No. 2013-06A

OFFICE OF ECONOMICS WORKING PAPER
U.S. INTERNATIONAL TRADE COMMISSION

Heterogeneity of Goods and Methods of Trade: Wholesalers, Intra Firm, or at Arms-Length

Michael Ferrantino*
Darren Sheets*
Danielle Trachtenberg*

U.S. International Trade Commission

June 2013

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*The authors are with the Office of Economics of the U.S. International Trade Commission.

Address correspondence to:
Office of Economics
U.S. International Trade Commission
Washington, DC 20436 USA

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Michael Ferrantino, Darren Sheets, and Danielle Trachtenberg[1]

6/28/13

Abstract

We examine the empirical determinants of modes of U.S. exporting, using a unique dataset that identifies whether exports are sold through wholesalers, at arms-length, or intrafirm. Exports of wholesalers are more likely to be reference-priced goods, while related-party exports are more likely to be R&D-intensive differentiated products, and arms-length exports are most common for homogeneous goods in unconcentrated industries.

Keywords

Intermediaries, trade, wholesalers, contractibility, product heterogeneity.

[1] The authors are with the Office of Economics of the U.S. International Trade Commission. This paper represents solely the views of the authors and does not represent the views of the U.S. International Trade Commission or any of its Commissioners. All comments are welcome.

1. Introduction

There has been a growing field of research recently on firm heterogeneity and intermediaries in international trade. Intermediaries are known to contribute a significant amount to total trade. From 2005 to 2007, intermediaries accounted for 41% of Chilean imports (Blum et. al., 2010). Wal-Mart alone accounts for 15% of consumer good exports from China to the U.S. (Basker and Van, 2008). In 2005, 22% of Chinese exports were by intermediaries; which is likely an underestimate due to misidentifying intermediaries based on firm name and licensing agreements before China's entry into the WTO (Ahn et. al., 2011). Also in 2005 17% of all Turkish exports were traded by an intermediary (Abel-Koch, 2011). Bernard et al. (2010a) finds that pure intermediaries (wholesalers and retailers) accounted for 9% of U.S. exports by value.

The aim of this paper is to identify the conditions associated with the degree of intermediation for U.S. exports. We consider three methods for exporting a good: related party trade (i.e. intra-firm trade between parents and affiliates), arms-length trade between unrelated parties but without intermediation, and exporting via a wholesaler intermediary. These forms of trade are subject to different kinds of transactions costs, and relate differently to the boundaries of the firm (Williamson, 1985). Related-party trade takes place within the firm, arms' length trade crosses one firm boundary, and wholesale trade crosses two boundaries (producer/wholesaler/importer).

This suggests the possibility that firms may choose a mode of exporting according to the "contractibility" of the products they export, which is inversely related to the degree to which their products are complex or differentiated. For multinational firms producing complex or differentiated products, the costs associated with intrafirm trade

may be relatively low because the firm has a greater ability to safeguard production processes, choose a cost-efficient production location and avoid costly contractual hold-ups. Conversely, homogenous goods generally do not require the same degree of safeguarding of firm production processes.[2] Homogenous goods would be expected to be exported through a wholesaler because the fixed costs of wholesale trade to the producer are substantially smaller than other modes of trade. Arms' length exports, which cross one firm boundary, might be expected to fall somewhere in between.

We find that more complex and differentiated goods are in fact likely to be exported through related-party trade. Wholesale exports appear to be more contractible than related-party exports. They are more likely to be homogenous and tend to be reference-priced. Arms' length exports are less likely to be R&D intensive, and more likely to appear for non-concentrated industries.

2. Literature

Bernard et al. (2010a) finds significant heterogeneity amongst exporters with respect to firm employment, volume/value of trade, and number of countries they export to. They find that firms that engage solely in wholesale or retail trade have lower employment than those that engage in no wholesale or retail trade. These firms trade less value but more products per country. Firms that engage in a mixture of wholesale/retail and direct trade have substantially higher employment than firms that only trade directly.

There has also been much research exploring why exporters use trade intermediaries. Ahn et al. (2011) and Akerman (2011) provide similar theoretical frameworks that find firms sort according to their productivity, and in general the least

[2] Agriculture products such as dairy, fruits, and horticulture are good examples of homogenous goods. In our data, of the top six industries exporting via wholesalers as a percentage of total trade, five are agriculture industries.

productive firms serve only the domestic market (or exit), the most productive export directly to the foreign market and all others use trade intermediaries. The intermediary provides lower fixed costs to access the foreign market than doing so directly, but has higher variable costs since the intermediary is providing a service. Firms that aren't productive enough to incur the larger fixed costs and trade directly use an intermediary to export. Ahn et al. (2011) uses Chinese census data at the firm level to empirically support the productivity sorting hypothesis. Intermediary unit values are also found to be higher than direct export values, consistent with model predictions that intermediaries have higher marginal costs.

With respect to country characteristics, Bernard et al. (2010b) and Ahn et al. (2011) both suggest that intermediaries are focused geographically. This is consistent with intermediaries possessing country specific knowledge that allows them to forego some costs of trade. Consistent with standard gravity model results, Bernard et al. (2010b) finds that exports are negatively related to distance and positively related to GDP. Ahn et al. (2011) finds that intermediary export share is positively related to distance and negatively related to GDP.[3] Since exports in general decrease with distance, this makes intermediaries even more valuable for trade as distance increases. They also find that when compared to direct exports, intermediaries are less sensitive to country characteristics.

There has also been recent research examining the role related party, or intra-firm, trade plays. Felbermayr and Jung (2009) get similar results as Ahn et al. (2011) and Akerman (2011) when firms sort according to their comparative advantage, which is a

[3] Bernard et al. (2010b) also finds this negative relationship with GDP, but doesn't find a statistically significant relationship with distance.

measure of firm level productivity that is a function of the firms brand reputation, labor input requirement to produce one unit, and variable distribution costs. In their model, firms can trade via a foreign intermediary or a wholesale affiliate of the firm. They find firms with higher quality products, lower costs, and stronger marketability tends to use intra-firm trade. This is for two reasons: intra-firm trade eliminates hold-up problems that can arise when trading with other firms and contracts between trading firms can raise costs for the exporter. Helpman et al. (2004) get similar results with respect to sorting by productivity and their model predicts the most productive firms will invest in horizontal FDI to serve the foreign market.

Bernard et al. (2010c) uses product and country characteristics to analyze firm decisions to import from related parties versus directly, or arm's length trade. Their motivation for using these characteristics is the large amount of observed heterogeneity amongst importers and contracting issues that can arise between importers and exporters. Of particular interest to this paper, they find that industries whose products require greater capital and skill intensity are more positively associated with intra-firm trade.

Rauch (1999) finds evidence using a gravity model that product differentiation has an effect on international trade. He groups commodities into one of three categories based on how the commodity is priced. Commodities that are priced on *organized exchanges*, for example the Chicago Mercantile Exchange, are considered to be homogenous commodities because they can be priced without knowledge of the specific producer. Commodities that are priced in trade journals are considered *referenced priced* and also homogenous for the same reason as commodities priced on organized exchanges. All other commodities are considered *differentiated* for their lack of any

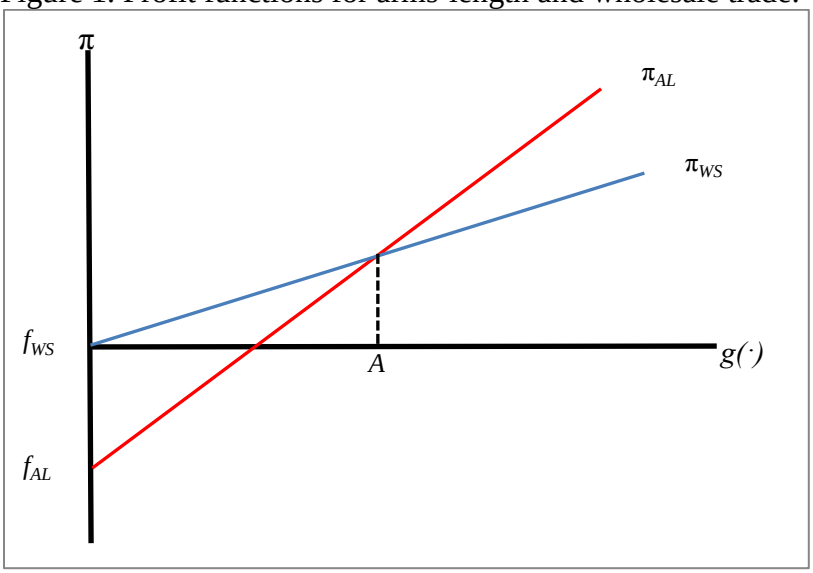
widely accepted price. This paper will use these commodity classifications to better understand how product differentiation influences firm's decisions to use intermediaries in international trade. While previous research has focused on firm and country characteristics of intermediary and direct exporters, this paper will focus on the products produced by the firm. In particular, we look for evidence that firms select their mode of export in part due to the products they trade.

3. Theoretical Framework

The previous research has focused on the relationships between arm's-length, wholesale, and related party trade while considering only two of these methods of trade in one model. This model wishes to combine all three of these methods of trade into one theoretical framework. To do so we will draw heavily upon the works of Ahn et al. (2011), Akerman (2011), Felbermayr and Jung (2009), and Helpman et al. (2004) essentially by simply synthesizing their frameworks.

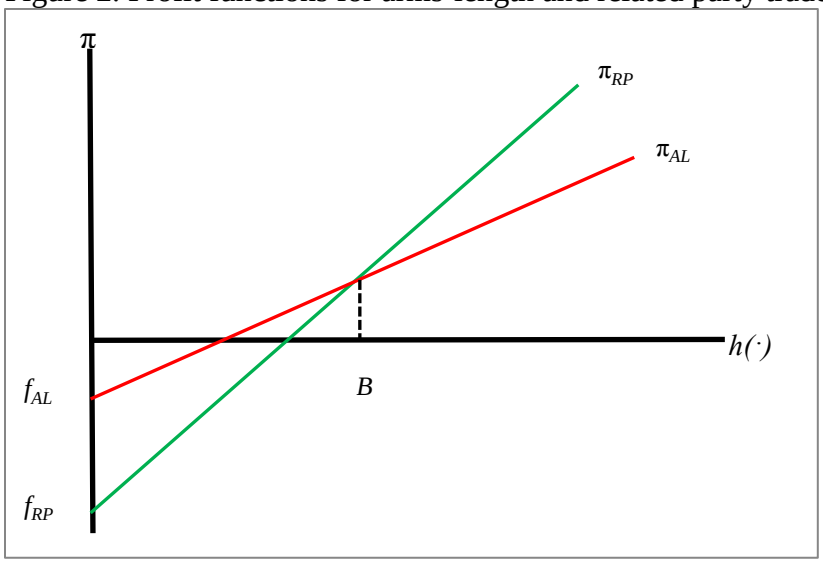
Ahn et al. (2011) and Akerman (2011) both provide similar theories that firms that trade via arm's-length have greater fixed costs, f_{AL}, than those that trade via a wholesaler where fixed costs are f_{WS}. The fixed costs for wholesale trade is lower because the firm forgoes the costs of setting up its own network in the foreign market. Revenue is greater for firms that trade via arm's length since wholesale trade requires paying the wholesaler for their service, which increases marginal cost. Profits, π, increase more quickly when trading via arm's-length. The point *A* represents the position where it becomes more profitable to engage in arm's-length trade rather than wholesale trade. Their models are summarized in figure 1. The function $g(\cdot)$ represents the firm's productivity.

Figure 1. Profit functions for arms-length and wholesale trade.



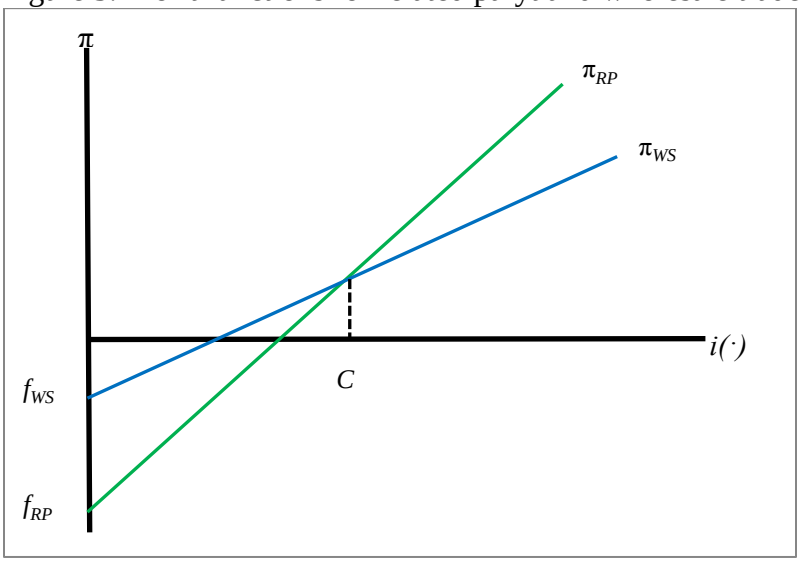
The model by Helpman et al. (2004) contains trade via arm's length which has lower sunk costs than trade via related party, $f_{AL} < f_{RP}$, but higher per-unit costs that results in a flatter profit function. The switch from arm's length to related party trade at point *B* is based on the productivity of the firm, i.e., the most productive invest in a subsidiary with FDI. Labor per unit output is represented by the function $h(\cdot)$. This is shown graphically in figure 2.

Figure 2. Profit functions for arms-length and related party trade.



In Felbermayr and Jung (2009) wholesale trade has lower fixed costs than related party trade. The switch from wholesale to related party trade at point *C* is related to the firm's competitive advantage which is a function in part of production costs and the marketability of its goods, $i(\cdot)$. This is summarized in figure 3.

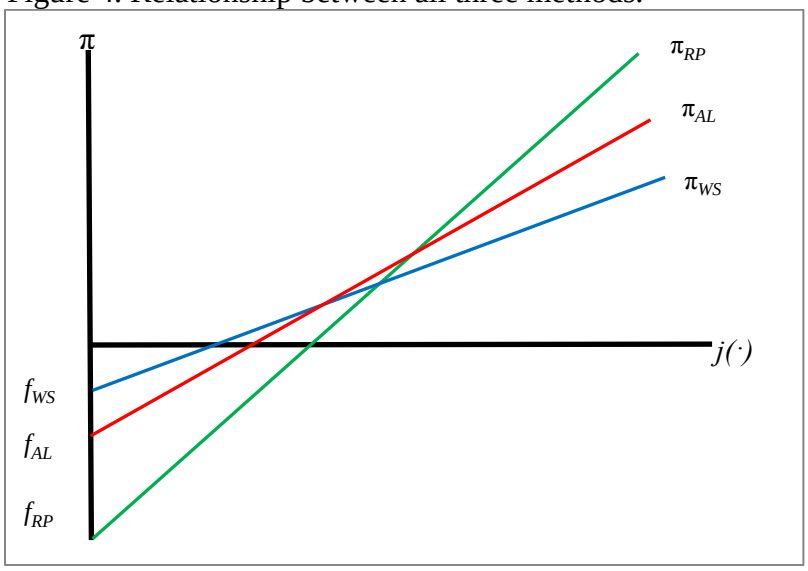
Figure 3. Profit functions for related paryt and wholesale trade.



Figures 1 and 2 make it easy to see the relationship between costs, $f_{WS} < f_{AL} < f_{RP}$. This relationship is also captured in figure 3. Figures 1-3 also provide simple visual evidence that $\pi'_{WS} < \pi'_{AL}$, $\pi'_{AL} < \pi'_{RP}$, $\pi'_{WS} < \pi'_{RP}$ respectively. Combining these we have $\pi'_{WS} < \pi'_{AL} < \pi'_{RP}$. These relationships are summarized in figure 4.

We now see the richness available by including all three trading methods in a single theoretical framework. We are no longer binding firms to progress solely from one method to another, but rather a firm may begin with a wholesaler, than proceed to arm's-length, and finally related party trade. A firm that is testing the waters of international trade for the first time is less likely to risk a large investment for an endeavor it is uncertain of. Wholesalers provide the cheapest way of trade since they already have facilities abroad. They are also relatively easy to use since they overcome country

Figure 4. Relationship between all three methods.



characteristics such as language, cultural, and legal barriers that can hinder trade. Once the firm has successfully traded and found a market receptive to their products, moving to arm's length trade is now easier. The firm knows there is a market for their product making the added expenses of arm's length trade worthwhile to save the marginal cost paid to wholesalers that flattens the profit curve. The argument for a move to related party from arm's length trade is similar.

Let us now turn out attention to $j(\cdot)$, the function that will determine the slope and intercept of the profit curves, and hence the level of wholesale, arm's-length, and related party trade. In line with previous research, $j(\cdot)$ should be a function capturing firm productivity, the firm's ability to write contracts for traded goods, and the quality or uniqueness of the firm's goods. The focus of this research is how product heterogeneity may influence the use of trade intermediaries, so let's discuss this in greater detail. Goods characteristics are important because they are how the firm earns profits. A unique good, a *heterogeneous good*, is likely to be more profitable than common goods, or

homogenous goods. Apple Inc. makes very unique products and is indeed very profitable. Compare this with the producers of oranges, which are quite homogenous, and less profitable. There are exceptions to this argument, for instance petroleum is quite homogenous yet very profitable. In general we hypothesize that heterogeneous goods are more likely to be trade related party. Doing so allows the firm to earn higher profits by taking advantage of cost savings and protecting firm level secrets about their goods. Homogenous goods on the other hand are more likely to be traded via wholesalers, because there are no secrets to protect about their goods and the marginal cost savings are likely not large enough to warrant the high fixed costs of related party or arm's length trade.

4. Data and descriptive statistics

For 2007, we observe 85 U.S. industries at the four digit NAICS code level. Data from the U.S. Census Bureau identifies the amount of each industries export value that is attributable to wholesale or related party trade. For each industry we calculate the *wholesale intensity*, the percentage of exports that are wholesale exports. Similarly, we calculate the *related party intensity*, the percentage of exports that are related party, or intra firm trade. Exports classified as neither are represented by *arms-length intensity*, intuitively this intensity represents trade in the traditional sense between countries. For example, a U.S. firm exports its goods directly to a French firm. Herfindahl-Hirschman index data is collected for manufacturing industries from the U.S. Census Bureau's 2007 economic census. U.S. Census data from 2006 is used to determine annual pay and employment for each industry. These data do not include four digit NAICS level data for many agriculture industries, so two digit level data is used so that the agriculture

industries will be included in our analysis.[4] Worldwide R&D expenses and sales are collected from the National Science Foundation. Much of these data is at the three digit NAICS level, thus many of our four digit observations will have identical values for these data. Previous research has found positive and significant results between intra-firm trade and the ratio of R&D to sales, thus we include this variable in our analysis.[5] This variable also provides a proxy for contract complexity that may arise in trade. Variables defining goods as organized, referenced, or differentiated are obtained from Rauch (1999).[6]

Inspecting the summary statistics in table 1 we observe on average approximately 17% of an industries total trade value is attributable to wholesale trade, 26% is related party trade, and 57% is arms-length trade between countries.

Table 1: Summary Statistics

	mean	sd	min	max
WS Intensity	0.169	0.118	0.036	0.598
RP Intensity	0.258	0.130	0.024	0.657
Arms-length Inten.	0.573	0.151	0.002	0.869
Mean Employ.	80.365	97.400	2.806	708.597
HHI	401.216	400.572	5.800	2030.700
Pay/Worker	44406.700	14217.980	24429.578	111211.766
R&D/Sales	0.024	0.029	0.004	0.150
Differ. Good	0.753	0.434	0.000	1.000
Refer. Good	0.200	0.402	0.000	1.000
Organized Good	0.047	0.213	0.000	1.000
N	85			

[4] We don't have wholesale export data for many agriculture industries; 1121, 1122, 1124, 1125, 1129, 1132, and 1133. Thus, without including these two level data agriculture would be left out of the analysis. The two level data is used for NAICS codes Oilseed and Grain Farming (1111), Vegetable and Melon Farming (1112), Fruit and Tree Nut Farming (1113), Greenhouse, Nursery, and Floriculture Production (1114), Other Crop Farming (1119), and Poultry and Egg Production (1123).

[5] For example, see Bernard et al. (2010c), Antras (2003), and Yeaple (2006).

[6] Rauch (1999) uses two approaches for creating this variable. A 'conservative' approach that minimizes the number of commodities classified as organized/exchange and a 'liberal' approach that maximizes. This research uses the variables from the conservative approach. However, regression coefficients and significance levels are very similar when using the variables from the liberal approach.

Table 2: Correlation Matrix

	WS	RP	Arms	Mean Emp.	HHI	Pay/ Worker	R&D/ Sales	Differ. Good	Refer. Good	Org. Good
WS	1									
RP	-0.08	1								
Arms	-0.59	-0.76	1							
Mean Emp.	-0.13	0.24	-0.11	1						
HHI	0.11	0.16	-0.20	0.61	1					
Pay/Worker	0.01	0.31	-0.25	0.43	0.34	1				
R&D/Sales	0.17	0.41	-0.45	0.12	0.14	0.64	1			
Differ. Good	-0.32	0.15	0.09	-0.09	-0.08	-0.25	-0.10	1		
Refer. Good	0.37	-0.08	-0.17	0.09	0.05	0.23	0.16	-0.90	1	
Organized Good	-0.06	-0.17	0.17	0.02	0.07	0.09	-0.11	-0.36	-0.07	1

To inspect the data set two subsets are created. In table 3, column (1) represents industries where wholesale intensity is greater than related party intensity and column (2) represents the opposite. We also conduct a difference of means test between these two columns to determine statistical significance. We observe that wholesale intense industries have mean employment significantly less than that of related party intense industries. There is not a statistically significant difference between the competiveness of wholesale or related party intense industries. Mean pay per worker is approximately 28% higher in related party intense industries when compared to wholesale intense industries. Pay per worker is likely to be closely related to employment size for an industry and in these data we calculate a correlation coefficient of .43 between these two variables. Related party intense industries also have significantly higher R&D to sales ratio. Industries that have more related party trade than wholesale trade also have a significantly larger portion of their products that are priced differentially. On average, approximately 82% of industries where related party trade is greater than wholesale trade have goods that are priced differentially, compared to 50% for wholesale intense industries. A similar observation is made when considering referenced price goods.

Approximately 39% of wholesale intense industries are referenced priced compared to 15% for related party intense industries. One inference to make from these summary statistics is that the more homogenous the good, the more likely it is to be traded by wholesalers. Equivalently, the more heterogeneous the good the more likely it is to be traded by related party exchange.

Given the above observations, why may firms choose between wholesale or related party trade based on the good they're producing? Let's first consider how the production process may differ between the two types of goods. The production of a differentiated good may require more intermediate steps that are unique (and possibly secretive) to the firm. Thus by trading within the firm they can take advantage of costs savings in the production process across countries to complete the final good.

A good example may be the automotive industry which is considered to produce a differentiated good and thus heterogeneous. For instance, U.S. high skilled labor and technology may be used to produce component parts that are then shipped to affiliate plants in Mexico which has a lower labor cost to assemble the final product. Trading intra-firm or wholesale is beneficial because of the labor cost savings. However, intra-firm may be preferred because a firm possesses a unique assembly process for a differentiated product, and trading via a wholesaler would not be efficient (since the wholesaler is unlikely to know this process) or expose the firm's process to its competitors, thus losing its advantage. Indeed, in 2000 more than 70% of U.S. auto and related equipment imports are intra-firm trade (Bernard et al, 2010c).

Compare this example with dairy product manufacturing, which is a referenced price good and thus homogenous. The production of dairy products is relatively well

documented and similar amongst the various producers. If cost savings are available by trading during the production process, intra-firm and wholesale will both be beneficial. But wholesale may be preferred, because the production process is better known amongst firms and there are less production secrets that could be exposed. The lower fixed costs of trade offered by the wholesaler likely benefit the producers of homogenous goods, whereas the producers of differentiated goods are benefited by keeping the production process within the firm. Not surprisingly, our data reveals dairy product manufacturing is the industry with the largest percentage of its trade attributed to wholesale trade, approximately 60%. Agriculture in general should be expected to be dominated by wholesale trade, and consistent with findings from Bernard et al. (2010c) we find that out of the six most wholesale intense industries, five are agriculture related.

Shifting focus from the production of the good, let's now consider the level of control a firm may wish to have over their final good, how this level of control can influence their revenues, and the decision to trade via an intermediary, intra-firm, or directly. Let's first consider another heterogeneous good, a semiconductor, which is also a leading U.S. export. The firm, by either trading directly or intra-firm, retains control of the good throughout the entire trade process and collects all the revenue from the final sale of the good. This is important because international trade by its nature segments consumers into different geographical locations. If the firm is able to apply third degree price discrimination, which is more likely for heterogeneous than homogenous goods, it can extract larger revenues. For instance, if Japanese consumers are willing to pay twice as much for a semiconductor than Mexican consumers, the firm can take advantage of this by intra-firm or direct trade. However, if the firm trades via an intermediary it loses

this pricing control, reducing its revenue and possibly exposing its product to arbitrage. With intermediaries now controlling the final good, Mexican wholesalers could trade semiconductors with Japanese purchasers taking advantage of the price differences. This effect is likely less important for homogenous goods since arbitrage and price discrimination are more difficult. For semiconductors in our data we observe approximately 78% of total trade value is intra-firm or direct, whereas only 22% is traded via intermediaries.

Table 3: Comparing Intensities Based on Magnitude

	(1) WS > RP	(2) WS < RP
	Mean	Mean
WS Intensity***	0.337	0.124
RP Intensity***	0.128	0.293
Arms-length Intensity	0.535	0.584
Mean Employment**	43.126	90.369
HHI	456.700	391.826
Pay/Worker***	36165.350	46620.794
R&D/Sales*	0.014	0.027
Differ. Good*	0.500	0.821
Refer. Good	0.389	0.149
Organized Good	0.111	0.030
N	18	67

Difference of means test is conducted for columns (1) and (2). * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

5. Estimation Methods

To determine the relationship between trading intensities (wholesale, related party, and arms-length), and industry characteristics such as employment level, market concentration, pay per worker, and good heterogeneity the following three equations will be estimated using different methods:[7]

[7] Organized goods comprise less than 5% of the goods traded on average. Thus this variable is omitted to avoid the dummy variable trap.

$$WS_i = \beta_0 + \beta_1 \ln(mean\ employment_i) + \beta_2 HHI_i + \beta_3 \ln(pay\ per\ worker_i) + \beta_4 \ln(R\&D/Sales) + \beta_5 DifferCon_i + \beta_6 ReferCon_i + \epsilon_i$$

$$RP_i = \gamma_0 + \gamma_1 \ln(mean\ employment_i) + \gamma_2 HHI_i + \gamma_3 \ln(pay\ per\ worker_i) + \gamma_4 \ln(R\&D/Sales) + \gamma_5 DifferCon_i + \gamma_6 ReferCon_i + \epsilon_i$$

$$Arms - Length_i = \delta_0 + \delta_1 \ln(mean\ employment_i) + \delta_2 HHI_i + \delta_3 \ln(pay\ per\ worker_i) + \delta_4 \ln(R\&D/Sales) + \delta_5 DifferCon_i + \delta_6 ReferCon_i + \epsilon_i$$

WS_i is the wholesale intensity for industry i, RP_i is the related party intensity, $Arms - Length_i$ is the arms-length intensity, $DifferCon_i$ is the conservative Rauch variable for differentiated prices, $ReferCon_i$ is the conservative Rauch variable for referenced prices, and ϵ_i is an error term. We estimate the model using different methods and find that our results are robust with respect to model specification. Aside from ordinary least squares estimation, we also estimate the model using logit, generalized linear model, and seemingly unrelated regressions.

Since our dependent variables are proportion data and thus between zero and one, OLS may be too simple for our estimation purposes. We'll apply a logit transformation to the independent variables mapping their interval of zero to one to the real line. First we assume a model of the following form:

$$y = \frac{e^{X'\beta}}{1 + e^{X'\beta}}$$

and applying simple algebra we have:

$$\ln\left(\frac{y}{1-y}\right) = X'\beta$$

The logit model above has particular limitations and thus a generalized linear model as suggested by Papke and Wooldridge (1996) will also be estimated.[8] We estimate a model of the form:

$$y_i = G(\beta_0 + \beta_1 \ln(mean\ employment_i) + \beta_2 HHI_i + \beta_3 \ln(pay\ per\ worker_i) + \beta_3 \ln(R\&D/Sales_i) + \beta_4 DiffCon_i + \beta_5 RefCon_i)$$

where $G(*)$ is the *link* function, and chosen such that $0 < G(a) < 1\ \forall\ a \in \mathbb{R}$. A natural choice for the link function is the logistic function and is commonly used. Doing so will guarantee that the predicted values are in the interval zero to one (Papke and Wooldridge, 1996).

We also estimate our model using seeming unrelated regressions (SUR). Under SUR each regression can be estimated individually using OLS as was done earlier. Unlike OLS SUR assumes that the error terms are correlated and this is likely true given the nature of our data. Indeed, upon inspection of the residuals from the earlier OLS equations we find the residuals between related party and arms-length trade regressions is highly correlated (-.76), and between wholesale and arms-length trade (-.59).[9] SUR is equivalent to OLS under two circumstances: when the error terms are uncorrelated and when each regression equation contains the same set of explanatory variables. Product variables will be omitted when they are not hypothesized to have a significant effect.

[8] See page 620 of Papke and Wooldridge (1996) for a detailed explanation of these limitations.
[9] The correlation coefficient between wholesale and related party trade is minimal, -.08.

6. **Regression Results**

Our regression estimations for the generalized linear model are presented in table 4.[10] We find evidence that certain methods of exporting are associated with R&D expenditures. We also find evidence for our central hypothesis that product heterogeneity may influence the method of exporting. We find the ratio of R&D to sales is positively related with wholesale and related party intensity, and negatively related with arms-length intensity. This relationship is statistically significant for related party and arms-length intensity. Products exported by firms engaged in related party trade are thus more likely to rely on innovative, firm-specific production processes that are worth safeguarding by incurring higher costs when exporting.

Table 4. Generalized linear model estimations

	Dependent variable		
	WS Intentisy	RP intensity	Arms-Length Intensity
ln(Mean Emp.)	-0.3358901*	-0.0123597	0.19023
	(0.1730162)	(0.1278756)	(0.1282105)
HHI	0.0005091*	0.0001135	-0.0003804*
	(0.0002879)	(0.0001681)	(0.0001713)
ln(Pay/Worker)	-0.4001858	0.2980525	-0.0439815
	(0.4247424)	(0.3696957)	(0.3147988)
ln(R&D/Sales)	0.125454	0.2379211**	-0.2641172**
	(0.1090484)	(0.0928965)	(0.1008254)
Differentiated	-0.1029367	0.6053774**	-0.4001852
	(0.2832315)	(0.2715793)	(0.2893368)
Referenced	0.7504662*	0.3528955	-0.7026973**
	(0.3796377)	(0.2662145)	(0.2991067)
Constant	4.167951	-3.726029	-0.5177276
	(4.600204)	(4.204243)	(3.702477)
N	72	72	72

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

[10] Results using the other estimation methods described are similar.

We find wholesale and arms-length trading intensities to be negatively related to differentiated products and related-party trade to be positively related. The relationship is statistically significant only for related party trade. This is evidence of one of our key hypotheses: goods that are heterogeneous are more likely to be traded within the firm rather than through a wholesaler. Further evidence that product heterogeneity influences the method of trade is seen in the coefficient for referenced price goods. This coefficient is positive for wholesale and related party intensity, and negative for arms-length intensity. The coefficient is larger in magnitude for wholesale intensity than related party intensity and statistically significant only for wholesale intensity. In this case, homogenous goods are associated more strongly with wholesale exports than related party exports. Arms-length exports are negatively associated with differentiated and referenced priced goods. Thus, our measure of product heterogeneity shows that heterogeneity is negatively associated with the level of arm's length and wholesale trade and positively associated with the amount of related party trade. Firms appear to choose their method of export based on the product they produce, with heterogeneous goods exported via related party trade.

7. Conclusions

In conclusion, we find that differentiated and R&D-intensive goods are associated with intra-firm trade. The heterogeneity of these goods implies it may be important to a firm to protect intellectual property or unique production processes in order for a product to remain differentiated and profitable. The relative profitability of heterogeneous goods may allow the firm to engage in intra-firm trade by lowering costs through investing abroad. In contrast, homogenous goods require less safeguarding. Reference priced

goods, which are homogenous in nature, are associated with wholesale trade. A wholesaler may have country specific knowledge and provide easier market access than trading directly, in addition to being less costly than setting up a foreign affiliate.

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Table 6: Industry Descriptions

NAICS Code	Description	NAICS Code	Description
1111	Oilseed and Grain Farming	3272	Glass and glass product manufacturing
1112	Vegetable and Melon Farming	3273	Cement and concrete product manufacturing
1113	Fruit and Tree Nut Farming	3274	Lime and gypsum product manufacturing
1114	Greenhouse, Nursery, and Floriculture Production	3279	Other nonmetallic mineral product manufacturing
1119	Other Crop Farming	3311	Iron and steel mills and ferroalloy manufacturing
1123	Poultry and Egg Farming	3312	Steel product manufacturing from purchased steel
1141	Fishing	3313	Alumina and aluminum production and processing
2123	Nonmetallic Mineral Mining and Quarrying	3314	Nonferrous metal (except aluminum) production and processing
3111	Animal food manufacturing	3315	Foundries
3112	Grain and oilseed milling	3321	Forging and stamping
3113	Sugar and confectionery product manufacturing	3322	Cutlery and handtool manufacturing
3114	Fruit and vegetable preserving and specialty food mfg	3323	Architectural and structural metals manufacturing
3115	Dairy product manufacturing	3324	Boiler, tank, and shipping container manufacturing
3116	Animal slaughtering and processing	3325	Hardware manufacturing
3117	Seafood product preparation and packaging	3326	Spring and wire product manufacturing
3118	Bakeries and tortilla manufacturing	3327	Machine shops and threaded product mfg.
3119	Other food manufacturing	3329	Other fabricated metal product manufacturing
3131	Fiber, yarn, and thread mills	3331	Agriculture, construction, and mining machinery manufacturing
3132	Fabric mills	3333	Commercial and service industry machinery manufacturing
3133	Textile and fabric finishing and fabric coating mills	3334	HVAC and commercial refrigeration equipment
3141	Textile furnishings mills	3336	Engine, turbine, and power transmission equipment manufacturing
3149	Other textile product mills	3339	Other general purpose machinery manufacturing
3151	Apparel knitting mills	3341	Computer and peripheral equipment manufacturing
3152	Cut and sew apparel manufacturing	3342	Communications equipment manufacturing
3159	Apparel accessories and other apparel mfg	3343	Audio and video equipment manufacturing
3161	Leather and hide tanning and finishing	3344	Semiconductor and other electronic component manufacturing
3162	Footwear manufacturing	3345	Electronic instrument manufacturing
3169	Other leather and allied product manufacturing	3346	Manufacturing and reproducing magnetic and optical media
3211	Sawmills and wood preservation	3351	Electric lighting equipment manufacturing
3212	Veneer, plywood, and engineered wood product mfg	3352	Household appliance manufacturing
3219	Other wood product manufacturing	3353	Electrical equipment manufacturing
3221	Pulp, paper, and paperboard mills	3359	Other electrical equipment and component manufacturing
3222	Converted paper product manufacturing	3361	Motor vehicle manufacturing
3251	Basic chemical manufacturing	3362	Motor vehicle body and trailer manufacturing
3252	Resin, rubber, and artificial fibers mfg.	3363	Motor vehicle parts manufacturing
3253	Agricultural chemical mfg.	3364	Aerospace product and parts manufacturing
3254	Pharmaceutical and medicine manufacturing	3365	Railroad rolling stock manufacturing
3255	Paint, coating, and adhesive manufacturing	3371	Household and institutional furniture mfg.
3256	Soap, cleaning compound, and toilet prep. mfg	3372	Office furniture (including fixtures) manufacturing
3259	Other chemical product & prep. mfg	3391	Medical equipment and supplies manufacturing
3261	Plastics product manufacturing	3399	Other miscellaneous manufacturing
3262	Rubber product manufacturing	5112	Software Publishers
3271	Clay product and refractory manufacturing		