.83695
		0.734			0.378
Agricultural goods	0.97559	1.06623	1.21261	1.42232	1.85913
	0.350	0.136	0.041		0.019

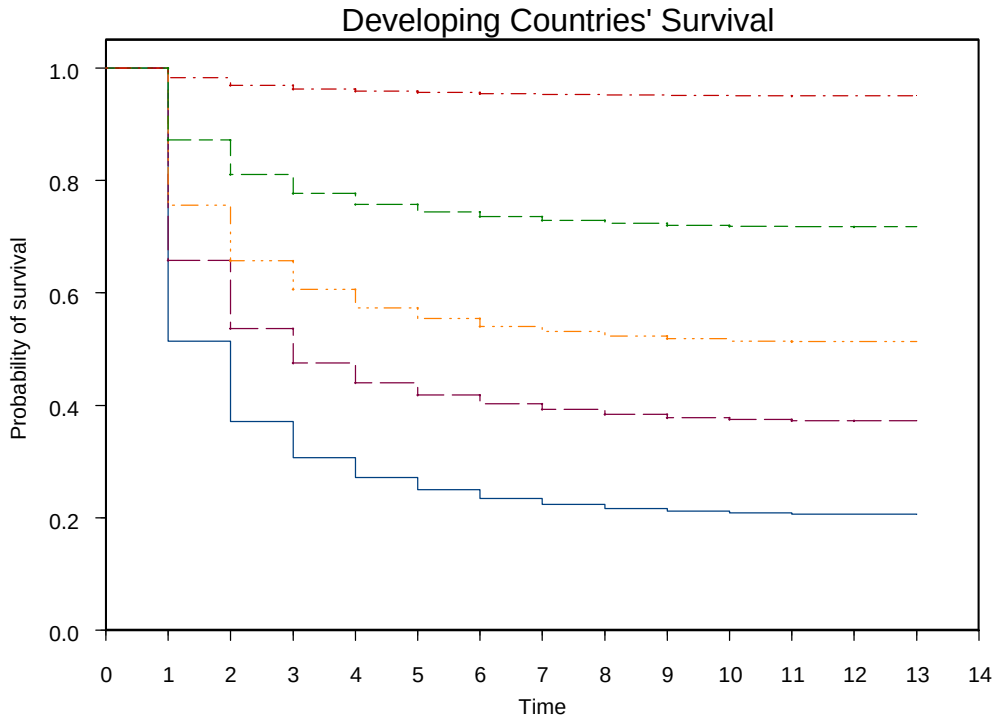
Developing Countries	Relationships with first year trade value				
	<$10,000	≥$10,000 & <$50,000	≥$50,000 & <$100,000	≥$100,000 & <$1,000,000	≥$1,000,000
Distance	1.01981	1.00765	1.00841	0.97595	0.89120
			0.029		
Language dummy	1.01164	0.97244	0.90848	0.78749	0.55298
	0.134	0.063	0.004		0.005
Contiguity	0.83447	0.65433	0.54262	0.35082	0.17357
Number of potential product suppliers	0.99632	0.99276	0.98993	0.98560	0.96704
GDP per capita	0.98612	0.98187	0.97060	0.97232	1.00540
					0.768
Multiple spell dummy	1.18610	1.40160	1.62929	2.51402	7.17897
GDP	0.91444	0.90558	0.89606	0.88164	0.89437
					0.003
%Δ relative real exchange rate	0.96270	0.92930	0.91048	0.90453	1.00121
					0.972
Ad-valorem transportation cost	1.01316	1.00588	0.97634	0.99550	1.18114
		0.301	0.164	0.827	0.018
Final goods	0.13702	0.11930	0.10247	0.08604	0.05370
Intermediate goods	1.10001	1.15549	1.13863	1.15819	0.99487
			0.005	0.005	0.981
Agricultural goods	0.82303	0.97307	1.08172	1.12896	0.56865
		0.494	0.342	0.192	0.201

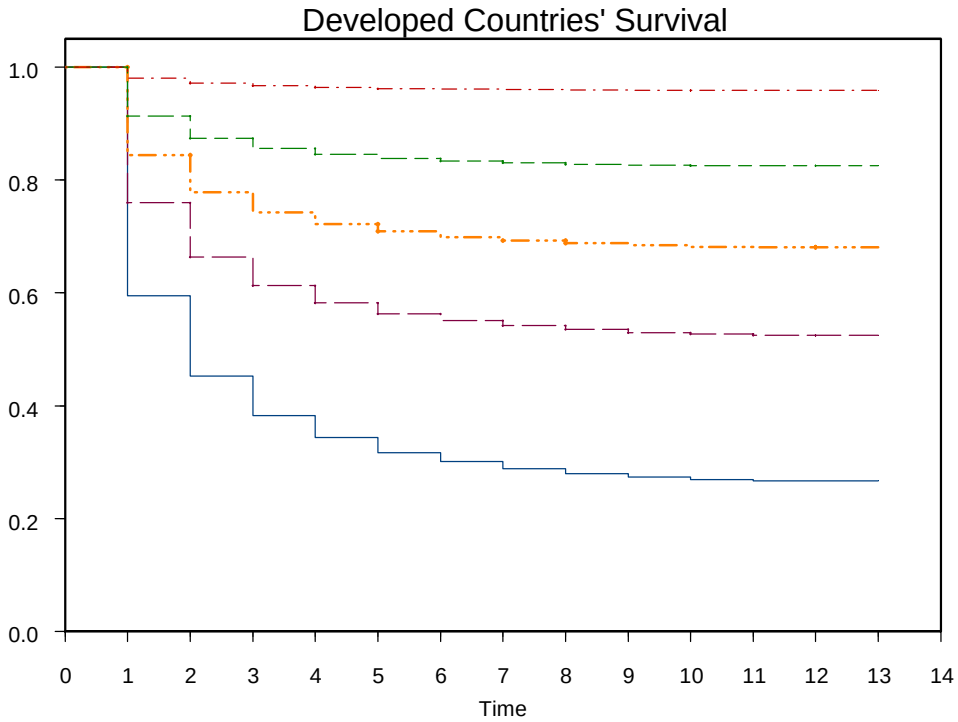
Observations	1,145,874
No. Subjects	424,237

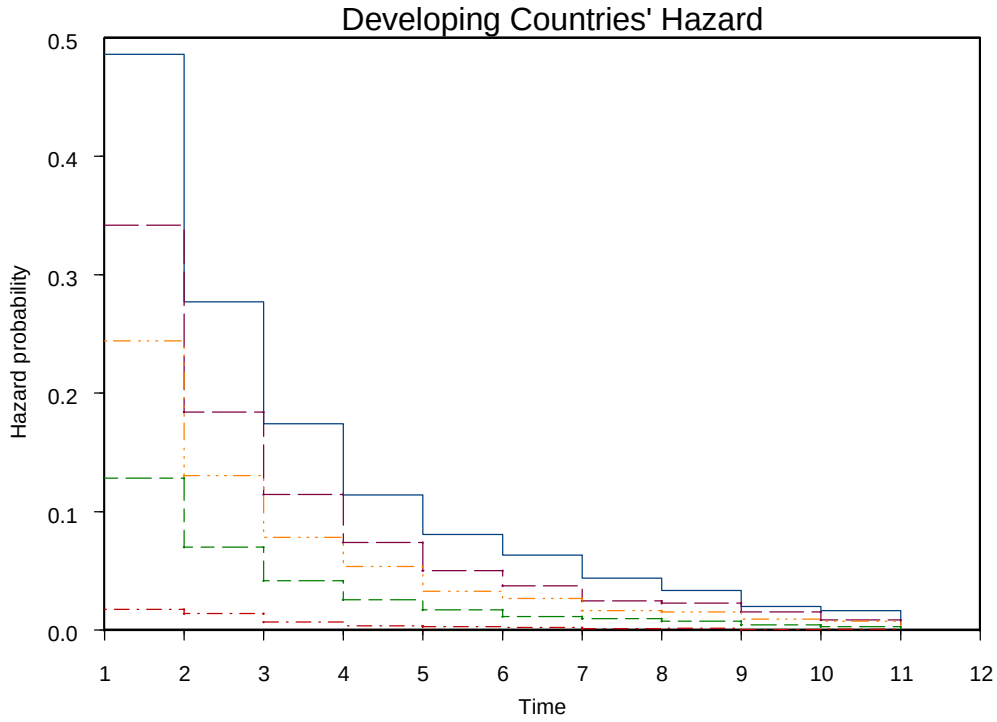
Notes: Only p-values greater than 0.01 are reported below the estimated hazard ratios
Stratified by regions and 1-digit SITC industries

B Referee's Appendix

Figure RA1 - Survival and Hazard by Initial Purchase, 10-digit HS data







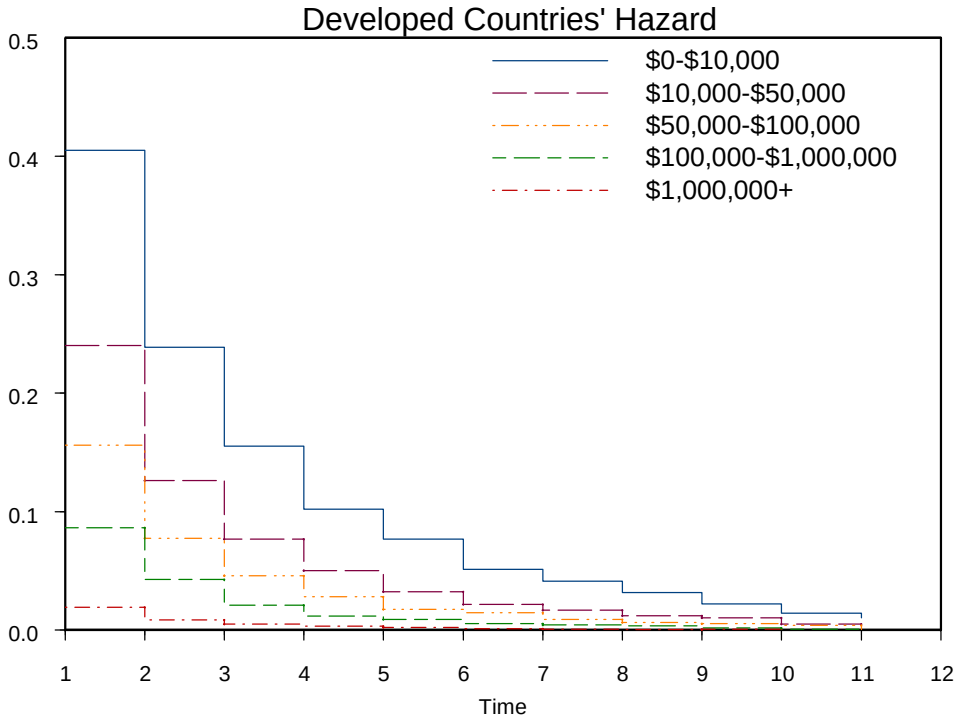


Table RA1 - Robustness Regressions, 1989-2001, Developing Countries

	Product level data						Industry level data	
	(1) Benchmark	(2) Gap-Adjusted	(3) First Spell	(4) Single Spell	(5) No 1989 Spells	(6) Market Share	(7) 5-digit	(8) 4-digit
Distance	1.02217	1.02681	1.02336	1.02935	1.01990	1.01718	1.02379	1.02306
Language dummy	0.93572	0.92323	0.92622	0.91060	0.94107	0.96753	0.87565	0.86738
Contiguous with USA	0.66416	0.58292	0.68592	0.48507	0.65732	0.60691	0.55216	0.58697
Number of potential product suppliers	0.99386	0.99311	0.99779	0.99325	0.99204	0.98925	0.99267	0.99307
GDP per capita	0.99823	0.99796	0.99378	0.99858	0.99756	0.99723	0.99203	0.99190
				0.054				
Multiple spell dummy	1.30997	1.32174			1.14332	1.53887	1.31939	1.30920
GDP	0.95422	0.94163	0.96290	0.93430	0.94753	0.94682	0.87519	0.82793
%Δ relative real exchange rate	0.97943	0.97672	0.98047	0.97950	0.98083	0.98041	0.98253	0.98549
Ad-valorem transportation cost	1.00584	1.00389	1.00103	0.99889	1.00695	1.04089		
		0.060	0.618	0.682				
Intermediate goods	0.95213	0.93612	0.94773	0.94840	0.98449	0.96660	0.93253	0.92966
					0.016			
Agricultural goods	1.02064	1.03558	1.02481	1.06143	1.02007	1.02636	0.94716	1.04142
	0.315	0.164	0.361	0.087	0.291	0.209	0.223	0.442
First year value	0.85773	0.85329	0.78636	0.85515	0.87071	1.00080	0.72812	0.89877
			0.019	0.100		0.381		0.339
Group 2	0.70188	0.68205	0.65678	0.63441	0.74163	0.67689	0.66189	0.67983
Group 3	0.50203	0.47346	0.43039	0.39112	0.55236	0.53417	0.43955	0.47714
Group 4	0.27685	0.25116	0.21717	0.17850	0.32207	0.50809	0.24522	0.27499
Group 5	0.09009	0.07896	0.07106	0.05022	0.10892	0.58791	0.08907	0.06838
Observations	839,119	885,305	628,768	500,762	789,517	839,119	237,915	117,552
No. Subjects	286,709	240,827	192,508	127,588	271,801	286,709	39,521	25,756

Notes: Only p-values greater than 0.01 are reported below the estimated hazard ratios

Stratified by regions and 1-digit SITC industries

For specifications (1)-(5) and (7)-(8) 'First year value' denotes the dollar value of imports (millions) and Groups 2-5 are defined as in Table 4.

For specification (6) 'First year value' denotes import market share (%) and Groups 2-5 are defined as follows:

Group 2	First year market share between 0.4% and 5%
Group 3	First year market share between 5% and 20%
Group 4	First year market share between 20% and 50%
Group 5	First year market share above 50%

Table RA2 - Cox Proportional Hazard Estimates with Group Varying Coefficients, 1989-2001 10-digit HS data

Developing Countries	Relationships with first year trade value				
	<$10,000	≥$10,000 & <$50,000	≥$50,000 & <$100,000	≥$100,000 & <$1,000,000	≥$1,000,000
Distance	1.02260	1.02309	1.02065	1.00698	0.96115
				0.021	
Language dummy	0.93242	0.88803	0.86705	0.91498	1.05757
					0.665
Contiguous with USA	0.74264	0.59574	0.56394	0.42794	0.30949
Number of potential product suppliers	0.99522	0.99325	0.99137	0.98840	0.97831
GDP per capita	1.00102	0.99832	0.99242	0.98951	0.98811
	0.019	0.023			0.088
Multiple spell dummy	1.10524	1.45663	2.01866	3.40717	13.99755
GDP	0.96312	0.94889	0.93053	0.92030	0.93983
%Δ relative real exchange rate	0.97552	0.98385	0.98638	0.98220	0.99609
					0.569
Ad-valorem transportation cost	1.01532	0.97488	0.93418	0.92463	1.01908
					0.815
Final goods	1	0.74465	0.57554	0.36085	0.12027
Intermediate goods	0.99000	0.91631	0.85763	0.83774	0.78401
	0.219				0.102
Agricultural goods	1.01454	1.06927	1.02356	0.96758	0.92923
	0.553	0.060	0.773	0.697	0.827
Observations			839,119		
No. Subjects			286,709		

Developed countries	Relationships with first year trade value				
	<$10,000	≥$10,000 & <$50,000	≥$50,000 & <$100,000	≥$100,000 & <$1,000,000	≥$1,000,000
Distance	0.98001	1.01091	1.02604	1.06018	1.10406
		0.013			
Language dummy	0.94965	0.82807	0.76220	0.65282	0.54039
Number of potential product suppliers	0.99424	0.98465	0.97571	0.96629	0.94485
GDP per capita	0.99959	0.99669	0.99757	0.99877	0.99371
	0.201		0.115	0.401	0.175
Multiple spell dummy	1.35233	2.53932	4.04653	7.00524	15.81319
GDP	0.97397	0.96372	0.95730	0.94838	0.93120
%Δ relative real exchange rate	0.99550	0.96452	0.96201	0.99651	0.94528
	0.243		0.038	0.841	0.259
Ad-valorem transportation cost	1.03008	1.03711	0.99902	1.03149	1.02345
			0.964	0.127	0.754
Final goods	1	0.54516	0.37042	0.20377	0.10424
Intermediate goods	0.93276	0.78932	0.76512	0.56977	0.33655
Agricultural goods	1.07512	1.13896	1.44581	1.16024	1.01693
	0.014			0.170	0.963
Observations			1,076,172		
No. Subjects			293,380		

Notes: Only p-values greater than 0.01 are reported below the estimated hazard ratios
Stratified by regions and 1-digit SITC industries

Table RA3 - Robustness Regressions, 1972-1988, Developed Countries

	Product level data						Industry level data	
	(1) Benchmark	(2) Gap-Adjusted	(3) First Spell	(4) Single Spell	(5) No 1972 Spells	(6) Market Share	(7) 5-digit	(8) 4-digit
Distance	0.96387	0.93184	0.95936	0.97419	0.96246	0.97010	0.99209	0.98007
							0.408	0.143
Language dummy	0.81075	0.79931	0.80398	0.80381	0.80923	0.81706	0.83938	0.77349
Number of potential product suppliers	0.98596	0.98499	0.98725	0.98541	0.98540	0.97868	0.99373	0.99491
GDP per capita	0.99237	0.99486	0.99083	0.99088	0.99127	0.99368	0.99441	0.99079
Multiple spell dummy	1.84074	1.83415			1.72663	2.13918	1.59099	1.73035
GDP	0.95277	0.94592	0.94184	0.93215	0.95080	0.94970	0.94300	0.93751
%Δ relative real exchange rate	0.82894	0.76496	0.85369	0.74073	0.83434	0.82787	0.90867	0.92363
Ad-valorem transportation cost	1.03786	1.03682	1.03954	1.04163	1.03930	1.07082		
Intermediate goods	1.00052	0.98036	1.06325	0.98379	1.03102	0.97470	0.85516	0.88833
	0.961	0.165		0.517		0.016		
Agricultural goods	1.03001	1.01455	0.92011	0.87705	1.02563	1.05440	0.96695	1.01780
	0.213	0.628	0.012		0.306	0.024	0.475	0.785
First year value	0.96885	0.97536	0.82288	0.86884	0.96917	1.00484	0.99117	0.99496
	0.090	0.223		0.067	0.080		0.130	0.179
Group 2	0.63645	0.60850	0.56007	0.51612	0.65408	0.74265	0.61762	0.61926
Group 3	0.44359	0.40881	0.34321	0.31261	0.46963	0.61865	0.44914	0.44915
Group 4	0.26740	0.22247	0.18489	0.15481	0.29451	0.52956	0.23721	0.23407
Group 5	0.08064	0.06133	0.07581	0.04927	0.09239	0.49237	0.08406	0.08331
Observations	705,022	744,512	534,032	461,351	537,526	705,022	201,383	113,973
No. Subjects	230,382	196,371	158,590	122,531	208,588	230,382	32,141	15,146

Table RA3 cont. - Robustness Regressions, 1989-2001, Developed Countries

	Product level data						Industry level data	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Benchmark	Gap-Adjusted	First Spell	Single Spell	No 1989 Spells	Market Share	5-digit	4-digit
Distance	0.99295	1.00838	1.01259	1.03177	0.98422	0.99408	1.04201	1.04541
	0.077	0.113	0.019			0.155		0.032
Language dummy	0.89014	0.91286	0.88903	0.89249	0.87877	0.88683	0.91376	0.86456
							0.036	0.039
Number of potential product suppliers	0.98948	0.98927	0.99560	0.98945	0.98774	0.98211	0.98739	0.98696
GDP per capita	0.99883	1.00161	0.99949	1.00120	0.99740	0.99911	0.99019	0.99083
			0.218	0.043				
Multiple spell dummy	1.79162	1.76666			1.44066	2.24676	2.35879	2.58871
GDP	0.96727	0.95915	0.96037	0.94007	0.96648	0.96338	0.93016	0.93838
%Δ relative real exchange rate	0.98958	1.04404	1.01946	1.06786	1.03803	0.99207	0.97422	0.99234
						0.029	0.079	0.730
Ad-valorem transportation cost	1.02835	1.03545	1.03961	1.04387	1.02515	1.06742		
Intermediate goods	0.84273	0.80525	0.79953	0.77134	0.87897	0.80111	0.85347	0.93133
								0.220
Agricultural goods	1.12119	1.14630	1.13733	1.16882	1.10941	1.12826	1.23988	1.37420
First year value	0.93436	0.95788	0.94443	0.83504	0.93808	1.00225	0.98781	0.93935
	0.022	0.134	0.219	0.101	0.021		0.331	0.164
Group 2	0.59061	0.55234	0.47553	0.42594	0.63631	0.68145	0.59980	0.64615
Group 3	0.39555	0.34823	0.27429	0.21950	0.44526	0.50434	0.38185	0.41495
Group 4	0.23145	0.19195	0.13628	0.10530	0.27270	0.43112	0.16578	0.20516
Group 5	0.08351	0.06042	0.04171	0.04108	0.10170	0.46107	0.02642	0.06408
Observations	1,076,172	1,131,036	833,019	688,875	1,004,700	1,076,172	271,504	92,356
No. Subjects	293,380	238,520	189,043	121,512	277,423	293,380	22,267	11,210

Notes: Only p-values greater than 0.01 are reported below the estimated hazard ratios

Stratified by regions and 1-digit SITC industries

For specifications (1)-(5) and (7)-(8) 'First year value' denotes the dollar value of imports (millions) and Groups 2-5 are defined as in Table 4.

For specification (6) 'First year value' denotes import market share (%) and Groups 2-5 are defined as follows:

Group 2	First year market share between 0.4% and 5%
Group 3	First year market share between 5% and 20%
Group 4	First year market share between 20% and 50%
Group 5	First year market share above 50%

Table RA4 - Reliability and value specific estimates for 1989-2001 10-digit HS data

Developed Countries	Relationships with first year trade value				
	<$10,000	≥$10,000 & <$50,000	≥$50,000 & <$100,000	≥$100,000 & <$1,000,000	≥$1,000,000
Distance	0.98011	1.01104	1.02619	1.06029	1.10422
		0.012			
Language dummy	0.95004	0.82850	0.76268	0.65323	0.54079
Number of potential product suppliers	0.99433	0.98479	0.97587	0.96647	0.94505
GDP per capita	0.99961	0.99674	0.99764	0.99885	0.99379
	0.228		0.125	0.432	0.180
Multiple spell dummy	1.35002	2.53332	4.03678	6.98694	15.80054
GDP	0.97411	0.96395	0.95753	0.94854	0.93133
%Δ relative real exchange rate	0.99500	0.96399	0.96091	0.99490	0.94246
	0.194		0.033	0.770	0.236
Ad-valorem transportation cost	1.02977	1.03715	0.99895	1.03237	1.02372
			0.961	0.118	0.752
Final goods	1	0.54371	0.36919	0.20303	0.10376
Intermediate goods	0.93305	0.79010	0.76583	0.57002	0.33628
Agricultural goods	1.08204	1.14643	1.45490	1.16769	1.02014
	0.007	0.006		0.153	0.956

Developing Countries	Relationships with first year trade value				
	<$10,000	≥$10,000 & <$50,000	≥$50,000 & <$100,000	≥$100,000 & <$1,000,000	≥$1,000,000
Distance	1.02120	1.02209	1.01960	1.00690	0.96155
				0.023	0.002
Language dummy	0.95909	0.90668	0.88565	0.90096	1.01331
					0.918
Contiguity	0.74141	0.59463	0.56240	0.42785	0.30984
Number of potential product suppliers	0.99523	0.99322	0.99130	0.98831	0.97825
GDP per capita	1.00082	0.99784	0.99185	0.98921	0.98817
	0.061	0.003			0.089
Multiple spell dummy	1.10518	1.45881	2.02478	3.41887	14.03837
GDP	0.96279	0.94803	0.92959	0.91883	0.93824
%Δ relative real exchange rate	0.97570	0.98399	0.98653	0.98228	0.99612
			0.002	0.001	0.570
Ad-valorem transportation cost	1.01529	0.97464	0.93381	0.92501	1.01916
					0.814
Final goods	0.19444	0.14507	0.11233	0.07012	0.02326
Intermediate goods	0.98975	0.91563	0.85696	0.83714	0.78278
	0.208				0.100
Agricultural goods	1.00962	1.06583	1.02011	0.96410	0.92492
	0.694	0.074	0.805	0.666	0.816
Observations			1,915,291		
No. Subjects			580,089		