The Modern Wholesaler: Global Sourcing, Domestic Distribution, and Scale Economies

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Abstract

Nearly half of all transactions in the $6 trillion market for manufactured goods in the United States were intermediated by wholesalers in 2012, up from 32 percent in 1992. Seventy percent of this increase is due to the growth of "superstar" firms - the largest one percent of wholesalers. Estimates based on detailed administrative data show that the rise of the largest firms was driven by an intuitive linkage between their sourcing of goods from abroad and an expansion of their domestic distribution network to reach more buyers. Both elements require scale economies and lead to increased wholesaler market shares and markups. Counterfactual analysis shows that despite increases in wholesaler market power and markups, scale has benefits for buyers: through globally sourced varieties, nation-wide distribution networks, lowered marginal costs, and increased quality.

Keywords: market power, intermediation, wholesale trade, geographic differentiation, imports, sourcing, returns to scale

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1 Introduction

New scale economies can quickly change a competitive marketplace. Large fixed investments may allow the biggest firms to develop better products and reduce marginal costs. For example, a new warehouse and logistics network, made useful by a globalized supply chain and coordinated by newly developed IT systems, can cost billions to develop. However, there is a payoff, these fixed costs can lead to lowered operating costs. A firm that develops such a network can easily dominate their competitors, simultaneously increasing markups, growing market shares through scale, and providing a more valuable service or product to their customers.[1]

What are the effects of these shifts in the fixed costs of globalization and technology on welfare? They may allow a subset of firms to dominate industries and extend market power. Simultaneously, their fixed investments may provide benefits to their customers. As illustrated by Bresnahan (1989) and Sutton (1991), market power is an endogenous outcome in markets characterized by fixed costs. However, outside of narrow industry-specific studies, aggregate studies focus on measuring market power, and do not evaluate welfare or the nature of these fixed costs.

I study the interaction of global sourcing and domestic distribution network fixed costs in the context of the business-to-business wholesale industry. Wholesalers are middlemen that sell almost exclusively to other businesses. With advances in electronic communication technologies and falling trade costs, we imagine that the economy is moving to a frictionless state where buyers and sellers seamlessly connect, bypassing such middlemen. In these markets, the opposite has occurred: using rich U.S. administrative data over the last two decades, I show that these wholesale middlemen are more important than ever, doubling the value of distributed goods to three trillion dollars, expanding their distribution networks, and connecting domestic buyers to international markets.

I make two principal contributions. First, I document the growing importance of wholesalers in distributing goods within the United States and show that this increase is driven by the intensive margin, with the largest wholesalers increasing in size. Second, I use a structural model to rationalize these trends, conduct counterfactuals to quantify their market consequences, and evaluate the role of market size and market power in globalization. I show that trade allows for the endogenous entry of higher quality wholesalers, who simultaneously exploit scale, gain market power, distribute more globally-sourced varieties, and charge higher markups. Market power is neither inherently good or bad, it simply characterizes the costs of underlying technologies.

De Loecker and Van Biesebroeck (2016), summarizing recent work at the intersection of international trade and industrial organization, find that trade studies largely ignore the distortionary effects of market power following the expansion of trade and downplay the importance of intra-national or localized competition between firms. This paper explicitly corrects for these gaps.[2] These results also illustrate an important linkage between technology, international trade, and market concentration. Academic and public discourse (The Economist, 2016; Autor et al., 2017) have highlighted

[1] This notion of scale economies entangles both traditionally defined scale and scope economies, where a large fixed cost is paid to realize a given marginal cost.

[2] Feenstra and Weinstein (2017) allows for variable markups in manufacturing, but they largely stem from variation on firm-level demand elasticity, not through oligopoly and competition.

both increasing market power and market concentration across the economy as areas of general interest. Possible explanations for this linkage include technological innovation, firm consolidation, and the influence of large, diversified shareholders.[3] This paper introduces another mechanism: the increasing returns to scale introduced by the fixed costs of international trade and their interaction with domestic investments, dovetailing with markup evidence from De Loecker et al. (2016); Hsieh and Rossi-Hansberg (2019) and holding true to the spirit of trade models since Krugman (1980). Berry et al. (2019) notes that the vast majority of work concerning aggregate competition levels avoids using the tools of modern industrial organization, reverting to either macroeconomic models or cross-industry regressions. This paper applies methods from industrial organization to a large economic sector, allowing for a model based decomposition of the effects of market concentration, in addition to the ability to conduct counterfactuals.

This paper unfolds in four parts. First, it uses detailed micro data to characterize the nature and growth of the U.S. wholesale sector. In 2012, independent wholesale businesses accounted for nearly 50% of sales to downstream buyers in the $6 trillion manufactured good market. This figure is driven by wholesaler growth, as transactions intermediated by wholesalers have grown faster than the overall market. From 1997 to 2007, the share of transactions intermediated by wholesalers increased 34%, with internationally sourced varieties accounting for half the gain. This growth is driven by the intensive margin through the increased market share of the largest 1% of wholesalers. This expansion corresponds to these large wholesalers increasing the number of imported varieties by 56% and domestic distribution warehouses by 70%. In contrast, the median wholesaler rarely imported and did not expand their distribution network.

Second, this paper structurally estimates downstream buyer demand for wholesalers, extending McFadden (1973) and Hausman, Leonard and McFadden (1995) to decompose wholesaling's benefits. Cost-minimizing downstream buyers either indirectly source intermediate goods from a wholesaler at a markup or directly source from a manufacturer and pay a large fixed cost. Heterogenous, geographically dispersed downstream buyers first choose how much to buy and then choose their optimal sourcing strategy from a set of wholesalers. Differentiated wholesalers compete horizontally (types of distributed varieties), vertically (distribution quality), and spatially (geographic reach). Demand is identified through geographic proxies for cost shifters, accounting markup data, and variation in choice sets across geography.

Third, the model endogenizes the prices, attributes, and entry decision of wholesalers.[4] I recover wholesaler marginal costs and operating profits from a price-setting supply system with oligopolistic competitors. Subsequently, I consider the entry costs of wholesalers, who make increasingly large fixed investments in (a) more efficiently sourcing products from far-flung foreign factories and (b) setting up domestic facilities to redistribute these products across the nation. These fixed costs are estimated using equilibrium conditions that rationalize both the number and type of operating

[3]For example see Azar et al. (2016); De Loecker and Eeckhout (2017); Gutiérrez and Philippon (2017); Barkai (2016).

[4]Other structural work with intermediates, such as Bar-Isaac and Gavazza (2015); Salz (2015), do not endogenize all of these decisions.

firms. This paper directly quantifies the changing trade-off between fixed costs and marginal costs.

Fourth, I quantify the gains from wholesaling and the tradeoffs of increased market-power by running counterfactuals under the fully estimated model. In the first scenario, indirect sourcing via wholesalers for international products is restricted to recover the downstream buyer gains from wholesaler-intermediated international trade. Through complementarities in investment, increases in international trade positively interact with the size of a wholesaler's domestic distribution network, compounding and nearly doubling the gain in downstream cost savings.[5] Specifically, the expansion of wholesalers into international trade in 2007 saved downstream buyers 9-10% per year in procurement costs as a percentage of purchase value ($500-540 billion). However, due to large fixed costs, the largest 1% of wholesalers were able to increase their overall market share by 30% and their operating profits by 60%. Similarly, the aggregate shift in wholesale technologies from 1997 to 2007, allowed the largest wholesalers to increase markups and market concentration, while simultaneously reducing the costs of downstream buyers.

There is an extensive theoretical literature on intermediation. Early work by Rubinstein and Wolinsky (1987) endows intermediates with a special matching ability to connect buyers and sellers. As summarized by Spulber (1999), these intermediaries can satisfy a variety of purposes: providing liquidity and facilitating transactions, guaranteeing quality and monitoring, market-making by setting prices, and matching buyers with sellers. This paper empirically addresses these purposes, combining the costs of facilitating transactions and ensuring quality as fixed costs that must be paid by a wholesaler, and allow a wholesaler to charge markups.[6]

The comprehensive empirical study of wholesaler markets is sparse. In industrial organization, Salz (2015) and Gavazza (2011) consider informational intermediaries and brokers, as opposed to physical good wholesalers. These papers address Spulber's last criteria, with wholesalers reducing the cost of matching buyers and sellers. They examine the effect of middlemen changing aggregate price levels and dispersion, largely holding the number and types of upstream suppliers, wholesalers, and downstream customers fixed. In an alternative approach, this paper focuses on the market conduct of the middlemen themselves. I continue holding the number and types of upstream and downstream customers fixed, but allow for endogenous middlemen entry, quality, and markups.[7]

In international trade, wholesalers are well documented by Feenstra and Hanson (2004), Bernard, Jensen, Redding and Schott (2010), Bernard, Grazzi and Tomasi (2011), and Abel-Koch (2013), who all find the rich and enduring presence of such intermediaries. A set of papers places wholesale exporters within a general equilibrium framework and validate a series of cross-sectional predictions (Akerman, 2010; Ahn, Khandelwal and Wei, 2011; Felbermayr and Jung, 2011; Tang and Zhang, 2012; Crozet, Lalanne and Poncet, 2013). Gopinath, Gourinchas, Hsieh and Li (2011) and Atkin

[5]Unlike Petrin (2002), I refrain from directly considering aggregate welfare. Downstream buyers in this model are firms, not consumers. Second, this is not a general equilibrium model - I do not consider who the underlying owners of firms are, nor do I directly model manufacturing firms. Similarly, I abstract from issues of double marginalization on manufacturer prices.

[6]Within international trade, Rauch and Watson (2004), Petropoulou (2008), Antràs and Costinot (2011), and Krishna and Sheveleva (2014) consider alternative theoretical models for the gains from intermediation.

[7]Papers such as Villas-Boas and Hellerstein (2006), Villas-Boas (2007), Nakamura and Zerom (2010), and Goldberg and Hellerstein (2013), consider retailers in a similar fashion to wholesalers.

Table 1: **Aggregate Statistics for All Manufactured Products**

	Year				
	1992	1997	2002	2007	2012
Domestic manufactured goods purchases *($ Billions in 2007 producer prices)*	$3,307	3,845	4,098	5,389	5,421
Domestic Production	3,246	3,711	3,748	4,851	4,836
Exports	453	652	689	1,046	1,286
Imports	514	785	1,038	1,585	1,871
Wholesaler delivery share *(Percent of all domestic deliveries)*	31.7%	31.9%	37.1%	42.5%	49.7%
Wholesaler, from domestic sources	*n/a*	26.3%	29.9%	32.4%	*n/a*
Wholesaler, from international sources	*n/a*	5.7%	7.28%	10.1%	*n/a*
Smallest 90% Wholesalers	*n/a*	7.5%	7.8%	8.0%	*n/a*
Middle 90-99.5% Wholesalers	*n/a*	12.7%	14.2%	16.7%	*n/a*
Largest 0.5% Wholesalers	*n/a*	11.6%	15.0%	17.8%	*n/a*

Notes: Quantities in producer prices. Exports and Imports assumed in producer prices unless conducted by a wholesaler, whereby prices are then adjusted using a wholesaler-specific margin. Data on 2012 derived from aggregate Census data. All data in 2007 Dollars using the BEA price deflator for good expenditures.

and Donaldson (2012) study the role of prices and pass-through, but do not consider the exact mechanisms that lead to pass-through. Bernard and Fort (2015) and Bernard, Smeets and Warzynski (2016) explore the emergence of factory-less good producers, which account for a portion of the wholesale industry. These papers all point to the importance of wholesalers, but consider their market structure as a black box.

2 Data and Industry Facts

Market intermediaries come in many varieties and forms: some act as market-makers and others act as distributors. I focus on the latter, which are called wholesalers and defined by the U.S. Census as:

> ... an intermediate step in the distribution of merchandise. Wholesalers are organized to sell or arrange the purchase or sale of (a) goods for resale (i.e., goods sold to other wholesalers or retailers), (b) capital or durable non-consumer goods, and (c) raw and intermediate materials and supplies used in production.

Within this category, I consider merchant wholesalers. These firms are independent of manufacturers and physically maintain possession of goods between manufacturer and downstream buyer.[8] While disclosure rules prevent revealing individual firms, this definition excludes firms that are vertically

[8] I exclude own-brand marketers to separate firms that design, market and sell, but that do not manufacture their products. In these cases, there is a surplus division problem that occurs between the design studios and the manufacturing arm; they are just two divisions of the same firm.

integrated with manufacturing or consumer retailing. Some large downstream firms, including retailer run distribution facilities, however they are not classified as merchant wholesalers in the data. In order to gain tractability, I present a simplified notion of the wholesale industry. End users can either buy directly from a manufacturer or from a wholesaler. Wholesalers source goods from a set of available manufacturers for a particular downstream user and then resell at an endogenously determined price.[9]

Wholesale trade can affect many economic segments: the choice of manufacturer location, the creation or destruction of value chains, the value of agglomeration economies. This paper focuses on a specific outcome - the role of intermediary market power on buyer costs and intermediary profits in physical good markets.

2.1 Data Description

I bring together a variety of censuses and surveys conducted by the U.S. Census Bureau, Department of Transportation, and Department of Homeland Security covering international trade, domestic shipments, and both the manufacturing and wholesale sectors. In particular, I use the Census of Wholesale Trade, Census of Manufacturers, Longitudinal Firm Trade Transaction Database, Commodity Flow Survey, and the Longitudinal Business Database, from 1992 to 2012. I focus on data from 1997-2007, as disaggregated firm-level data from 1992 and 2012 are not comparable due to industry reclassifications. All data is in 2007 dollars using the BEA Price Deflater for good expenditures.[10]

These databases are linked together every 5-years at the firm level and provide data on wholesale distribution in 56 distinct product categories, corresponding to North American Industry Classification System (NAICS) 6-digit sectors. I treat each of these product categories as a separate market. I focus on wholesalers independent of manufacturing establishments, and collect details on each wholesaler's aggregate sales, physical locations, operating expenses, and imports. Survey data provides statistics on the distribution of the origin, destination, and size of shipments across wholesalers and manufacturers.

The primary data limitation is that transaction prices are not directly observed. Data is only collected on the total value of goods bought for retail and the value these goods are resold for. I denote wholesaler prices as a function of upstream manufacturer prices. A wholesaler price of \$1.3 implies that it costs \$1.3 to indirectly buy \$1 manufactured output (at the "factory gate"). Wholesalers prices p_w are constructed as follows:

$$p_w = \frac{\tilde{p}_w q_w}{\tilde{p}_m q_m},$$

[9] As is the case for the vast majority of economic studies, I simplify many aspects of the wholesale industry to balance realism with parsimony and tractability. In reality, there are many more business structures, ranging from exclusive contracts to brokers. For example, I implicitly incorporate exclusive contracts into my model through the unobservable term ξ in Section 3. As for brokers, I veer on the conservative side and consider sales aided by such agents as direct sales from manufacturers to downstream users, and thus part of the outside option in equation (6) in Section 3.

[10] Certain industries related to petroleum, alcohol, and tobacco are removed due to data issues. Further details and the process of merging these databases is detailed in Appendix A.

Table 2: **Merchant Wholesaler Statistics**

	Year		
	1997	2002	2007
Sales (2007 $'000)	$7,272	$9,285	$14,345
Merchandise Purchases for Resale (2007 $'000)	$5,493	$7,047	$10,940
International Sourcing (mean %)	17%	20%	23%
Number of International Country Sources (mean)	0.565	0.69	0.793
Number of International Country Source-Products (mean)	3.825	5.082	6.431
Physical Locations (mean)	1.206	1.263	1.300
Wholesaler Price (mean sales/merchandise purchases)	$1.32	$1.32	$1.31
(average across markets)	$1.39	$1.40	$1.41
Wholesaler Average Operating Costs (mean $)	$1.21	$1.19	$1.16
(average across markets)	$1.27	$1.25	$1.24
Approx. Product Markets	56	56	56
Approx. Wholesalers	222,000	218,000	214,000
Average Number of Imported Varieties			
Smallest 90% Wholesalers	1.8	2.4	3.1
Middle 90-99.5% Wholesalers	15.8	21.1	27.2
Largest 0.5% Wholesalers	137.4	183.6	213.8
Average Number of Domestic Locations			
Smallest 90% Wholesalers	1.0	1.1	1.1
Middle 90-99.5% Wholesalers	2.0	2.2	2.4
Largest 0.5% Wholesalers	14.2	20.7	23.9

Notes: International products measured at the HS-8 level. Prices and average costs computed first in the aggregate, then averaging over each of the 56 markets. All data in 2007 Dollars using the BEA price deflator for good expenditures.

where $\tilde{p}_m$ and $\tilde{p}_w$ represent the (unobserved) price paid by the wholesaler to a manufacturer and the price paid by a downstream firm to a wholesaler respectively, with q representing quantities. This follows the logic of Atkin and Donaldson (2012).[11]

A second limitation of the shipment data is the lack of information on the identity of downstream buyers; I only know the quantity purchased and their geographic location. This will have serious implications on my modeling choices. The model will have to provide a way of understanding possible unobserved heterogeneity in buyers - especially in the tradeoff between foreign and domestic products as well as between one-off and repeat buyers (who may require a broader set of available products).

While there is wide heterogeneity across NAICS 6-digit sectors. I explicitly generalize away from such differences, focusing on average changes across time. These changes are relevant to the larger picture and have implications for markups and prices at the economy-wide level.[12]

2.2 Descriptive Results

The data shows the rise of wholesalers both in aggregate and within intermediate goods sectors over time. It also highlights a series of facts that inform my modeling decisions. Within wholesaling, the largest wholesalers have been gaining market share while (a) expanding globalized sourcing and (b) increasing the number of domestic distribution outlets. This coincides with wholesalers increasing operating markups while simultaneously decreasing operating costs. Wholesalers serve geographically proximate buyers that request low-valued shipments, even though these customers have been requesting ever-larger shipments over time. I elaborate on these descriptive facts below.

Fact 1 *The share of manufactured products distributed by wholesalers has increased over time, particularly for imported goods.*

Manufactured products can be shipped via one of two modes, (a) directly from a manufacturer to a downstream user or (b) indirectly through a wholesaler. Table 1 shows the aggregate share of domestic absorption of manufactured goods distributed by all wholesalers from 1992 to 2012, with detailed data from 1997 to 2007. In 1997, wholesalers accounted for the distribution of just 32% of all manufactured goods. In 2007, wholesalers accounted for 42.5% of all shipments to downstream buyers.

Such aggregate trends may be caused by compositional shifts across product types. A regression with appropriate controls accounts for this possibility. I regress the wholesaler market share with yearly and product type fixed effects for 1997, 2002 and 2007 across approximately 400 product types, with standard errors clustered at the product type.[13]

$$\begin{aligned}
\text{wholesale share}_{i,t} &= \underset{(.01)}{.33} + \underset{(.01)}{.05} \times \mathbb{I}_{2002} + \underset{(.02)}{.09} \times \mathbb{I}_{2007} + \vec{\beta}\mathbb{I}_i + \epsilon_{it} \\
r^2 &= .92 \\
\text{observations} &\approx 1200
\end{aligned}$$

Regressors $\mathbb{I}_t$ are dummy indicators by years, and $\mathbb{I}_i$ are indicators for product types. Wholesale distribution shares increased on average by 5 percentage points from 1997 to 2002 and another 4 percentage points from 2002 to 2007, broadly reflecting the change in aggregate market shares.

Simultaneously, the proportion of goods distributed by wholesalers and acquired abroad has similarly increased. The trend is highlighted in Table 1. In 1997, such products accounted for 18% of wholesaler sales and 6% of all domestic purchases. By 2007, these products made up 32% of wholesalers sales and 10.1% of all domestic purchases.

[11] In the United States, the Robinson-Patman Act prevents price discrimination to downstream buyers. Thus, an upstream manufacturer cannot charge a wholesale distributor different prices from a downstream buyer, conditional on purchase type. This statute has a long and complex history and the enforcement is not consistent (Ross, 1984). See Appendix (B.3) for further discussion.

[12] Additionally, individual market data is restricted by Census disclosure procedures, as data on highly concentrated industries is confidential.

[13] I used the 6-digit commodity code from the Commodity Flow Survey. Similar results hold at higher levels of aggregation.

Fact 2 *The largest wholesalers increased market shares and imported a greater share of their products.*

Most work on intermediates treats wholesalers in this sector as identical within a market. As shown in Tables 2 and 1, there is incredible heterogeneity in wholesalers, both inter-temporally and cross-sectionally.[14] Over just 10 years, the average wholesaler has nearly doubled real sales and become 35% more likely to source products internationally, importing 68% more types of products at the Harmonized System (HS) 8-digit category level. On average, these wholesalers increased the number of domestic distribution centers by 8%.

Changes across time provide insight into why certain wholesalers are increasing their market shares. The average wholesaler in the 99.5th percentile of a sector by sales controls nearly 1% of the national market, a share hundreds of times larger than the smallest wholesaler. Considering geographic and quantity market segmentation, this can easily translate to large effective market shares in particular segments and thus the ability to exert market power. Additionally, these large wholesalers are differentiated in many other ways; compared to a median wholesaler, they are 4 times more likely to import goods from abroad and have nearly 20 times more domestic distribution centers.

Even starker are the inter-temporal trends across wholesalers. The 99.5th percentile of wholesalers increased their aggregate market shares 50%, while increasing the average number of imported product varieties from 140 to 210 and the number of distribution locations by 68%. In contrast, the median wholesaler's market share stayed constant, with no measurable change in the number of domestic distribution centers. Substantial heterogeneity may imply that larger wholesalers make strategic competitive decisions, while the smallest wholesalers are too small to exert market power.

Fact 3 *Average wholesaler markups are increasing, even though reported operating costs are falling.*

In 1997, aggregating across industries, wholesalers charged downstream customers \$1.32 for \$1.00 worth of manufactured goods. In 2007, wholesalers charged \$1.31 for the same service. However, wholesaler accounting operating costs fell substantially from \$0.21 to \$0.16, leading to implied aggregate markup increases from 9.3% to 12.7%, after accounting for the cost of goods sold. This aggregate trend further masks average price increases across industries and is confirmed at the industry level. Regressing accounting profits[15] on year and industry fixed effects and allowing for industry-clustered standard errors:

$$\begin{aligned}\log(\text{accounting profit rate}_{i,t}) &= \underset{(.03)}{1.83} + \underset{(.05)}{.31} \times \mathbb{I}_{2002} + \underset{(.05)}{.48} \times \mathbb{I}_{2007} + \vec{\beta}\mathbb{I}_i + \epsilon_{it} \\ r^2 &= .85\end{aligned}$$

Compared to 1997, wholesale industry-level accounting profit rates were 30 percent higher in 2002

[14] Detailed statistics are available in Appendix Tables A1 - A3

[15] Computed at (revenue - operating expenses - cost of goods sold)/revenue after inventory adjustment at the 6-digit NAICS industry level.

Table 3: **Geographic Spread**

Source/Destination	2002 Share of Domestic Shipments Wholesalers	Manufacturers
Same State	54.2%	32.3%
Same Census Region	67.0%	46.7%
Same Census Division	75.2%	59.8%

Notes: Each cell represents the percent of shipment by overall type of shipper within a geographic scope.

Table 4: **Shipment Size in Producer Prices**

Shipment Size		% by Shipper Type		% by Shipment Type	
log ($)	$′000	Wholesalers	Manufacturers	Wholesalers	Manufacturers
<6	<1	14.9%	3.9%	71.4%	28.6%
7-8	1- 3	12.9%	4.7%	64.1%	35.9%
8-9	3- 8	16.9%	8.7%	55.9%	44.1%
9-10	8 - 22	24.0%	16.1%	49.3%	50.7%
10-11	22 - 60	14.4%	22.8%	29.0%	71.0%
11-12	60 - 160	8.8%	19.1%	22.9%	77.1%
12-13	160 - 440	4.7%	9.4%	24.3%	75.7%
13-14	440 - 1,200	2.1%	5.8%	19.2%	80.8%
>14	>1,200	1.3%	9.5%	7.9%	92.1%

Notes: Figures in real 2007 dollars. Quantities equal revenues in producer prices. First two columns each sum to 1. Each row in the last two columns sum to 1.

and 48 percent larger in 2007.[16]

These increased markups are consistent with increasing concentration, but not immediately rationalized by the increase in total wholesaler market share. To increase market shares, there must be improvements in wholesaler technology, products, or reach, to compensate downstream firms. Having focused primarily on the upstream aspect of the data, I shift to describing the nature and types of buyers in my model.

Fact 4 *Wholesalers, unlike manufacturers, predominantly ship products to nearby destinations.*

Wholesalers specialize in local availability: they form a middle link in getting goods from a factory to retailers and downstream producers. This fact is illustrated in Table 3. For example, a wholesaler is nearly 70% more likely than a manufacturer to conduct a shipment within the same state. The dominance of local shipments allows wholesalers with distribution centers in relatively isolated locations to exert local market power.

Fact 5 *Smaller purchases predominantly originate with wholesalers, instead of manufacturers.*

Downstream wholesaler shipments are of much smaller value than manufacturer shipments. Table 4 shows that shipments worth $1000 or less in producer prices account for 15% of total wholesaler shipments, but only 4% of manufacturer shipments. In contrast, shipments of over $1,000,000 account for only 1% of wholesaler shipments, but 10% of manufacturer shipments. Certain wholesalers

[16]Results are robust to running this exercise in levels. Industry profits increase from 6.6% to 9.11% in 2002 and 10.5% in 2007.

may exert market power in small shipments, even if they exhibit smaller overall market shares. In Appendix A.5, I note that that purchase sizes are slightly increasing over time, implying that a shift of buyer types does not explain the movement to wholesalers.

3 Model

To compute downstream gains and losses from wholesaling, I construct a demand system paired with a wholesaler supply and entry model. Estimates from the demand model can determine downstream valuations for prices and various wholesaler attributes such as international sourcing. The supply model considers the relationship of prices with underlying marginal costs and market competition. Finally, the wholesaler market entry game will produce entry cost estimates for counterfactual estimation.

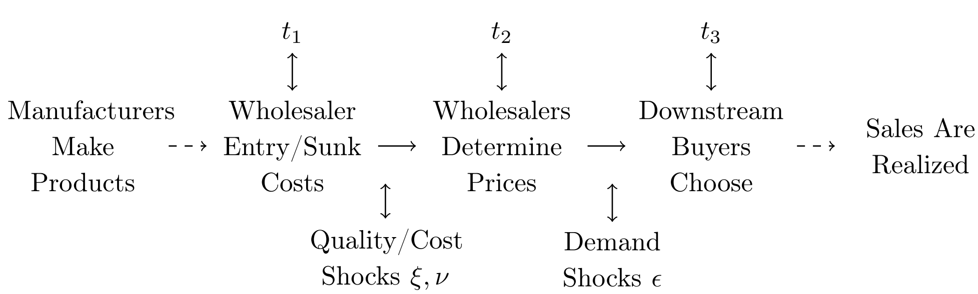
I estimate a series of static games at 5-year intervals using detailed data from 1997, 2002, and 2007 - when industry codes retain compatibility. Each firm makes a one-time sunk-cost decision to enter the market in each time period. This paper cannot feasibly consider all possible sunk costs, and subsumes all costs into two related decisions, whether to participate in international trade, and if they should open an expansive domestic distribution network. This paper does not reflect on the identity of the firms, allowing for tractability without having to make restrictive assumptions of the number of entrants or the forward looking expectations of continuing firms.

3.1 Model Overview

This model is an empirical implementation of Sutton (1991). I model three periods (as visualized in Figure 1), $t_1 - t_3$. At t_1, wholesalers make market entry and sunk cost decisions. At t_2, wholesalers choose their prices. At t_3, downstream buyers choose who to buy from.

In a pre-period t_0, the characteristics of upstream manufacturers are chosen, they determine what to produce and how much to charge for it. This empirical strategy will take decisions made at t_0 as exogenous and open for future analysis; the focus will be on estimating and solving stages t_1 through t_3.

Figure 1: Model Timing



Wholesalers' joint entry and investment choices are consolidated in t_1. Wholesalers simultaneously decide to enter a market and choose their fixed investments. Empirically, wholesalers choose their warehouse locations and how intensely to participate in global sourcing. Wholesalers pay a fixed cost, conditional on their choices, and receive the ability to consolidate and ship manufacturer goods. Following this stage, wholesalers receive marginal cost and product quality shocks, conditional on their entry choices.

At stage t_2, wholesalers choose their prices. They take into account expected buyer characteristics and their competitor attributes to choose a price. I model this choice in terms of Bertrand competition with differentiated products. Wholesaling is an industry where capacity constraints are relatively easy to solve, even in the short run. Trucks can be quickly and easily leased on short notice and inventory can be readily acquired from the upstream manufacturing sector. At this stage, wholesalers have rational expectations of downstream buyer demand.

Downstream purchase choices occur in a discrete choice framework. At t_3, each of these downstream buyers make a choice to either source indirectly from a particular wholesaler or directly from a manufacturer. Each individual downstream buyer realizes a wholesaler-specific preference shock and makes their purchasing decision. Demand is fully realized.[17]

This model is solved through backward induction, focusing first on the demand system, then the pricing system, before concluding with the market entry step.

3.2 Stage 1: Wholesaler Market Entry

Wholesale firms can with investments a after paying fixed costs E_a. The configuration a outlines sunk cost investments on two dimensions. First, what products to source, including what foreign varieties to procure. Second, the size of their warehouse distribution network.

Following Berry et al. (2015), N wholesalers are observed entering as with configuration a, which is composed of the product sourcing strategy $s \subset \mathcal{S}$ and warehouse configuration $l \subset \mathcal{L}$. Sourcing strategies can take one of several forms: wholesaler w can choose a domestic variety, a variety from high-income foreign sources, and/or source a low-income foreign variety. These varieties are indexed by $i \in \mathcal{I}$. Combined, these possibilities form the set $\mathcal{S}$. In distribution, wholesalers can locate warehouses in any of the fifty states along with the District of Columbia. The set of permutations form the set $\mathcal{L}$.

As in most entry models, this model does not necessarily have a unique equilibrium. It is possible that one equilibrium allows for only small wholesalers and another equilibrium allows for only large wholesalers. However, fixed entry costs may still be identified in these models, under the assumption that the current market configuration is an equilibrium (Berry et al., 2015). In particular, two conditions must hold: (1) wholesalers will only enter if their expected operating profits are greater than entry costs, and (2) additional wholesalers (with a set of attributes a) will not not earn expected operating profits greater than entry costs. Once wholesalers pay these fixed costs E_a and enter the market, each wholesaler receives a a vector of qualities ξ that shifts a downstream buyer's valuation

[17] As standard in the Industrial Organization literature, I omit discussion of the intensive form of downstream purchases (the number and the size of purchases). I take the number of these buyers as exogenous. In Appendix F, I follow the Trade literature and endogenize market sizes. I find qualitatively similar parameter estimates, but with the aggregate welfare effects dampened by 10%.

for each of the varieties, and ν that shifts wholesaler marginal costs for each variety.[18] The draws $\xi = \{\xi_i | i \in \mathcal{I}_w\}$ and $\nu = \{\nu_i | i \in \mathcal{I}_w\}$ are conditional on their entry configuration a and drawn from some joint distribution $G(\xi, \nu | a)$.

Returning to the equilibrium conditions, (1) implies that the the upper bound of entry cost $\bar{E}_a$ is:

$$E_a \leq \mathcal{E}_{\xi,\nu}^{N} [\pi(a) | N] = \bar{E}_a. \tag{1}$$

The notation $\mathcal{E}_{\xi,\nu}^{N} [\pi(\cdot) | N]$ denotes the expected profit over random variables (ξ, ν) conditional on N_a observed wholesalers with attributes a participating.[19]

If the current market configuration is an equilibrium, then it would be unprofitable for one additional wholesaler to enter with attributes a. Condition (2) then implies that the lower bound of the entry cost $\underline{E}_a$ is:

$$\underline{E}_a = \mathcal{E}_{\xi,\nu}^{N+1} [\pi(a) | N_a + 1] \leq E_a. \tag{2}$$

These bounds do not require a market entry equilibrium to be computed. Rather, they only require that the current configuration of firms is in equilibrium, which does not need to be unique.[20]

It is important to note that firms may endogenously choose ξ and ν, I explore that possibility in the appendix, but do not model or estimate this in the main text. However, I note this choice is not completely independent of the discrete choice a, thus I subsume the draws of ξ and ν, making them conditional on a, but allow for the distribution of these draws to change over time, along with the costs for a. In particular, this allows for firms that have large global distribution networks to have both lower marginal costs $\nu$and quality ξ, with both the benefits and costs increasing over time, reflecting new logistics technologies.[21]

3.3 Stage 2: Wholesaler Prices

Following entry, every wholesaler w has a configuration $a = (s, l)$, quality draws ξ, and marginal cost draws ν. I collect these attributes in $\mathbf{x} = (s, l, \xi, \nu)$. Wholesale firms set prices for each variety $i \in \mathcal{I}_w$ they sell (indexed by source) and attempt to maximize profits, subject to their own attributes and prices, as well as all other wholesaler attributes $\mathbf{x}$ and prices $\mathbf{p}$:

$$\pi_w \equiv \sum_{i \in \mathcal{I}_w} (p_{w,i} - c_{w,i}(\mathbf{x}_w)) Q_{w,i}(\mathbf{p}, \mathbf{x}). \tag{3}$$

The function $Q_{w,i}$ represents the total sales of product variety i by wholesale firm w, with prices $p_{w,i}$ and constant marginal cost $c_{w,i}$. This takes into accounted the expected behavior of downstream buyers conditional on the prices and attributes of all wholesalers, as well as the outside option of directly buying from a manufacturing firm. Wholesalers can change their marginal cost only though their original fixed investments. This simplification reflects that assumption that economies of scale

[18] In an abuse of notation, the ξ and ν are vectors over all varieties i sold.

[19] The number of wholesalers with alternative configurations $a' \neq a$ are constant in both equilibrium conditions.

[20] Extensions consider the fixed costs of changing the configuration of a particular wholesaler. Wholesalers must not find it profitable to deviate from their current configuration and this allows us to infer the particular costs of changing from a to a'. Such approaches are in Eizenberg (2014); Pakes et al. (2015).

[21] I further discuss the implications of this in both the results and counterfactual sections.

must stem from ex-ante investments. These marginal costs are a function of a wholesaler's attributes $\mathbf{x}_w$.

Wholesale firms w optimally choose prices $p_{w,i}$ for each variety i to maximize total profits π_w. This maximization takes into account the attractiveness of other firms, the viability of direct sales from a manufacturer, as well as the canabalization of their other varieties. The first order conditions imply marginal costs as a function of their own prices as well as cross-price elasticities to account for potential sales cannibalization.

$$c_{w,i} = c\left(p_{w,i}, Q_{w,i}, \frac{dQ_{w,i'}}{dp_{w,i}}; \forall i, i' \in \mathcal{I}_w\right). \tag{4}$$

We assume these wholesaler marginal costs $c^*_{w,i}$ are a function of wholesaler-source attributes:

$$c_{w,i} = c\left(\tilde{\mathbf{x}}_{w,i}, \nu_{w,i}\right) = \tilde{\mathbf{x}}_{w,i}\gamma + \nu_{w,i}. \tag{5}$$

The vector $\tilde{\mathbf{x}} = [\mathbf{x}/\nu]$ includes wholesaler observables, such as the extent of international sourcing and number of domestic distribution locations, as well as the quality draw ξ.

3.4 Stage 3: Downstream Demand

Finally, heterogenous downstream buyers choose an optimal source for a given purchase.

These downstream buyers seek to minimize procurement costs. There are two main methods of sourcing a good, either directly from a manufacturer or indirectly through a wholesaler. The buyer needs to choose whether to buy a domestically sourced variety or a foreign sourced variety. To simplify estimation and data requirements, I assume that each purchase is for a single good, produced in a single location.[22]

These downstream buyers are observably differentiated in two dimensions: where they are located and how much they need to buy (in producers' value). Buyer j needs q_j units of a good and is located in l_j. The same downstream buyers are also unobservably different in two dimensions: their valuation for a particular variety (differentiated by countries of origin) and their valuation for using a wholesaler with a broad product line (one that carries many varieties).

If a buyer buys directly from any manufacturer, they pay:

$$C_{j,m} = q_j \times F_m(q_j) \times \exp(\epsilon_{j,m}). \tag{6}$$

Direct sourcing from a manufacturer costs the number of units bought, the amortized per-unit fixed cost $F_m(q_j)$, and an unobserved direct-buy match value ϵ. The function $F_m(q_j)$ can capture either scale economies (perhaps through shipping cost) or scale diseconomies (perhaps through scarcity).[23]

Indirect sourcing through a wholesaler forgoes the fixed cost, but incurs the wholesaler price $p_{w,i}$, and has wholesaler-buyer-variety observable $\delta_{j,w,i}$ and unobservable $\epsilon_{j,w,i}$ shifters. The set $\mathcal{W}$ is the set of wholesale firms and the set $\mathcal{I}$ is the possible set of varieties. A downstream firm minimizes

[22] While bundling of products by country of origin in shipment is likely to occur, I am not able to observe this behavior in the data. However I do not observe significant amounts of bundling between product categories (such as fruits vs meat), largely alleviating this issue.

[23] There is no price p_m as prices are always denoted in manufacturer prices. I also consolidate the choices over the set of manufacturer varieties and consider the aggregate valuation. See Appendix C for a relaxation of this step.

their cost C:

If a buyer j buys indirectly from a particular wholesaler w, a product variety i costs:

$$C_{j,w,s} = q_j \times p_{w,i} \times \exp\left(\delta_{j,w,i}\right) \times \exp\left(\epsilon_{j.w.i}\right), \ \forall w, i \in \{\mathcal{W} \times \mathcal{I}\}$$

Following McFadden (1980) and Bresnahan et al. (1997), I assume the distribution of the vector of $\overrightarrow{\epsilon}$ for a given buyer j is drawn from a "principals of differentiation" (PD) nested logit model. Unobserved differentiation in buyer preferences has two dimensions. First, buyers have unknown preferences between products sourced domestically and from abroad (dimension variety $i \in \mathcal{I}$). Second, buyers also have preferences over wholesaler attributes. They may prefer a wholesaler with a broad product line, containing both domestically and internationally sourced products (dimension $n \in \mathcal{N}$). This relaxes the independence of irrelevant alternatives, and allows for purchases within categories to be correlated. Thus, if a wholesaler that sources internationally increases its prices, downstream buyers will likely switch to another wholesaler that also sources internationally rather than a wholesaler that only sources domestically. The parameter $\sigma = (\sigma_i, \sigma_n)$ measures these two effects.

A downstream firm minimizes their cost C_j over all wholesaler-variety combinations:

$$C_j = \min_{w,i} \{C_{j,m}, C_{j,w,i}, \ldots, C_{j,W,I}\}$$

Normalizing the cost of sourcing directly from a manufacturer and taking natural logarithms produces a standard discrete choice problem:

$$\arg \max_{w,s \in \{\mathcal{W} \times \mathcal{S}\}} \{0, \delta_{j,w,i} + \epsilon_{j,w,i}, ..., \delta_{j,W,I} + \epsilon_{j,W,I}\}. \tag{7}$$

While $\epsilon_{j,w,i}$ is an random variable, $\delta_{j,w,i}$ is deterministic. We parametrize δ as a function of buyer and seller observables and parameters α:

$$\delta_{j,w,i} = \delta\left(q_j, l_j, s_w, l_w, p_{w,i}, \xi_{w,i}; \alpha\right),$$

where q_j is the size of a purchase, l_j is the location of a buyer, s_w is the sourcing strategy of wholesaler w, l_w are the warehouse locations of wholesaler w, and $p_{w,i}$ is the wholesaler price for variety i.

Conditional wholesaler market share While I cannot observe all attributes of a buyer i, I observe some characteristics. I summarize these observables as $\tilde{j} \subset j$. Within observable type $\tilde{j}$, the model aggregates across downstream buyers values over their buyer-specific shock ϵ. The probability of a purchase from wholesaler w, conditional on observable downstream purchaser type $\tilde{j}$ is a function of mean valuation $\delta_{j,w,i}$ and unobserved preference parameters σ:[24]

$$s_{w,i|\tilde{j}} = s\left(\delta_{j,w,i}; \sigma\right). \tag{8}$$

Accounting for incorrect market size definitions Markups are heavily reliant on market size definitions. Small firms will charge a fixed markup that does not vary due to their size, while large

[24] This function's closed form is derived in Appendix (B.5).

firms will exercise market power and charge a higher price. Mis-measured or inaccurate market definitions will skew attempts to gauge market power. The use of administrative data further complicates this; wholesaler data appears at the 6-digit NAICS level. For example, NAICS code 421830 indicates all wholesalers that sell "Industrial Machinery and Equipment." Such market definitions may be overly broad and should be adjusted to account for hypothetical sub-markets.

I introduce a new term ψ that considers the "addressable" market size. Firms compete with proportion ψ of the competition.[25] The downside is that we cannot directly know which firm is a direct competitor versus a firm that participates in a different "submarket". This prevents us from considering the direct effect of a particular firm on another and evaluate only aggregate statistics in our counterfactuals.

This term, ψ, will be disciplined directly by the use of establishment-level accounting data. [26]

Wholesaler market share The overall market shares of a wholesaler w for variety i aggregates across a wholesaler's market share across observable $\tilde{j}$ types of buyers:

$$s_{w,i} = \sum_{\tilde{j} \in \tilde{\mathcal{J}}} s_{w,i|\tilde{j}} \mu_{\tilde{j}} \tag{9}$$

Where $s_{w,i|\tilde{j}}$ represents the market share of wholesaler w with buyers with observable attributes $\tilde{j}$, and $\mu_{\tilde{j}}$ denotes the relative mass of buyers of type $\tilde{j}$. [27] Total sales $Q_{w,i}$ is simply the the share of buyers times the total mass of buyers M:

$$Q_{w,i} = s_{w,i} \times M.$$

3.4.1 Linking the Model to Data: Multi-Product Wholesalers

The underlying data only provides prices for wholesalers that source a single variety. Prices for multi-product wholesalers are reported in aggregate. To get prices and costs by source, multi-product wholesaler details are recovered separately using data from single-product wholesalers. The demand estimation for parameters α is done only for single product wholesalers.[28] Using summing restrictions, I recover parameters for multi-product wholesalers that source both domestically and

[25] In a simple single logit demand specification, define the adjusted market share $s^{\psi}_{w,i|j}$ of wholesaler w selling variety i to buyer of type j as:

$$s^{\psi}_{w,i|j} = \frac{\exp\left(\delta_{w,i|j}\right)}{\exp\left(\delta_{w,i|j}\right) + \psi_{w,i} \sum_{w',i' \neq w,i} \exp\left(\delta_{w,i|j}\right)}.$$

The coefficient $\psi_{w,i}$ is implicitly defined as

$$\exp\left(\delta_{w,i|j}\right) + \psi_{w,i} \sum_{w',i' \neq w,i} \exp\left(\delta_{w,i|j}\right) = \psi \sum_{w,i} \exp\left(\delta_{w,i|j}\right),$$

where ψ is the share of competitors in a particular submarket.

[26] See the discussion of identification in Section (4) for more details. While this appears to be an ad-hoc solution, the alternative solution is to use a single market defined by the data or markets defined ex-ante (as in the use of UPC-scanner data). See Table (6) for a preliminary analysis.

[27] While the mass of buyers $\mu_{\tilde{j}}$ is exogenous (as in common with most of the literature), in the Online Appendix we allow $\mu_{\tilde{j}}$ to vary and find quantitatively similar results.

[28] This doesn't hamper estimation of σ, which uses aggregate market shares.

from abroad. This is a product-side interpretation of the logic underpinning De Loecker et al. (2016).

For exposition, assume a wholesaler sells both a domestic variety D and a international variety F. Instead of observing prices $p_{w,F}$ and $p_{w,D}$ separately, I observe the sales weighted average $\bar{p}_w$, where the weights are the known sales shares, $M_{w,F}$ and $M_{w,D}$. The pricing estimation stage recovers multiplicative markups $\mu_{w,F}$ and $\mu_{w,D}$, as well as data on single-product wholesalers on $c_w(\cdot)$.

Generalizing away from downstream buyer heterogeneity, this produces the following relations governing prices and costs[29]:

$$\bar{p}_w = M_{w,D}p_{w,D} + M_{w,F}p_{w,F} \tag{10}$$

$$p_{w,D} = \mu_{w,D}c_{w,D} \tag{11}$$

$$p_{w,F} = \mu_{w,F}c_{w,F}. \tag{12}$$

To close the system, I assume that the unobserved component of cost $\nu_{w,i}$ is identical across domestically and internationally sourced goods, rewriting equation (5) as:

$$\log c_{w,F} - \log c_{w,D} = \tilde{\mathbf{x}}_{w,F}\gamma_F - \tilde{\mathbf{x}}_{w,D}\gamma_D \tag{13}$$

This is justified as wholesalers appear to provide the same levels of customer service to their downstream buyers, even if product acquisitions costs observably differ, once attributes x (including recovered product quality) are accounted for. Thus, a product that originates from China is handled and shipped by the same local warehouse worker as a product produced in Alabama.

Equations (10) - (13) can be combined to solve for $p_{w,D}$, $p_{w,F}$, $c_{w,D}$ and $c_{w,F}$. This technique is easily generalizable to more than two products.

4 Estimation

There are three sets of parameters to estimate: buyer demand parameters (α, ψ, σ), marginal cost parameters γ, and fixed entry costs E_a. Estimation and identification details are described in reverse chronological order, starting with demand, then supply, and lastly entry.

4.1 Stage 3: Choice of Downstream Buyer

The demand parameters $\theta = (\alpha, \psi, \sigma)$ are identified by the distribution of prices, accounting markups, observed wholesaler attributes, plausibly exogenous instruments, aggregate statistics across downstream buyer types, and the timing assumptions from the multi-stage model.

Demand Parameterization I parameterize the common component of demand of buyer type j for wholesaler w's variety i as:

$$\delta_{j,w,i} = \alpha^p \log p_{w,i} + \alpha^q \log q_j + \sum_{l \in \{state, region\}} \alpha^l \mathbb{I}_{l_w = l_d} + \mathbf{a}_{w,i}\alpha^a + \xi_{w,i} \tag{14}$$

[29] For details on markup calculations see Appendix D.

These preferences are a function of wholesaler price's for a variety ($p_{w,i}$), the size of a downstream buyer's purchase (q_j), if the wholesaler has a warehouse near a downstream buyer ($\mathbb{I}_{l_w=l_d}$), a vector of wholesaler characteristics/industry fixed effects ($\mathbf{a}_{w,i}$), and a wholesaler-variety shifter $\xi_{w,i}$. In estimation, I allow for three varieties, a domestic variety, a variety from a high income foreign country (denoted "North"), and a variety from a low income foreign country (denoted "South").

The vector $\mathbf{a}$ includes characteristics of the wholesaler, such as the number of international sources (the number of HS-8 product lines), as well as market-level observables, which include market-year fixed effects as well as indicators for the source of the good and the location of the wholesaler. All these characteristics are endogenous, however, they are determined earlier in the game, and are taken as fixed in this stage. The residual $\xi_{w,i}$ denotes the economist-unobserved quality of wholesaler w selling variety i.

The parameter vector $\alpha = \left(\alpha^p, \alpha^l, \alpha^q, \alpha^a\right)$ captures a downstream buyer's sensitivity to wholesaler prices, location choices, and purchase quantities. The parameters α^p and α^q capture the trade-off between the variable cost of buying q units at price p from a wholesaler with the fixed cost of directly sourcing q units of the good from the manufacturer.

4.1.1 Demand Identification

The price coefficient α^p is identified from a set of geographic-based cost-shifters. The geographic and quantity based buyer valuations α^l and α^q are identified using a series of closely related aggregate moments. The parameters α^a and σ are identified from the set of observed wholesaler attributes. Market competition parameter ψ is estimated using changes in accounting markups. Parameter σ is also identified using geographic variation in the wholesaler choice set for downstream buyers. The central assumption, common in demand estimation, is that buyer preferences are both time-invariant and location-invariant (up to a series of fixed effects). Identification derives from variation in choice sets due to factors exogenous to demand.[30]

Price Instruments Identification issues arise from the correlation between unobserved quality ξ and wholesaler price p. A standard regression of price on market shares may bias price coefficients. The simplest instruments are signals of marginal costs, correlated with a wholesaler's cost but not quality ξ.

I use wholesaler-level accounting cost data $\tilde{c}$, which are an informative signal of marginal costs. However, as marginal costs c are a function of quality ξ, we need need to separate out marginal cost elements. I combine the geographic nature of Hausman et al. (1994) and Nevo (2001) instruments with standard cost-based shifters. Assume that marginal costs c_w for wholesaler w has two components, $c_{w,\xi}$ and $c_{w,l}$, where $c_{w,\xi}$ is correlated with ξ. Component $c_{w,l}$ is due to the unobserved cost of doing business in a particular location l. This includes warehouse rents and fork-lift operator labor costs. While these costs are unobserved, I use the observed average operating costs of other

[30] I discretize the types of downstream buyers. I use 51 geographic bins (the fifty US states + DC) and nine purchase size bins (see the data section).

wholesalers in different product categories within nearby geographic regions. These costs c_{-w} only share their component $c_{-w,l}$ with c_w.

I use accounting cost data and form instruments by aggregating across wholesalers in unrelated wholesale sectors at the ZIP code, county, and state levels. I denote this accounting cost $\tilde{c}_{-w,l}$. For example, accounting costs of medical equipment wholesalers will be used as a price instrument for industrial chemical wholesalers. This assumes that the unobserved product quality for an industrial chemical wholesaler will be uncorrelated with accounting costs for medical equipment wholesalers. I collect these shifters as instruments Z_1.[31]

Aggregate Shipment Moments Aggregate data on shipment patterns identifies the preference (a) between sourcing indirectly from a wholesaler and directly from a manufacturer and (b) between sourcing from a local and a distant source.

Large purchases tend to be sourced directly from manufactures and small purchases tend to be sourced indirectly through wholesalers. This tradeoff is identified using the overall wholesaler market share for a given quantity q:

$$s_{W|q} = \sum_{w\in\mathcal{W}}\sum_{i\in\mathcal{I}}\sum_{\tilde{j}\in\tilde{\mathcal{J}}} s_{w,i|\tilde{j}}\mu_{\tilde{j}}\mathbb{I}\left\{q_{\tilde{j}} = q\right\},$$

where $s_{W|q}$ denotes the total market share of all wholesalers conditional on buyer purchase size q. This is a function of observable market share $s_{w,i|\tilde{j}}$ and buyer weights $\mu_{\tilde{j}}$. Additionally, $\mathcal{W}$ represents the set of all wholesalers, $\mathcal{I}$ represents the set of wholesaler varieties, and $\tilde{\mathcal{J}}$ represents the set of observable buyer types $\tilde{j}$.

The desirability of a local wholesaler versus a distant wholesaler is identified by the observed share of local, regional, and national shipments:

$$s_{W|l} = \sum_{w\in\mathcal{W}}\sum_{i\in\mathcal{I}}\sum_{\tilde{j}\in\tilde{\mathcal{J}}} s_{w,i|\tilde{j}}\mu_{\tilde{j}}\mathbb{I}\left\{l_{\tilde{j}} = l_w\right\}$$

This identifies shipments that do not cross state or regional lines, where the location of the buyer and the location of the wholesaler correspond.

In addition, the share of consumers sourcing from wholesalers that sell (1) only domestic varieties, (2) only international varieties, and (3) both varieties, in each geographic market are matched to observed data. This also helps partially identify the nested logit parameter σ, along with α^l. Collectively, I denote these moments as $\mathbf{m}_1$.

Aggregate Markup Moments Industry trends in accounting markups identify ψ. For each period t and industry combination W, I compute aggregate accounting markups as:

$$\mu_{W,t}^{accounting} = \frac{\sum_{w\in W} Revenue_t}{\sum_{w\in W} Operating\ Cost_t}$$

Assuming that these markups are consistently biased across time, with Operating $\text{Cost}_{W,t}$ =

[31]Implicit is the assumption that downstream demand is not correlated across industries. However, each of these product groups are small relative to the overall local economies.

$\epsilon^{OC} \times \text{Variable Cost}_{W,t}$ and under the constant marginal cost assumption from the supply-side of Section (3), the relative accounting markups are directly related to actual markups $\mu_{W,t}$:

$$\frac{\mu_{W,t}^{accounting}}{\mu_{W,t-1}^{accounting}} = \frac{\mu_{W,t}}{\mu_{W,t-1}}$$

This is done for additional sets of wholesalers W'. I consider combinations of wholesalers by global and domestic sourcing; as well as multi-location and single-location wholesalers.[32] As the level of markups without variable market power is pinned down by α^p, this moment pins down effective market size ψ from the changes in markups over time. I denote these moments $\mathbf{m_2}$.

Correlation Coefficients Estimation uses two additional sets of instruments to identify the nested logit correlation parameter σ. The first assumes that buyers have similar preferences, but some have different choice sets, due to regional variations in wholesaler networks. The second assumes that even without wholesalers, there would still be a downstream market, and uses this downstream market size as an instrument.

Nest Market Share Shifters The first identification strategy for σ follows the logic of Berry et al. (1995). Different downstream buyers face different choice sets due to wholesaler geographic differentiation. A wholesaler's entry choices are made before quality $\xi_{w,o}$ is drawn, allowing the number and attributes of competitors to identify σ. In practice, if there are many (few) wholesalers, then within observed wholesaler market shares will be small (large). The intuition is illustrated in a simplified case without observable downstream buyer heterogeneity and one nest. The demand share equation takes the form:

$$\ln(s_{w,i}) - \ln(s_0) = \alpha^p \log p_{w,i} + \sigma \ln\left(s_{w,i|i}\right) + \xi_{w,i}.$$

The market shares of a wholesaler w selling variety i, conditional on selling variety i is denoted $s_{w,i|i}$. This share is correlated with $\xi_{w,i}$ as wholesalers with higher quality draws will not only have higher unconditional market shares, but higher market shares conditional on their attributes. The market of share of direct sourcing from a manufacturer is s_0. A valid instrument needs to satisfy the exogeneity criterion, but at the same time relate to the regressor of interest. As the number and attributes of wholesalers are chosen before the realization of ξ, exogeneity is mechanically satisfied. Estimation generalizes this to include the number of wholesalers with the same sourcing strategy (single-source or multiple-source) and sourcing particular varieties (domestically, high foreign) at the regional and state level. I collect these instruments as Z_2.

Aggregate Market Size Shifters The second instrument uses size of the downstream market as a shifter for the number of wholesalers present. As in Berry et al. (2015), the size of the downstream market is plausibly exogenous. The larger the market, the greater the possible profits, and thus more wholesaler entry.[33] The number of downstream buyers in this world is related to a

[32]I collect the logarithms of these relative accounting markups by industry from 1997 to 2007.

[33]I relax this assumption in Appendix F.

baseline demand; in markets with a high downstream baseline demand, many wholesalers are likely to set up warehouses, driving down realized market shares. Summing across discrete buyer types j, total demand in a location is:

$$M_l = \sum_{j \in \mathcal{J}} M \cdot \mu_j \mathbb{I}\left(l_j = l\right).$$

I collect these instruments as Z_3 after averaging across all the states with the presence of a particular wholesaler w.

Empirical Implementation

Estimation follows Petrin (2002), adapted to a multiple-stage nested-logit model with observably heterogenous agents. Conditional on parameters and observable data, equations (9) and (14) produce estimates for unobserved quality ξ and aggregate moments $\mathbf{m}$. A generalized method of moments objective function is constructed using the following two sets of moments:

$$\begin{aligned} Z'\xi &= 0 \\ \mathbf{m}_{data} - \mathbf{m} &= 0 \end{aligned}$$

The matrix Z consists of instruments (Z_1, Z_2, Z_3). The vector $\mathbf{m}_{data}$ consists of the empirical analogs of estimated moments. See Appendix B.5 for a full description of the empirical estimation routine.[34]

4.1.2 Downstream Buyer Demand Estimates

Table 5: **Downstream Firm Choice Estimates**

Parameter	Estimate	Parameter	Estimate
log (Price)	-3.015	Within State Shipment	3.065
	(0.101)		(0.099)
log (Shipment Size)	-0.421	Within Region Shipment	1.310
	(0.000)		(0.081)
log (# Warehouses)	0.750	σ_i (Varieties)	0.659
	(0.011)		(0.069)
South Imports × log (HS-8 lines)	0.704	σ_n (Wholesaler Breadth)	0.512
	(0.014)		(0.051)
North Imports × log (HS8 lines)	0.531	ψ (Submarket Size)	0.145
	(0.013)		(0.007)
Fixed Effects	6-Digit Industry × Variety, Year × Variety		

Notes: Results from an optimizing generalized method of moments (GMM) routine using a derivative-free gradient search. Robust GMM standard errors presented. See text for full regression specification. North refers to high-income country sources. South refers to low-income country sources.

Table 5 reports results from the estimation of downstream buyer choices. All coefficients, except

[34] Geographic controls are included at the region-market level as a robustness check. Results are similar..

for σ, are relative to direct purchases from manufacturers.[35] As noted in Section 3.4.1, estimates are derived from single-source wholesalers.

Buyers are extremely price sensitive, as the estimated price coefficient implies highly elastic demand. Wholesalers with multiple locations are generally more appealing than those with few locations, regardless of whether they are present in the same location as a downstream buyer. Omitted fixed effects control for market-source and year-source deviations in valuations.

Three coefficients consider the importance of observed downstream buyer heterogeneity and are precisely identified by the aggregate moments. A wholesaler in the same state, and to a lesser extent in the same region, is extremely valuable for downstream buyers. Similarly, the benefit to indirect sourcing versus direct sourcing is declining in shipment size. Wholesalers provide almost no benefit to downstream buyers receiving the largest shipments. Estimates for ψ show that the typical data-implied market size is about 1/7 the market size implied by naive use of administrative data (Ganapati, 2020).

The nest coefficients σ relates the substitutability between internationally sourced and domestically sourced goods, as well as between a wholesaler with different product availabilities (single-source versus multi-source). A value of 1 implies zero substitutability between these categories, and a value of 0 implies no differentiation in the substitutability between categories. I find there to be imperfect substitutability between domestically and internationally produced varieties (σ_i), as well as between wholesalers with different sourcing strategies (σ_n). This is important since it implies that (a) internationally sourced varieties are imperfect substitutes for domestically sourced varieties and (b) multi-source wholesalers are imperfect substitutes for single-source wholesalers. An analogy from retail for (a) would be that Parmesan Cheese (from Italy) and Vermont Cheddar (sourced domestically) are imperfect substitutes. For (b), this implies that buying Parmesan Cheese from an Italian-only grocery store is different than buying the same cheese from Krogers.

4.2 Stage 2: Wholesaler Pricing and Marginal Costs

Wholesaler marginal cost identification proceeds in two steps. First, demand estimates help back out implied marginal costs, $\hat{c}_{w,i}$ for each wholesaler and variety combination. Second, marginal cost parameters γ are estimated..

Marginal costs are directly derived from equation (4). They are a function of the demand parameters $\theta = (\alpha, \psi, \sigma)$, conditional on characteristics $\mathbf{x}$ and price $\mathbf{p}$. Once recovered, wholesaler attributes can be projected onto these marginal costs $\hat{c}$:

$$\log \hat{c}_{w,i} (\theta; \mathbf{x}, \mathbf{p}) \quad = \quad \tilde{\mathbf{x}}_{w,i} \gamma + \nu_{w,i}, \tag{15}$$

where $\tilde{\mathbf{x}} = [\mathbf{x}/p]$ are all characteristics after omitting price.

As a departure from the standard methodology, marginal costs are also a function of unobserved quality ξ. Products with higher ξ, especially concerning better customer service or availability, are

[35] In terms of robustness, results in Appendix C show the importance of my instrumentation strategy. Estimation in a simplified model shows the importance of price instruments. I obtain a significant positive coefficient on price, which would indicate that consumers like higher priced goods, even conditional on quality.

Table 6: **Supply Estimation Statistics**

Panel A: Wholesaler Marginal Costs ($ per $1 of producer output)			
	1997	2002	2007
Full Model With Local Market Power	1.093	1.077	1.061
National-Level Market Power Only	1.150	1.151	1.155
Monopolistic Competition	1.163	1.171	1.180
Panel B: Markups (Price/Marginal Cost)			
	1997	2002	2007
Full Model With Local Market Power	1.268	1.297	1.326
National-Level Market Power Only	1.206	1.213	1.218
Monopolistic Competition	1.193	1.193	1.193
Panel C: Wholesaler Operating Profits (Real 2007 Billon USD)			
	1997	2002	2007
Full Model With Local Market Power	408	543	832
National-Level Market Power Only	325	396	569
Monopolistic Competition	307	353	496

Notes: Marginal costs and markups derived from equation (4). Wholesaler operating profits derived from equation (3). Localized markets imply downstream customer heterogeneity and wholesaler market power. National markets allow for wholesaler market power at the national level ($\psi = 1$), but no downstream customer heterogeneity. Monopolistic competition shuts down both downstream customer heterogeneity and wholesaler market power. Profits are the sums across all considered wholesale markets. Markups are costs are aggregated across all purchases in all markets.

likely to incur higher marginal costs. The structural error $\nu_{w,i}$ is assumed to be known only after all wholesaler attributes are chosen, but before prices are chosen. I assume that there exists Z_ν, such that $E\left[\nu Z_\nu\right] = 0$.[36] As quality ξ and wholesaler attributes x are chosen or realized in a earlier period, these characteristics form a plausible vector Z_ν.

Implied Costs and Markups To gauge the importance of considering localized, geographically linked markets, Table 6 compares implied markups and marginal costs across three scenarios. Panel A considers the mean wholesaler's marginal cost of delivering $1 of upstream producer output to a downstream buyer. Panel B displays the mean wholesaler's markup for delivering the same $1 of upstream producer output to a downstream buyer. Panel C presents the implied aggregate profits from equation 3. In each panel there are three rows. The first presents results from the full localized demand model (with the benefit of local shipping and submarkets ψ), the second from a model with a single national market (without submarkets, $\psi = 1$), and the last from a model with monopolistic competition.

In terms of marginal costs, the full model produces marginal costs about 6-10% lower than monopolistic competition, markups 6-11% higher than monopolistic competition, and implied operating

[36]Standard errors are computed using a parametric bootstrap. Demand estimates are assumed to be a multivariate normal distribution with an estimated variance-covariance matrix. Bootstrap draws from this distribution to produce estimates of θ_{BS} that are used to recompute $\xi_{BS}\left(\theta_{BS}\right)$ and $\hat{c}_{BS,w,o}\left(\theta_{BS};\mathbf{X}\right)$. These new estimates for ξ_{BS} and $\hat{c}_{BS}$ are then used to produce standard errors for estimates for marginal cost parameters γ.

Table 7: **Marginal Cost Regressions**

Parameter	Estimate	Parameter	Estimate
log(Plants)	0.029	Xi x I2	-0.041
	(0.10)		(0.08)
Xi x 1992	0.210	Xi x I3	-0.086
	(0.07)		(0.08)
Xi x 2002	0.182	South Imports $\times$ log (HS-8 lines)	-0.068
	(0.07)		(0.20)
Xi x 2007	0.169	North Imports $\times$ log (HS8 lines)	-0.084
	(0.07)		(0.19)
Fixed Effects	6-Digit Industry $\times$ Variety, Year $\times$ Variety		

Notes: Dependent variable is log (marginal cost). North refers to high-income country sources. South refers to low-income country sources. Robust standard errors reflect errors in demand estimates through a parametric bootstrap methodology. See text for full regression specification.

profits 30-60% larger. This difference rises over time. From 1997 to 2007, marginal costs decrease under the full model, but increase under monopolistic competition. Similarly, the markups increase under the full model, but stay fixed under monopolistic competition. Essentially, a wholesaler may have a small localized monopoly (say within New England) and may exert market power with only small buyers in that region alone. The full "localized market" model accounts for this market power, while models with a single national market average out wholesaler market shares across markets and thus attenuate any market power findings.

Wholesaler Marginal Costs Estimates Table 7 follows equation (15) and regresses marginal cost on a set of covariates. The specification includes product-market-year fixed effects (at the 6-digit NAICS level). The marginal cost of distributing globally sourced products is 16-18% higher than domestically sourced products.[37] Higher unobserved quality ξ implies higher marginal costs, though this relationship is stronger for domestically sourced products than internationally sourced ones, and weakens over time. Finally, wholesalers with many domestic distribution locations have slightly lower marginal costs, perhaps reflecting better optimization technology.

4.3 Stage 1: Wholesaler Market Entry

Market entry cost estimation utilizes a set of equilibrium assumptions. As direct evidence on fixed costs is sparse, they are recovered indirectly. Bounds for wholesaler entry costs (E_a) for a wholesaler with configuration a use two equilibrium conditions: (1) wholesalers will only enter if their expected operating profits are greater than entry costs, and (2) additional wholesalers of the same configuration will not earn expected operating profits greater than entry costs. As shown in equations (1) and (2), these equilibrium conditions imply upper bounds $\bar{E}_a$ and lower bounds $\underline{E}_a$ on entry costs.

[37] Derived from the exponent of the fixed effect estimates.

Table 8: **Average Entry Costs Bounds Across Product Markets** ('000 2007 Dollars)

Wholesaler category / # of Locations	1997 Domestic Only	1997 International Importer	2007 Domestic Only	2007 International Importer
One State	[543 566]	[2,507 2,981]	[706 785]	[3,448 4,204]
Two States	[3,533 3,860]	[11,420 17,020]	[4,713 5,404]	[14,670 19,170]
Three States	[5,098 5,497]	[20,810 29,500]	[10,290 12,750]	[42,340 87,970]
Four-Six States	[10,700 12,620]	[30,830 43,830]	[18,550 23,850]	[65,190 139,300]
Seven+ States	[53,080 89,170]	[166,500 278,200]	[57,290 108,100]	[257,300 476,500]

Notes: Each cell displays bounds for fixed entry costs. Results are the product of regression of wholesaler and market characteristics regressed on fixed entry cost estimates.

The following empirical analogs are computed:

$$\bar{E}_a = \mathbb{E}_{\xi,\nu}\left[\pi\left(a\right)|N_a\right] \quad \text{and} \quad \underline{E}_a = \mathbb{E}_{\xi,\nu}\left[\pi\left(a\right)|N_a+1\right],$$

where $\mathbb{E}_{\xi,\nu}$ is the expectation over the distribution of quality ξ and marginal cost ν draws, which takes the joint distribution $G^a_{\xi,\nu}$ for wholesalers of configuration a. The upper-bound takes the expectation of net profits for the number of wholesalers N_a as observed in the market. The lower-bound takes the expectation of net profits when an extra wholesaler of type a, or N_a+1 wholesalers, are present in the market.

These bounds are empirically implemented by simulating counterfactual net profits π_a for each wholesaler configuration a. This estimation technique can hypothetically provide extremely wide bounds. In practice, due to the number of wholesalers typically available in a market, bounds are relatively narrow, with the exception of the very largest wholesalers.[38]

Table 8 considers the lower and upper bounds of fixed entry costs E_a for various wholesaler configurations a. While the underlying calculations are done by wholesaler category and industry, displayed results are the product of wholesaler and market characteristics regressed on fixed entry cost estimates. These results are further binned by broad groupings a'. For clarity, wholesalers that only participate in international trade are combined with wholesalers that participate in both domestic and international trade.

For a wholesaler that operated one domestic distribution location in 1997 and only sourced domestically, annualized fixed entry costs are around \$500,000. Similarly, wholesalers that participate in international trade and operate in at least six states have annualized fixed costs between \$170 and \$280 million dollars, which are reasonable considering billions in yearly sales. This discrepancy is even greater for wholesalers in 2007. Moreover, this table shows that the biggest gains in operating profits accrue to wholesalers that both participate in international trade and have extensive domestic distribution networks.

[38]Bounds can be computed for every every possible observed configuration of a wholesaler. However, as there are 2^{51} possibilities for wholesaler location choices, not all possible configurations are seen in the data. The counterfactual will only consider the number of locations, not the specific configuration.

It is also important to consider the implications of these entry cost estimates. They are not just the estimates for the configuration a, but also the draws of marginal costs $\nu$and quality ξ that go along with them. I do not model the potentially endogenous choice of ν and ξ. As such, we should not interpret the results as "it has become more expensive to participate in international trade". Rather, the firms that participate in international trade, with wide networks are now substantially different, potentially providing higher quality and lower marginal cost. I now turn to decomposing this results to make sense of this.

5 Model Implications

The probability of a buyer sourcing from a wholesaler has increased from 32% to 42% from 1997 to 2007, even though the number of wholesalers has fallen. There are multiple channels to decompose buyer gains from wholesaling. These include changes in wholesaler varieties, prices, economies of scale and quality (which can be further decomposed into gains from domestic and international sourcing strategies), and local product availability. What is the relative importance of each of these channels? Table 9 decomposes these gains through the lens of the demand and pricing models.

I compute the following statistic for a variety of counterfactuals:

$$\hat{s}_W = \frac{s_W\left(\mathbf{x}^{2007}\right) - s_W\left(\mathbf{x}^{CF}\right)}{s_W\left(\mathbf{x}^{2007}\right) - s_W\left(\mathbf{x}^{1997}\right)}.$$

Where $s_W(\cdot)$ is the aggregate market share of wholesalers, $\mathbf{x}^{2007}$ refers to data from 2007, $\mathbf{x}^{1997}$ refers to data from 1997, and $\mathbf{x}^{CF}$ refers to a particular counterfactual. In these counterfactuals, I first fix all attributes of wholesalers to their 2007 levels and then adjust the object of interest to match the mean in 1997.

Table 9 nets out differences in the distribution of downstream buyers[39] and considers changes in four categories; price effects, domestic distribution networks, domestic and international sourcing, and the variety of wholesalers. Column (1) displays these results considering the average of these effects across all sample markets. These changes are further broken down according to the size of the wholesalers. Columns (2), (3), and (4) consider the smallest 90% of wholesalers, the middle 90-99% of wholesalers, and the largest 1% of wholesalers. Positive numbers indicate changes that are surplus enhancing for buyers, and negative numbers indicate changes that are surplus reducing.

The first channel considers changes in prices. As average wholesaler prices increase, this effect works against an increase in wholesaler market share. If 1997 wholesaler prices were offered in 2007, the increase in wholesaler market share would be 16 percent larger. As shown in Table 7, both internationally sourced products and high quality domestic distribution incur higher marginal costs. While smaller in comparison, markups also increase, reflecting increased market power, primarily for the largest 1% of wholesalers.

The second channel reflects changes in domestic distribution networks due to more regional

[39]Formally, counterfactuals are run considering only the composition of buyers in 2007; changes to the composition of buyers in 1997 are netted out. The underlying individual counterfactual decompositions do not linearly sum up to 100% as effects can interact both positively and negatively.

Table 9: **Decomposition of Shift to Wholesaling from 1997 to 2007**

		Wholesale Firm Size Percentile		
	All Firms	0-90%	90-99%	Top 1%
Gains Due To Price Effects	-9%	0%	-3%	-7%
Gains Due to Distribution Network	39%	2%	6%	31%
Gains Due to Sourcing Quality	80%	2%	12%	38%
Due to Domestic Sourcing	56%	4%	13%	24%
Due to International Sourcing	16%	1%	3%	8%
Gains Due To Firm Choices	-1%			

Notes: This table decomposes changes to the market shares of wholesaler distribution versus direct distribution from 1997 to 2007. The table decomposes this by various changes to wholesaling from 1997 to 2007. For example, the first column of the first line states that wholesaler market share in 1997 would be 9% smaller than the observed wholesale market share if wholesalers charged prices similar to 2007. Data is averaged across markets.

warehouse locations. This accounts for 40% of the total gain in aggregate wholesaler market shares. In particular, the largest wholesalers have drastically scaled up in size and offer local distribution to a greater subset of domestic buyers. Even though the number of firms hasn't increased, many national firms offer local services, consistent with Rossi-Hansberg et al. (2020).

The third channel considers the changes to the quality of domestic sourcing and international sourcing through wholesalers. Changes in domestic sourcing account for 3/4 of this change, and changes to international sourcing account for the remaining 1/4. This may reflect better customer service for downstream buyers or more comprehensive procurement strategies from wholesalers. Wholesalers may offer more varieties within each category. As with the other channels, changes are disproportionally driven by the largest 1% of wholesalers. This channel reflects on changes to unobserved quality, through the ξ term. It is important to note that ξ is a modeled as a quality draw, that comes conditional of the firm configuration choice a in a given year. Thus, large firms, making choices of a, are receiving higher ξ draws in 2007 than in 1997. The choice of $a$reflects these potentially endogenous choices.

The last channel examines the presence of idiosyncratic downstream buyer-wholesaler preference shocks. Downstream buyers choose the source with the highest value (or lowest cost) inclusive of these shocks. As the number of wholesalers decreases, wholesale market share mechanically falls, as downstream buyers receive fewer shocks to choose from. If the number of wholesalers in 2007 was at 1997 levels, the change in wholesaler market share would be 1% smaller.

6 Counterfactuals Market Power Analysis

I run two sets of counterfactual scenarios to understand the trade offs between fixed costs, market power, and downstream costs. The first narrowly quantifies the role of international trade fixed costs in market power and downstream costs. The second takes a bigger picture view and considers aggregate changes in the wholesaling industry from 1997 to 2007.

Table 10: **Changes from Intermediated International Trade**

	Baseline			**Scenario 1** Static Changes			**Scenario 2** Static + Free Entry/Exit		
	1997	2002	2007	1997	2002	2007	1997	2002	2007
Panel A: Levels									
Number of Wholesalers	220000	220000	210000	220000	220000	210000	[350,000 370,000]	[360,000 390,000]	[400,000 440,000]
Number of Wholesalers/Market	3929	3929	3750	3929	3929	3750	[6,250 6,607]	[6,429 6,964]	[7,143 7,857]
Average Local Herfindahl index (HHI)	2654	3212	3550	2346	2413	2859	[558 652]	[543 699]	[654 928]
Wholesaler Mean Market Share	46%	50%	52%	41%	45%	47%	[36% 37%]	[39% 42%]	[46% 42%]
Wholesaler Mean Markups	1.273	1.333	1.391	1.213	1.221	1.244	[1.193 1.194]	[1.193 1.194]	[1.194 1.196]
Panel B: Changes									
Δ Downstream Costs (bil)				\$156	\$175	\$241	[\$331 353]	[\$366 391]	[\$495 538]
Δ Wholesaler Profits (bil)				-\$123	-\$206	-\$364	[\$0 0]	[\$0 0]	[\$0 0]
Δ Profits - Δ Costs(bil)				-\$279	-\$381	-\$605	[\$-353 -331]	[\$-391 -366]	[\$-538 -495]
Δ Costs/Purchased Value				4.0%	4.3%	4.5%	[8.6% 9.2%]	[8.9% 9.5%]	[9.2% 10.0%]

Notes: Static gains are computed as the compensating variation needed to maintain the same expected utility for downstream customers, assuming no changes in the number, type, or prices of wholesalers. Static gains allow wholesalers to update their prices in response to changes in their ability to source international varieties. Entry/Exit gains allow wholesale firms to enter or exit the market caused by variations in fixed costs or operating profits due to change in international sourcing. All figures in Billions of 2007 dollars. Herfindahl indices are computed over localized markets that with downstream customer heterogeneity and estimated submarkets ψ. Shares and markups are averaged over all NAICS-6 national markets (and differ from Table 6).

6.1 Counterfactual: Role of International Trade

To quantify the downstream effects of international trade and innovations in wholesaling, I shut down indirect importing by downstream buyers. While downstream buyers can still import foreign products by directly sourcing from abroad (in the outside option), they can no longer indirectly source foreign goods through wholesalers.

I simulate two scenarios, one fixes the set of wholesalers, and the other allows for wholesaler entry/exit. The first scenario considers the current set of wholesalers to be fixed, and restricts them to only distributing domestic varieties. Without new entry and market repositioning by existing wholesalers, this simulates the short-run changes in outcomes due to wholesaling.

The second scenario considers the role of wholesaler entry and exit. By restricting wholesaler participation in international trade, a subset of wholesalers may exit, and another subset of wholesalers may enter. This counterfactual computes alternative equilibria, using a simplified wholesaler choice set. If particularly valuable wholesalers (from a buyer perspective) exit, this could lead to negative consequences. However, if entering wholesalers exert less market power than exiting wholesalers, this could lead to positive outcomes. Mechanically I allow for wholesalers to keep their draws of of ξ and ν, conditional on their configuration choice, wrapping up the entire investment decision in the choice of a.[40]

Table 10 summarizes the market effects of indirect international sourcing under the two counterfactuals. The first set of columns presents baseline results for 1997, 2002, and 2007. The second set of columns, labeled "Scenario 1," summarizes changes due to indirect international sourcing, considering wholesaler price responses, but not wholesaler entry/exit decisions. The third set of columns labeled "Scenario 2" allows for wholesaler entry/exit and is discussed in the next section. Panel A displays the results of each counterfactuals in levels. I interpret the downstream "welfare" as cost savings, as downstream firms are minimizing their procurement costs. Panel B considers changes in wholesaler profits and downstream buyer costs.

6.1.1 Scenario 1: Fixed Set of Wholesalers

I shut down the ability of wholesalers to import products from abroad, but do not allow for entry/exit. In summary, this causes a negative shock to both downstream firms and the wholesalers themselves, simultaneously reducing market power.

In Panel A, counterfactual wholesaler market shares decrease. This reflects the value downstream buyers place on sourcing products from abroad through wholesalers. For example, in 2007, aggregate wholesaler market concentration in a typical wholesale market (these markets are defined using buyer type j and ψ) falls from a Herfindahl index (HHI) of 3,600 to 2,900, as international sourcing is heavily concentrated in the largest wholesalers.[41] This also causes a similar decrease in markups, as the largest wholesalers lose a significant amount of market power.[42]

[40] If wholesalers are further likely to change an un-modeled investment in ξ or ν, by investing less, this will further amplify the gains to intermediated international trade.

[41] Earlier working papers reported national-level HHI statistics.

[42] This HHI statistic reflects the average HHI faced by a downstream buyer $\tilde{j}$, accounting for both geography and

Figure 2: **Downstream Buyer Cost Savings due to Intermediated International Trade**

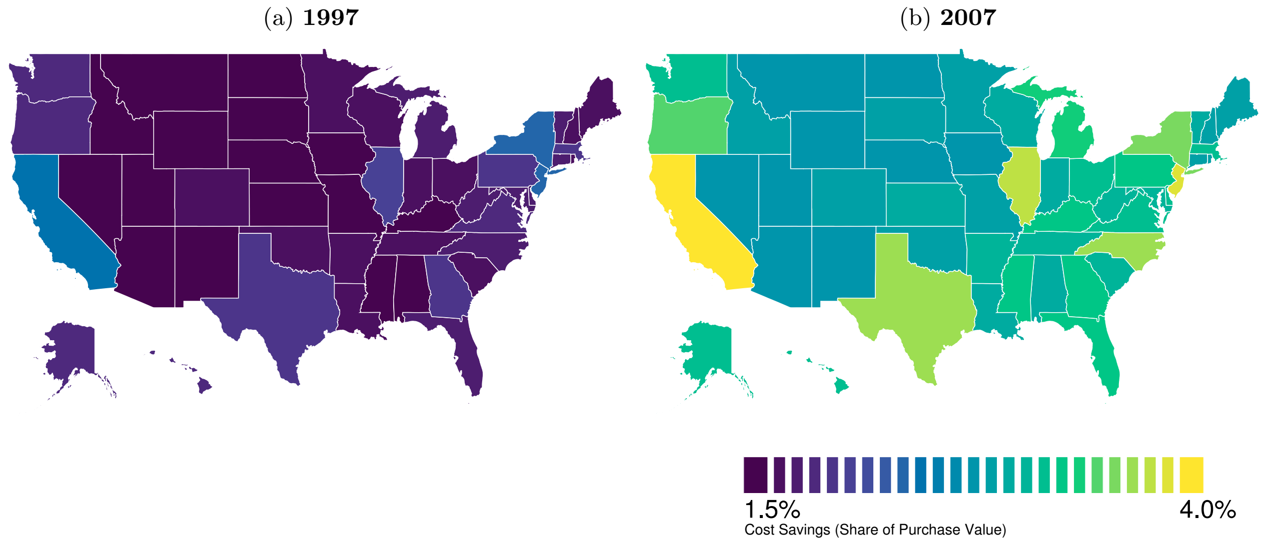


Table 11: **Operating Profits Change from Limiting International Trade**

	Wholesaler Size		
	Smallest 90%	90-99%	Largest 1%
1997	7%	1%	-52%
2002	11%	11%	-53%
2007	13%	15%	-62%

Notes: Profits re-computed after resolving iteratively for best-response prices, holding fixed the number of wholesalers.

Panel B considers the changes in market outcomes. In 2007, the loss would reflect a $230 billion increase in downstream costs, or 4.5% of downstream expenditures.[43] These figures can be further decomposed across types of downstream buyers, both geographically and by purchase size.

Figure 2 displays the geographic distribution downstream of international-trade related changes to buyer costs (as a share of total expenditures) in 1997 and 2007. In 2007, California, New Jersey, and Texas all show an approximately 4% change in downstream costs. In contrast, the inland states of Wyoming, Montana, and Nebraska show approximately half the gain in costs, with all three under 3%. Similarly, smaller buyers disproportionally benefit from the growth in wholesaling, as they are more likely to source from a wholesaler.

Different types of wholesalers also differentially profit from international sourcing. Specifically, the largest wholesalers derive more of their sales and operating profits from facilitating international sourcing. Table 11 computes the aggregate changes in operating profits across wholesalers by size. In 1997, by limiting indirect international trade, the smallest wholesalers benefit with operating profits rising 7%, as some downstream buyers switch from using international to domestic varieties. The largest wholesalers see a 50% decrease in operating profits as they are no longer able to source

implied market size ψ.

[43] This figure assumes that the outside option, sourcing from manufacturers, is unchanged. This framework is unable to distinguish the gains due to changes in the outside option, just changes relative to the outside option.

products from abroad, and are not completely able to offset the loss in sales with domestically sourced products. The results from 2007 follow the same pattern, but are larger in magnitude. The smallest wholesalers see a 13% gain in operating profits, while the largest wholesalers face a 60% decline.

6.1.2 Scenario 2: Allowing Wholesaler Entry/Exit

This scenario offers an extremely simplified view of competition, with all wholesalers taking one of three configurations: as a local wholesaler with only domestic sourcing, a globalized wholesaler with only international sourcing, or as a hybrid wholesaler with both international and domestic sourcing. In this scenario, the international-only wholesalers exit the market; they are no longer able to source products. The hybrid wholesaler no longer has to pay the costs of international distribution, but loses sales from their international varieties.

Combining the data with this model's estimated parameters, domestic source-only wholesalers are the smallest, with the lowest fixed entry costs and low expected qualities ξ and high marginal costs ν. These domestic-only wholesalers also tend to have small, extremely local distribution networks, with only one distribution outlet. Hybrid domestic-international wholesalers have the largest fixed entry costs, but the highest expected qualities and lowest marginal costs. These hybrid wholesalers also frequently have large national distribution networks, with multiple geographically dispersed distribution points.

As there are two categories of remaining wholesalers, there may still be more than one equilibrium. For example, there may be one domestic wholesaler and two hybrid wholesalers, or three domestic wholesalers and one hybrid. This analysis chooses the equilibrium with the greatest number of hybrid wholesalers. As the hybrid wholesalers have higher expected qualities and lower marginal costs, such wholesalers can be considered large first-movers.[44] In computation, I simulate market entry 30 times and use both the upper and lower bounds of fixed cost estimates.

Table 10 summarizes market outcome changes. In the third set of columns in Table 10, I show aggregate changes in downstream costs, wholesaler profits, and market size, after allowing for simplified wholesaler entry. International trade leads to net losses of between $500-540 billion in 2007, with free entry driving out wholesale profits. Market forces drive out the best wholesalers (i.e. those that had both domestic and internationally sourced products). However, the free entry condition allows more domestic-only wholesalers to enter the market, partially compensating for the loss of wholesalers that source globally. Market power (as measured by both concentration and markups), substantially decreases. The HHI indices reflect unconcentrated markets and markups resemble monopolistic competition. However, this does not lead to downstream gains as customers lose access to national distributors and must source international products directly.

Importantly, I do not allow for the distribution of quality and marginal cost draws, ξ and ν, to change for each type of wholesaler. Therefore, local-only wholesalers will be restricted from

[44] Alternative results are calculated with equilibria that provide for the greatest number of domestic only wholesalers. While different in some of the wholesaler count statistics, results are roughly similar.

Table 12: **Scenario 2: Intertemporal Comparison Statistics**

		Wholesalers with 1997 Technology in 2007	
	2007 Data	Scenario: Fixed Entry	Scenario: Free Entry
Number of Wholesalers	210000	220000	[250,000 330,000]
Number of Wholesalers/Market	3750	3929	[4,464 5,893]
Δ Downstream Costs (bil)		$292	[$160 229]
Δ Wholesaler Profits (bil)		$163	[$0 0]
Δ Profits - Δ Costs(bil)		-$129	[$-229 -160]
Mean Wholesaler Share	52%	45%	[46% 48%]
Aggregate Wholesaler Share	55%	47%	[49% 51%]
Wholesaler Mean Prices	1.408	1.387	[1.393 1.395]
Wholesaler Mean Markups	1.326	1.269	[1.258 1.265]
Average Herfindahl index (HHI)	3550	2654	[1,368 2,026]

Notes: Market shares computed using the value of distributed goods in producer prices. Scenario 1 considers the wholesale market without wholesaler entry and exit. Scenario 2 allows wholesalers to enter the market. Mean results averaged over all markets. Figures in the last row differ from prior tables as they consider the unweighted mean across markets.

improving quality or reducing marginal costs. With this limitation in mind, I switch to considering inter-temporal change.

6.2 Counterfactual: Wholesaler Technology Changes

What is the net benefit to downstream buyers and wholesalers due to aggregate market changes from 1997 to 2007? Total indirect sourcing has increased 35% in market share and 98% in real shipments. Section 5 parses out these gains through the demand model and attributes these gains to various changes in the types of wholesalers. This counterfactual assesses the net valuations of these changes by including both downstream buyer costs and wholesaler profits. In particular, within each year, I do not allow for the draws of quality and marginal cost to change, rather the focus is on the result from different distribution of the full vector of wholesaler configurations, (a, ν, ξ).

6.2.1 Scenario 1: Fixed Set of Wholesalers

Table 12 computes a variety of market outcomes by placing the universe of 1997 wholesalers in a 2007 environment. The first column lists a variety of relevant market outcomes, and the second column presents baseline data from 2007.

The third column of Table 12 considers the first scenario. The set of wholesalers from 1997, along with their attributes, are placed in their corresponding markets in 2007. In this counterfactual, wholesalers only change their prices. As the number of wholesalers is larger in 1997, the number of wholesalers increases in the counterfactual. However, these wholesalers are of lower quality, higher price, and lack the domestic distribution reach and internationally sourcing ability of wholesalers in 2007. The wholesaler share of this market decreases by 13%. Analogously, the cost savings of downstream buyers decrease by $292 billion. Market power decreases, with both the HHI and markups returning to their 1997 level.

In 2007, the total size of the market is much larger, accounting for 10 years of economic growth. As the both the entry of wholesalers and the investment in wholesaler attributes are restricted, remaining wholesalers are able to increase their profits by $163 billion. By offsetting the decrease in downstream costs with wholesaler profits, total surplus decreases by only $129 billion. This total figure is equivalent to 1-2% of 2007 gross domestic product. To further refine this figure, I allow for a simplified form of wholesaler entry in the next section.

6.2.2 Scenario 2: Allowing Wholesaler Entry/Exit

In this scenario there is only one type of wholesaler, wholesalers that are present in 1997, and thus the model does not require an equilibrium selection procedure. Potential wholesalers draw types, qualities, and marginal costs from the observed distribution of wholesalers in 1997. Wholesalers choose to enter if the expected profits from entry are greater than fixed costs, and choose not to enter if expected profits are less than entry costs. Letting N denote the number of wholesalers in the market, this implies the following two conditions must hold:

$$E_G\left[\pi^{2007}\left(N+1\right)\right] < 0, \qquad\qquad 0 > E_G\left[\pi^{2007}\left(N\right)\right]$$

The function $\pi^{2007}\left(N\right)$ computes the profits by placing N wholesaler draws from the empirical distribution of $G\left(\cdot\right)$ for wholesalers that were present in 1997. The expectation is then computed over this distribution $G\left(\cdot\right)$. This simulates counterfactual markets if wholesalers compete away their profits through a free entry condition.

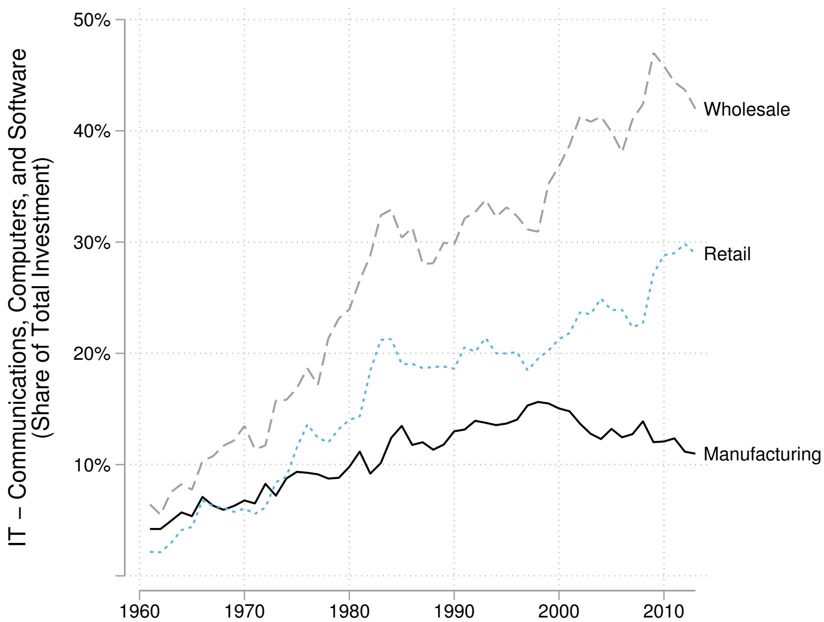
The third column of Table 12 computes changes in market outcomes relative to the observed set of wholesalers in 2007. If wholesaling technology from 1997 was placed in 2007, free entry would allow more wholesalers to enter due to high potential profits. This entry would result in market power (markups and HHI) falling substantially. In terms of wholesalers, aggregate wholesale market share would decrease 5-6 percentage points from the 2007 baseline, but the number of wholesalers would increase 15-50%. Downstream costs would also increase by $160-230 billion. As these new wholesalers are neither particularly different or efficient, aggregate surplus under free entry is lower than that under a limited set of entrants.

7 Underlying Technologies

While changes in the costs and benefits of international sourcing drive some of the observed evolution in the wholesaling marketplace, this paper does not directly address all the underlying technologies driving observed trends. This section provides a preliminary analysis. First, I discuss changes to the outside option, directly sourcing from a manufacturer. Second, I provide preliminary data concerning the use of information technology in the wholesale sector.

All wholesaler quality estimates are relative to the outside option, as are wholesaler prices. If domestic manufacturing is declining in quality or availability, downstream buyers will naturally substitute towards foreign suppliers, which may only be accessible through indirect sourcing. Similarly, changes in relative manufacturer's prices across sources may change the relative valuation of

Figure 3: **Information Technology Share of Total Investment**



Source: BEA Investment Data

wholesaling versus direct sourcing. Further work, using both international trade data and domestic production data could provide new insights. Recent research (Bernard and Fort (2015) and Bernard, Smeets and Warzynski (2016)) and anecdotal evidence suggest that the rise in wholesalers may be due to an economy-wide trend in former manufacturing firms closing domestic production operations, and only retaining design and distribution facilities. However, these single-brand importers are excluded in my data sample.[45]

While this paper is able to bound the costs and the returns to scale for both international sourcing and domestic investment (and their complementarity), it does not discuses what technology underpins this change. Figure 3 provides preliminary and suggestive evidence that innovations and expenditures on information technology (IT) may be driving these trends. Computing allows for both coordination and logistics at a vast national scale. This figure shows the share of investment on software and computers (an important component of IT) in both the manufacturing and wholesale sectors. While investment shares started at similar levels 1960, the path diverged, especially after 1995. Today, IT accounts for 45% of all investment by wholesale firms, but only 10% of investment by manufacturers. This finding corresponds favorably to my data; however, showing causality requires further analysis.

8 Conclusion

Wholesalers and intermediaries are critical to global and domestic supply chains. This paper establishes a set of facts regarding wholesalers in relation to their upstream sources and downstream

[45] See Appendix E for further evidence.

buyers. The distribution of goods in the United States through wholesalers has substantially increased, with the very largest wholesalers both increasing their domestic distribution networks and sourcing more foreign products. These facts are combined with a demand model to estimate downstream user preferences for intermediated trade. Wholesaler market entry is endogenized to consider counterfactuals regarding changes in fixed costs and the complementarity of a wholesaler's international sourcing strategy with their domestic distribution network. The data provides evidence of fixed-cost induced market power, where counterfactual wholesaler concentrations and markups are lower in the absence of international trade and quality advances. However, downstream buyers gain substantial savings from the expansion of the wholesale industry, which more than offsets increases in wholesaler market power.

Largely, modern empirical industrial organization has had little to say about average economy-wide levels of competition (Berry et al., 2019), with discussion primarily using time-series and cross-sectional analysis (Autor et al., 2017). This paper uses the tools of industrial organization, leveraging both demand and supply data to understand why competition is decreasing and the effects on $6 trillion in downstream purchases. Globalization and distribution networks are a wedge that may allow for both (a) more market power and (b) widespread benefits. In the context of wholesaling, the benefits dominate changes in market power. This result stems from both the observed data and the model's estimated parameters; other industries, time periods, or contexts will provide different results.

There is wide scope for both extending this framework and examining various assumptions. In terms of expansion, future work could use a model of intermediation with heterogenous demand and place wholesalers in a tractable general equilibrium framework to consider aggregate surplus changes. Alternatively, additional work should consider changes in upstream manufacturing. Gains are all relative to sourcing directly from a manufacturer. Difficulties in sourcing from a manufacturer (both domestically and internationally) can offset gains from wholesaling. This paper also leads to questions that examine the boundary of the firm: should a manufacturing firm expand domestic distribution networks, or outsource to a wholesaler?

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Online Appendix (For Online Publication)

A Data Sources and Construction

A.1 Data Used

I bring together a variety of censuses and surveys conducted by the United States Census Bureau, Department of Transportation, and Department of Homeland Security covering international trade, domestic shipments and both the manufacturing and wholesale sectors. I use the Census of Wholesale Trade, Census of Manufacturers, Longitudinal Firm Trade Transaction Database, Commodity Flow Survey, and the Longitudinal Business Database, from 1992 to 2012.

The Census of Wholesale Trade (CWH) collects data every five years on the entire universe of wholesale establishments, subdividing wholesalers by both type and ownership structure. In particular the CWH divides wholesale establishments into merchant wholesalers (MW) and manufacturers sales and branch offices (MSBO). As this paper considers wholesalers that are independent from manufacturers, I exclude MSBO and other similar establishments from analysis. However, aggregate census statistics may not distinguish between these two establishment forms and overestimate the wholesaler market presence. Notably, distribution centers owned by downstream buyers, such as those by large retail chains are systematically excluded from this census.[46] This dataset is central to the analysis and provides administrative data on operating costs, merchandise purchases, total sales, goods sold, and buyer types.[47] Wholesale industries distributing products with sales consisting of more than 50% non-manufactured goods are excluded. This includes certain petrochemical segments distributing crude oil, and all agricultural and mining sectors. Data from 1992 and 2012 are not directly comparable to data from 1997-2002 due to changes in industry classification systems. (The 1992 data uses the Standard Industrial Classifications and 2012 data uses a significant revision of the NAICS system.)

The Census of Manufactures (CMF) aggregates data every five years on the universe of manufacturing establishments. This extensively used dataset provides information on a range of values, including total shipments and various operating and capital expenses. I focus on the value of shipments in producer values. This database helps in calculating the total domestic absorption of manufacturing products as well as the share of goods shipped directly by manufacturers. As with the CWH, the CMF lacks explicit quantity data for the vast majority of industries (notable exceptions include cement, concrete, and steel).

The Commodity Flow Survey (CFS) is conducted every five years and collects data on a random selection of shipments for a set of establishments. This data is collected for both wholesale and manufacturing establishments and is used to construct crosswalks between manufacturing and wholesale

[46] The second largest building in the United States by usable space is the Target Import Warehouse in Lacey, Washington. However I assume that such buildings are classified as retailers and not wholesalers, with Target operating as the final destination.

[47] The biggest drawback of this data is the lack of quantity data. I will explicitly account for this in the model and estimates by considering units in terms of producer prices.

sectoral designations. Additionally the micro-data includes statistics on the origin, destination, and value of individual shipments, as well as export status.

The Longitudinal Firm Trade Transaction Database (LFTTD) tracks and links imports and exports by product at the firm level. This database catalogues all import and export transactions by date from 1992 onwards in terms of both value and quantity. Tying all the datasets together, the Longitudinal Business Database provides a way to link individual establishments from the CWH, CMF, and CFS at the firm level, as well as linking these firms with trade data from the LFTTD. The process of merging these databases and further details are reported below.

A.2 Census of Wholesale Trade (CWH)

The U.S. Census Defines a wholesaler in the 2007 North American Industry Classification System (NAICS) as:

> The Wholesale Trade sector comprises establishments engaged in wholesaling merchandise, generally without transformation, and rendering services incidental to the sale of merchandise. The merchandise described in this sector includes the outputs of agriculture, mining, manufacturing, and certain information industries, such as publishing.
>
> The wholesaling process is an intermediate step in the distribution of merchandise. Wholesalers are organized to sell or arrange the purchase or sale of (a) goods for resale (i.e., goods sold to other wholesalers or retailers), (b) capital or durable non-consumer goods, and (c) raw and intermediate materials and supplies used in production.
>
> Wholesalers sell merchandise to other businesses and normally operate from a warehouse or office. These warehouses and offices are characterized by having little or no display of merchandise. In addition, neither the design nor the location of the premises is intended to solicit walk-in traffic. Wholesalers do not normally use advertising directed to the general public. Customers are generally reached initially via telephone, in-person marketing, or by specialized advertising that may include Internet and other electronic means. Follow-up orders are either vendor-initiated or client-initiated, generally based on previous sales, and typically exhibit strong ties between sellers and buyers. In fact, transactions are often conducted between wholesalers and clients that have long-standing business relationships.
>
> This sector comprises two main types of wholesalers: merchant wholesalers that sell goods on their own account and business to business electronic markets, agents, and brokers that arrange sales and purchases for others generally for a commission or fee.

I focus on the first type of business, merchant wholesalers, which are further described as:

> Merchant wholesale establishments typically maintain their own warehouse, where they receive and handle goods for their customers. Goods are generally sold without transformation, but may include integral functions, such as sorting, packaging, labeling, and other marketing services.

In addition, I omit three types of wholesalers, first those that are classified as Manufacturer's Sales and Branch Offices (MSBO), those that are classified as own-brand importers and markets, and firms classified as agents/electronic markets. This specifically excludes what Bernard and Fort (2015); Bernard et al. (2016) consider former manufacturers that may have transitioned from domestic manufacturing into foreign manufacturing and domestic distribution. If these firms are included as wholesalers, the wholesale shares of distribution increase more dramatically.

For clarity, I've reproduced the selected portions of the Economic Census form from 2007 for NAICS 423190 - Electrical Goods Wholesalers in Figure 4 (forms from 1997 and 2002 are similar are publicly available). In question 19, I exclude firms that are classified as "14: Own-brand importer and marketer", "20: Manufacturers' sales branch or office", "41-48: Agent, broker, or commission merchant", "49: Electronic market", or "77: Other broker or agent".

Wholesalers are classified according to their NAICS code. A market is defined as all downstream buyers that buy and sell from these NAICS codes. For example, Code 421610 refers to wholesalers participating in the resale of "Electrical Apparatus and Equipment, Wiring Supplies and Construction Material". While establishments may appear to belong to multiple codes, this project only considers the Census-designated code. Future research projects may further explore multiple-industry wholesalers. Firms may own establishments in multiple NAICS wholesale sectors. I divide foreign imports proportionally between sectors, weighting by the volume of goods purchased.

Sales are aggregated considering the wholesaler's purchase cost from their upstream source, net of export sales, and correcting for inventory adjustments. Prices are in manufacturers' dollars and computed using the ratio between the sales to downstream buyers divided by upstream purchases by the wholesalers. Wholesale industries that derive more than 50% of revenues from products that are not manufactured are removed from analysis. These industries pertain primarily to mining and agricultural products. Additionally, NAICS sectors 424710 and 424720 dealing with petroleum and petroleum products are removed, as are NAICS sectors 424810, 424820, and 424940 that deal with beer, wine, and tobacco products. Petroleum products are removed as a result of the industry taking a unique form due to the ownership and distribution of pipeline networks. Alcohol and tobacco products are often regulated at the wholesaler level by individual states. Some states do not allow for direct sourcing by downstream retailers and force the usage of wholesalers, rendering my model of wholesaling spurious.

A.2.1 Wholesaler Prices

Wholesaler prices are systematically denoted in producer prices. Therefore a wholesaler price of \$1.3 implies that it costs \$1.3 to indirectly buy \$1 manufactured output (at the "factory gate").

Wholesalers prices p_w are constructed as follows:

$$p_w = \frac{\tilde{p}_w q_w}{\tilde{p}_m q_m},$$

where $\tilde{p}_m$ and $\tilde{p}_w$ represent the price paid by the wholesaler to a manufacturer and the price paid by a downstream firm to a wholesaler respectively. Variable q_m represents the quantity purchased from a manufacturer, and q_w represents the quantity sold by a wholesaler. In practice, quantity data is unavailable for most industries, so $p_m q_m$ is approximated by

$$C_m = p_m q_m,$$

where C_m represents the expenditures of a wholesaler on manufactured goods. Similarly

$$R_w = \tilde{p}_w q_w,$$

where R_w represents the revenue of a wholesaler. In Figure 4, C_m corresponds to question 16(b) and R_m corresponds to question 5(a).

I clean the data so wholesaler inventory changes are netted out, thus:

$$p_w = \frac{\tilde{p}_w}{\tilde{p}_m}.$$

As estimation requires a normalization, I set $\tilde{p}_m = 1$, so wholesaler prices p_w are all relative to producer prices $\tilde{p}_m$. I explore robustness to this price definition in Appendix B.3, where I allow differentiated buyers to face different wholesaler prices.

In addition, I require operating cost data to derive accounting markups, this corresponds to question 16(b) in Figure 4.

A.2.2 Wholesaler Sales Data

Wholesaler sales data is broken down by product origin by merging the LFTTD and CWH on firm-level characteristics. First, total sales are derived from the line item referring to "Sales and operating receipts." Purchases from manufacturers are derived from the line referring to "Purchases of merchandise for resale."

Data from the LFTTD denotes the imports by country of origin. Countries (outside of the U.S.) are divided into two varieties using the World Bank's World Development Indicators Database from 1997. Sources with per-capita gross domestic product (GDP) over \$10,000 are categorized as high-income sources. Sources with per-capita GDP under \$10,000 are classified as low-income sources. The cut-off county in my database is Slovenia; all richer countries are high-income sources. Due to extensive literature highlighting the pass-through nature of Hong Kong's economy (Feenstra and Hanson (2004)), imports from Hong Kong and Macau are re-classified as Chinese imports.

As the World Bank estimates are not complete, I manually categorize a small subset of countries. Afghanistan, Iraq, Kosovo, Myanmar, Nauru, Sao Tome and Principe, South Sudan, Somalia, and Timor-Leste are classified as low income countries. San Marino is classified as a high income country. Overseas territories of the UK, Netherlands, and France are classified according to their parent country's status (see Gibraltar, Curacao, and St. Martin/Sint Maarten).

Wholesaler purchases of domestic manufactured goods are computed by subtracting imports from total merchandise purchases for resale. Finally, sales are adjusted to only consider domestic buyers. I subtract the percentage of sales and purchases that are used for export shipments. This export data is collected directly on the CWH forms. Additionally there are a subset of wholesaler firms that participate in multiple NAICS wholesale sectors. I allocate imports proportionally by the

Figure 4: Selected Survey Questions: 2007 Economic Census

U.S. DEPARTMENT OF COMMERCE
Economics and Statistics Administration
U.S. CENSUS BUREAU
FORM
WH-42319 (12/07/2006)

2007 ECONOMIC CENSUS
Electrical Goods

OMB No. 0607-0929: Approval Expires 12/31/2008

DUE DATE
FEBRUARY 12, 2008

Mail your completed form to:
U.S. CENSUS BUREAU
1201 East 10th Street
Jeffersonville, IN 47134-0001

Please read the accompanying information sheet(s) before answering the questions.

Need help or have questions

WH-42319

. . .

5 SALES, SHIPMENTS, RECEIPTS, OR REVENUE

		Mark "X" if None	2007 $ Bil.	Mil.	Thou.	Dol.
A. Sales and operating receipts *(Include the gross selling value of business conducted for others. Include shipping and handling charges. Exclude sales taxes and Hawaii's General Excise Tax.)*	0100	☐				

. . .

16 SELECTED EXPENSES

		Mark "X" if None	2007 $ Bil.	Mil.	Thou.	Dol.
A. Operating expenses *(Include payroll. Exclude cost of goods sold and interest expense.)*	0140	☐				
B. Purchases of merchandise for resale, net of returns, allowances, and trade and cash discounts *(Include amounts allowed for trade-ins.)*	1160	☐				

. . .

19 **B.** TYPE OF OPERATION
Which ONE of the following best describes this establishment's principal type of operation in 2007?
(Mark "X" only ONE box.)

Merchant wholesaler, buying and selling on own account

0600
12 ☐ Importer
13 ☐ Exporter
11 ☐ Merchant wholesale distributor or jobber
14 ☐ Own-brand importer and marketer
20 ☐ **Manufacturers' sales branch or office**

42319053

. . .

Agent, broker, or commission merchant

0600
41 ☐ Auction company
42 ☐ Broker, representing buyers and sellers
43 ☐ Commission merchant
44 ☐ Import agent
45 ☐ Export agent
46 ☐ Manufacturers' agent
49 ☐ **Electronic market - business-to-business marketplace that facilitates the sale of goods via the Internet or other electronic means, and operates on a commission or fee basis**

cost of goods sold between the multiple sectors.

A.3 Outside Share (Direct Sourcing) Data Construction

Both the summary statistics in Section 2 and the estimation routine in Section 4, require the construction of the total downstream market size and the share of the downstream market not served by U.S. based wholesalers (the outside option). As wholesalers in the Census of Wholesale Firms (CWH) and and manufacturing producers in Census of Manufacturers (CMF) use different classification systems, a series of NAICS Wholesale to NAICS Manufacturers code concordances are used. See Ganapati (2015) for an overview of the process. In addition, the Import-Export Database (LFTTD) uses the Harmonized System (HS) of good classification, and the Commodity Flow Survey (CFS) uses the Standardized Classification of Transported Goods (SCTG). Ganapati (2015) also uses the micro-data in the CFS and the LFTTD to provide concordances between the various NAICS, HS and SCTG codes at different levels of aggregation.

Total domestic absorption is computed as:

$$\begin{aligned}\text{Total Domestic Absorption} &= \text{Domestic Production}\\ &+ \text{International Imports}\\ &- \text{International Exports.}\end{aligned}$$

Data on domestic production originates from the CMF as the sum of all domestically manufactured products. Data on international imports and exports originates from the LFTTD. For domestic wholesalers in the LFTTD, values are deflated by average wholesaler markups over manufacturer prices. This produces "total domestic absorption" in terms of producer's prices. Since manufacturers and producers are not modeled in this paper, these prices are considered fixed. Alternative computation uses the CFS for domestic production and international export data.

Similarly domestic absorption accounted by wholesalers is computed as:

$$\begin{aligned}\text{Domestic Wholsaler Absorption} &= \text{Domestically Sourced Wholesaler Shipments}\\ &+ \text{Wholesaler Imports}\\ &- \text{Wholesaler International Exports.}\end{aligned}$$

The first two components are computed using the combination of the CWH along with the LFTTD. The CWH reports total shipments and total exports, the LFTTD reports the total imports of a firm. Wholesaler international exports are computed using the self-reported CWH figure for total exports, alternatively the LFTTD may also be used.

Table 1 aggregates these statistics across the entire sample. See the main text for further analysis and a summary.

A.4 Detailed Wholesaler Statistics

Tables A1-A3 highlight additional wholesaler statistics by wholesaler size rank.

Table A1: **Market Shares and Import Probabilities by Market Share Quantile**

Market Shares			
Share Quantile	Year 1997	2002	2007
0-10	0.0001%	0.0001%	0.0001%
10-20	0.0003%	0.0003%	0.0003%
20-30	0.0006%	0.0006%	0.0005%
30-40	0.0010%	0.0010%	0.0009%
40-50	0.0015%	0.0015%	0.0013%
50-60	0.0023%	0.0023%	0.0021%
60-70	0.0036%	0.0035%	0.0033%
70-80	0.0059%	0.0059%	0.0057%
80-90	0.0114%	0.0115%	0.0114%
90-99	0.0404%	0.0426%	0.0461%
99-99.5	0.1740%	0.1970%	0.2356%
99.5+	0.8241%	1.0197%	1.1335%

Import Probabilities			
Share Quantile	Year 1997	2002	2007
0-10	5%	6%	8%
10-20	6%	9%	10%
20-30	9%	10%	13%
30-40	11%	13%	16%
40-50	13%	16%	19%
50-60	15%	18%	22%
60-70	19%	22%	26%
70-80	23%	26%	30%
80-90	27%	31%	36%
90-99	39%	42%	48%
99-99.5	60%	62%	67%
99.5+	74%	78%	81%

Table A2: **Number of Source Countries and Products by Market Share Quantile**

Import Countries			
Share Quantile	Year 1997	2002	2007
0-10	0.1	0.1	0.1
10-20	0.1	0.1	0.2
20-30	0.1	0.2	0.2
30-40	0.2	0.3	0.3
40-50	0.3	0.3	0.4
50-60	0.3	0.4	0.5
60-70	0.5	0.5	0.7
70-80	0.6	0.8	0.8
80-90	0.9	1.1	1.3
90-99	2.0	2.4	2.7
99-99.5	5.1	6.3	6.5
99.5+	9.9	12.4	13.6

Import Country-Products Combinations			
Share Quantile	Year 1997	2002	2007
0-10	0.2	0.3	0.4
10-20	0.4	0.4	0.5
20-30	0.5	0.8	0.9
30-40	0.7	1.1	1.4
40-50	1.0	1.4	1.7
50-60	1.4	1.8	2.6
60-70	1.9	2.5	3.5
70-80	5.0	4.1	5.0
80-90	5.0	8.8	11.6
90-99	13.7	18.0	24.6
99-99.5	54.1	77.0	73.4
99.5+	137.4	183.6	213.8

Table A3: **Number of Locations by Market Share Quantile**

Multi-location Firms by Quantile			
Share	Year		
Quantile	1997	2002	2007
0-10	0%	0%	0%
10-20	0%	0%	0%
20-30	0%	0%	1%
30-40	1%	1%	1%
40-50	1%	1%	2%
50-60	2%	2%	3%
60-70	4%	4%	4%
70-80	7%	7%	7%
80-90	13%	13%	14%
90-99	28%	30%	31%
99-99.5	50%	53%	57%
99.5+	63%	68%	71%

Average Locations by Quantile			
Share	Year		
Quantile	1997	2002	2007
0-10	1.0	1.0	1.0
10-20	1.0	1.0	1.0
20-30	1.0	1.0	1.0
30-40	1.0	1.0	1.0
40-50	1.0	1.0	1.0
50-60	1.0	1.0	1.0
60-70	1.0	1.1	1.1
70-80	1.1	1.1	1.1
80-90	1.2	1.2	1.3
90-99	1.8	2.0	2.1
99-99.5	4.7	5.9	6.9
99.5+	14.2	20.7	23.9

A.5 Distribution of Buyer Types

I present an additional fact that describes the time evolution of buyer types in the Commodity Flow Data.

Fact 6 *The distribution of buyer types has slightly skewed towards larger shipments over time.*

One hypothesis explaining the shift towards wholesaling is the spread of "just in time" manufacturing and supply practices. These business models forgo a small number of large deliveries for a larger number of smaller shipments. This provides downstream buyers with more flexibility and reduces inventory costs. In aggregate, such practices would imply that there is a shift towards smaller order sizes. If wholesalers are more adept at shipping smaller orders, then this may induce a shift of buyers switching to wholesalers. However, this has not occurred, as shown in Figure 5; Downstream buyers have slightly increased the average size of their orders over time.[48]

A.6 Geographic Differentiation

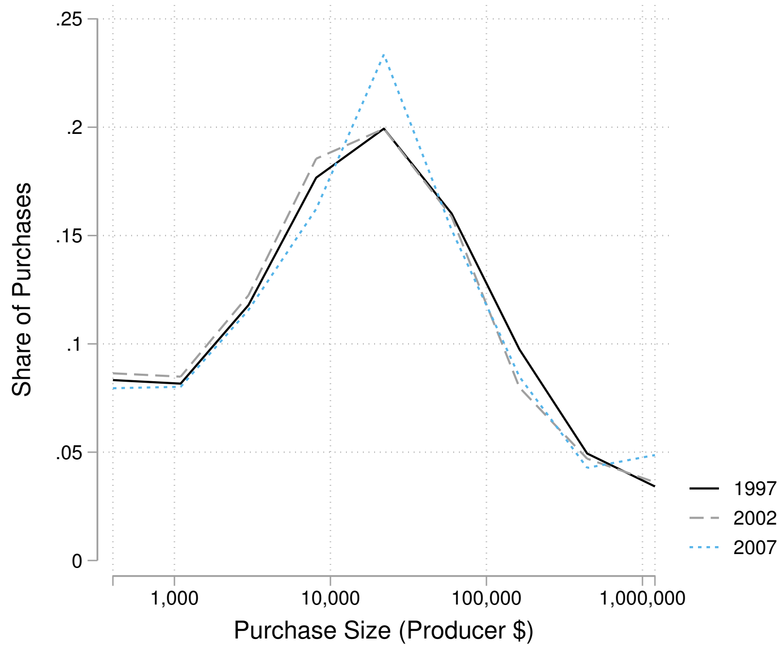
In lieu of a continuous distance measure, this project discretizes downstream buyer location by U.S. state[49], which are each located in 4 regions and 9 divisions. This project considers three distinct levels of distance with regards to the downstream buyer, wholesalers that are located in the same state, wholesalers located in the same census division and wholesalers located in a different census division. Figure 6 displays these divisions.

An alternative approach that would allow for tractable computation would be to map distance directly to distance indicator variables. This would prevent issues arising from considering the

[48] A related fact shows that the geographic distribution of buyers has not significantly changed over the same time period.

[49] The District of Columbia is redefined as a state for this project.

Figure 5: **Distribution of Buyers**



Figures in real 2007 dollars.

distance between New York and Connecticut differently than the distance between New York and New Jersey, due to Census division classifications. Instead of considering buyers that are within the same census division or region, the alternative would be to consider other states within pre-specified distance bands. For example, distance band 1 for New York would include all wholesalers in states that are reachable within 4 hours (250 miles) and distance band 2 would include all wholesalers in states that are within 8 hours (500 miles). Preliminary results show that estimates in Sections 4 and 5 are largely consistent and the aggregate estimates in Section 6 are similar. However, the geographic breakdown is slightly changed, with the surplus gains due to intermediation slightly rising in small New England and South Atlantic States (in particular Rhode Island and Delaware) and slightly falling in rural Mountain States (Wyoming and Montana). The primary restriction here is the lack of computing power, enabling full estimation.

A.7 Wholesaler Case Study

Consider the case of specialty industrial chemicals. This sector grew 28% between 2008 and 2013; however, the share of products distributed by independent wholesalers increased 37%. Industry reports (Elser et al., 2010; Jung et al., 2013, 2014) highlight two types of observations, (a) why particular downstream buyers contract with wholesalers instead of manufacturers and (b) what differentiates successful wholesalers from unsuccessful wholesalers.

Downstream buyers face heterogenous barriers to directly purchasing chemicals from a manufacturer. According to a 2009 Boston Consulting Group survey, 80% of downstream buyers with

Figure 6: **U.S. Census Regions and Divisions**

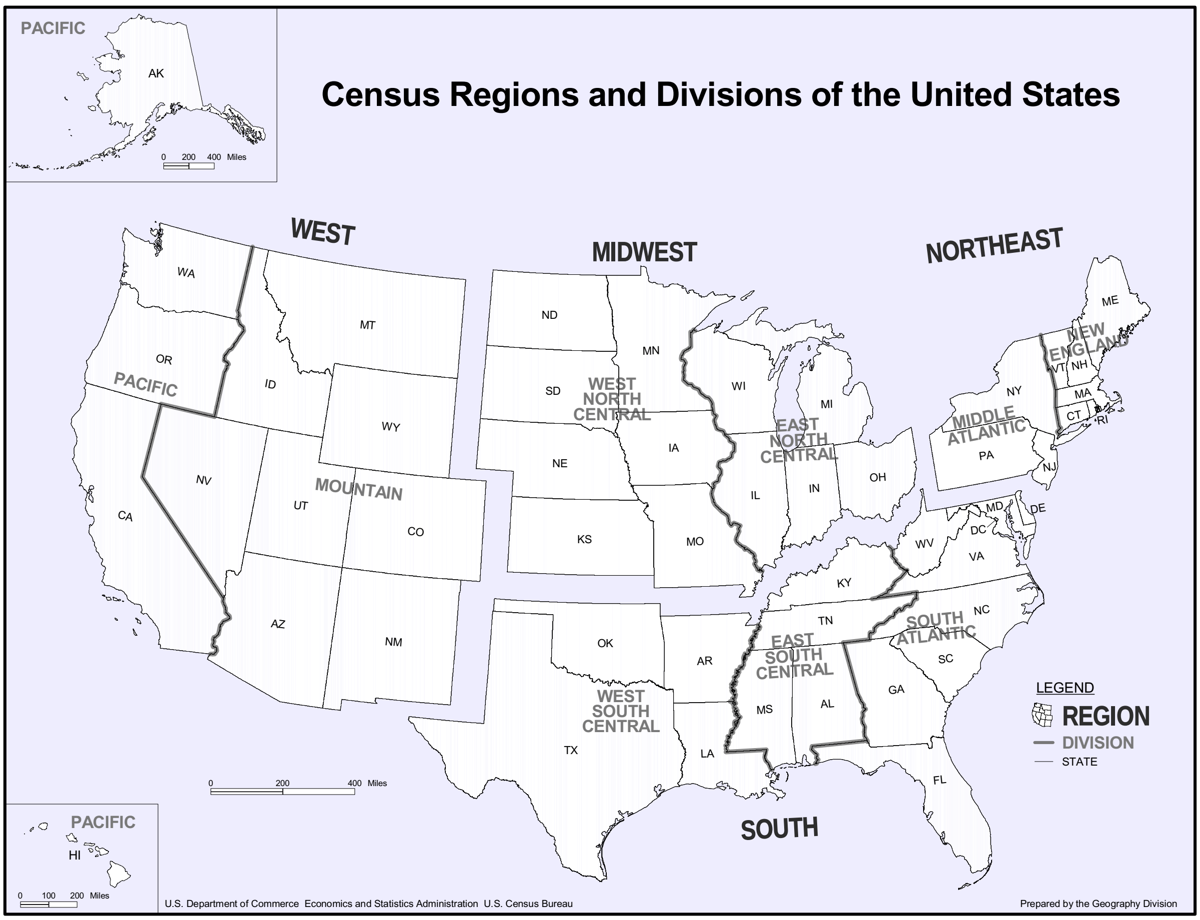
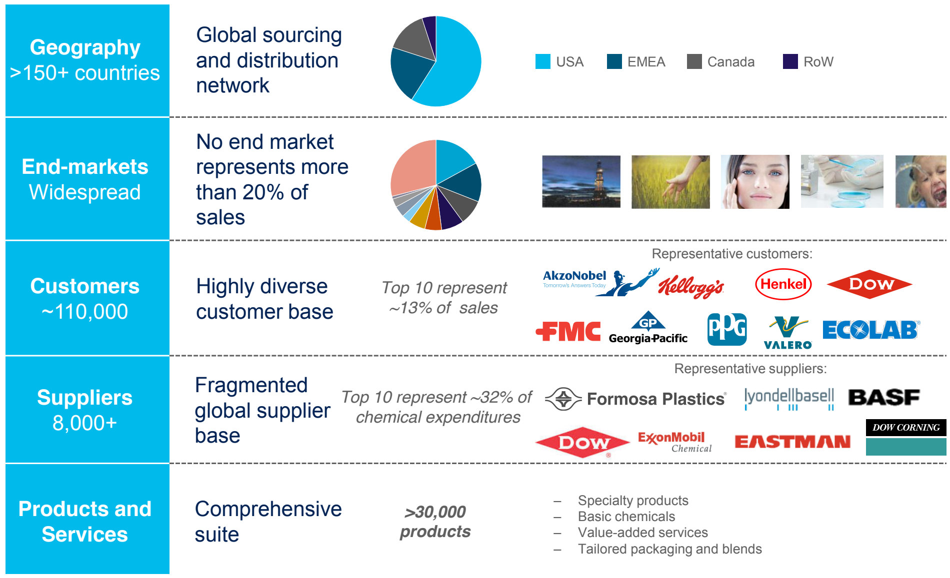


Figure 7: **Univar Presentation at 2015 Barclays Industrial Distribution Forum**



Source: Univar Investor Relations

purchases valued under €100,000 sourced goods indirectly through wholesalers, while larger purchasers nearly always sourced directly from a manufacturer. Downstream buyers value traditional distributor attributes such as price, quality, and globally sourced varieties, and are differentiated on two characteristics, their size and geographic location.[50]

In the industrial chemical market, wholesaler distributors perform three functions as they (a) source products from multiple manufacturers, (b) repackage these products, and (c) ship these products to downstream buyers. While the global market for distributors is still fragmented, it is experiencing rapid consolidation, with the three largest companies in 2011 holding 39% of the North American market. In particular, the largest distributors have grown faster than the market, driven by both organic expansion and market acquisitions. In contrast, smaller distributors face increasing fixed costs, as they try to "combine global reach with strong local presence." (Jung et al., 2013)

Consider one of the large speciality chemical distributors, Univar. A slide detailing their business plan is presented in Figure 7. Univar is a large industrial chemical wholesaler with North American shipments of approximately $10.4 billion in 2014. The company was formed in 1928, increasing its distribution footprint through acquisitions and expansions. Today, it sources 30,000 varieties of chemicals and plastics from over 8,000 internationally distributed suppliers. Univar uses its 8,000 employees to run a distribution network spanning hundreds of locations to supply 111,000 buyers.[51]

Downstream buyers may need a variety of chemicals, and they may source these chemicals directly from manufacturers such as DuPoint and BASF, or indirectly through Univar. However,

[50]Smaller downstream buyers "typically lack the critical mass needed to tap into low-cost sources for chemicals from China, Eastern Europe, or the Middle East." In addition, these downstream buyers not only value price, product quality, and technical support, they prize flexibility and speed of delivery, which are highly correlated with geographic proximity.

[51]Univar's business plan is summarized in a slide presented as Appendix Figure 7.

BASF and DuPont facilities may be located in distant locations and only stock their own product lines. Instead of individually sourcing chemicals, downstream buyers may pay a markup and have Univar do this for them, where Univar would source the shipments from each respective chemical manufacturer and reship them to a convenient loading bay. This tradeoff between convenience and price is one of the central dynamics underpinning the wholesale industry. This also offers insight into why the wholesale industry may be gaining market share, as the proliferation of new global sources and varieties may make it harder to optimally source intermediate products for production.[52]

B Demand Systems

This section provides micro-foundations for the indirect downstream profit functions used in Section 3. This provides support for both the two-stage demand system and allows for simple extensions. While this specific toy demand model provides micro-foundations for the exact demand structure presented in the main paper's model, it is slightly generalizable, while still providing the needed structure. There are two critical elements, the first requiring a single-input invertible production function, and the second requiring that the expectation of the marginal cost is sufficient for the wholesaler's decision in the last demand stage (in period t_4).[53]

B.1 Downstream Profit Maximization (1st Demand Stage)

To highlight downstream buyers' choices of purchase quantity before the realization of idiosyncratic match shocks, consider a hypothetical downstream buyer. Assume that these downstream buyers produce output using a single input, such that output $q = x$, where q is the single input. Downstream buyers face constant elasticity of substitution (CES) demand for $x > 0$ units, with elasticity $\sigma > 1$ and demand-shifter $\eta > 0$. Additionally, suppose there are fixed cost of production f drawn from some distribution $F(\cdot)$.

First, I solve the firm's problem disregarding the fixed cost. Demand takes the form:

$$x = \eta p^{-\sigma}$$

Under such a CES demand framework, these downstream buyers charge markup μ, which is a function of the elasticity of substitution σ:

$$\mu = \frac{\sigma}{\sigma - 1}.$$

This markup is invariant of the demand shifter η. The optimal price, p^*, charged by such a downstream buyer is the product of the marginal cost of production mc and the markup μ:

$$p^* = mc \cdot \mu.$$

[52] Feenstra and Weinstein (2017) show that the number of manufactured varieties in the U.S. has increased over time due to global trade.

[53] The logic here closely follows Hausman et al. (1995), switching the buyer's problem to consider a producer's profit maximization.

This price can be plugged back into the demand equation, solving for the optimal q^*:

$$x^* = \eta\left(\mu \cdot mc\right)^{-\sigma}.$$

Since the production function is one-to-one with the input, $q^* = x^*$. However, this assumes that downstream buyer marginal cost mc is known. In the two-stage decision, downstream buyers must choose q^{**} in a first period, with knowledge of only the possible distribution of mc. Then in the second period, downstream buyers choose p^{**} to clear the market. Solving through backwards induction, conditional on x^{**}, a downstream buyer chooses p^{**} such that:

$$p^{**} = \left(\frac{x^{**}}{\eta}\right)^{-1/\sigma}$$

Then in the first stage, a wholesaler solves:

$$\max \mathbb{E}\left[\left(p\left(x\right) - mc\right) \times x\right]$$

Plugging in values, iterating expectations of marginal cost, and taking first order conditions:

$$\begin{aligned} \pi\left(x\right) &= x\left(\frac{x}{\eta}\right)^{-1/\sigma} - x\mathbb{E}\left[mc\right] \\ \pi'\left(x\right) &= \frac{\sigma-1}{\sigma}\left(\frac{x}{\eta}\right)^{-1/\sigma} - \mathbb{E}\left[mc\right] \end{aligned}$$

Setting the first order conditions to zero and solving for x^{**}:

$$\begin{aligned} x^{**} &= \eta\left(\mathbb{E}\left[mc\right]\mu\right)^{-\sigma}. \\ &= q^{**} \end{aligned}$$

Where the last equality comes from the linear production function. This two stage demand provides for the same prices and quantities as before, however it also allows for uncertainty in the realized marginal cost.

If the demand shifter η comes from some underlying distribution $N\left(\cdot\right)$, then the distribution of q^* will come from this same distribution scaled by $\left(\mu \cdot mc\right)^{-\sigma}$.

Revisiting fixed cost f, expected profits are:

$$E\left(\pi\right) = E\left(\left(p^{**} - mc\right)q^{**}\right) - f \quad = \quad \tilde{\pi}\left(E\left(mc\right)\right) - f$$

Where $\tilde{\pi}$ is an increasing function in terms of the expected marginal cost. Production only occurs if $\tilde{\pi} - f > 0$.

Aggregate downstream profits are a decreasing function of marginal cost, thus a reduction in marginal costs increases downstream profits.[54] The second stage's demand decision involves choosing the optimal wholesaler to reduce this marginal cost. Additionally, these profits are a function of the fixed cost f; lowered marginal costs imply that more firms will be able to enter the market. Aggregating across the draws for downstream demand η and the fixed costs f, this produces a mass of buyers M_q that demand q units. If $\mathbb{E}\left(mc\right)$ falls, then the mass of M_q will shift upwards. In my model $\mathbb{E}\left(mc\right)$ is directly related to $\mathbb{E}\left(\bar{U}\right)$, the expected utility of indirectly sourcing from a

[54] Note that $\sigma > 1$.

wholesaler.

B.2 Downstream Cost Minimization (2nd Demand Stage)

The indirect downstream profit function can be micro-founded through a simple cost minimization function for a downstream buyer. Suppose the cost of directly sourcing q units is:

$$C_{direct} = qp_0 F(q)$$

Where p_0 is the per-unit cost and $F(q)$ is the per-unit overhead cost of setting up purchases for q units. Suppose the indirect cost of sourcing q units is:

$$C_{indirect} = qp_1$$

Where p_1 is the per-unit cost. For simplicity, suppose there isn't an overhead cost. The logarithm of per-unit costs are then:

$$\begin{aligned} \log\left(\frac{C_{direct}}{q}\right) &= \log(p_0) + \log\left(\frac{F(q)}{q}\right) \\ \log\left(\frac{C_{indirect}}{q}\right) &= \log(p_1) \end{aligned}$$

As long as downstream profits or utility are a function of the difference in per-unit costs, then the estimating equation is appropriate.

B.3 Quantity discounts

Business to business transactions often take a form where the sale price is a function of the the quantity purchased. While estimated model does not directly account for this, a simple modification allows for quantity discounts to be easily added, without changing the implication of the model. Suppose that wholesaler price p depends on the purchased quantity q through discount factor $d(q)$ and a mean price p:

$$p_q = p \times d(q).$$

The discount function $d(q)$ is a schedule that multiplies some baseline price conditional on the purchase quantity q.

Simplifying the mean utility δ_q from equation (14) for any wholesaler selling to a buyer purchasing q units produces:

$$\delta_q = \alpha \log p_q + f(q) + \xi$$

Where $f(q)$ represents the different preferences for wholesalers depending on purchase quantity q. Substituting the function for price:

$$U_q = \alpha \log p + \underbrace{\alpha \log d(q) + f(q)}_{\tilde{f}(q)} + \xi$$

Instead of recovering $f(q)$, estimation now recovers $\tilde{f}(q)$. In terms of buyer surplus calculations and market entry estimates, results are essentially unchanged. In terms of marginal cost estimates, similar logic prevails, and this paper computes a mean marginal cost with industry-year fixed effects netting out buyer compositional changes. However for counterfactuals, I assume that this discount structure $d(q)$, through $\tilde{f}(q)$, is invariant. That is prices p_q can only change through p and not through $d(q)$, which will remain fixed.

B.4 Constant Elasticity of Substitution

The choice between wholesalers is modeled as a discrete choice decision and is micro-founded above. This modeling assumption is used both for tractability and realism, even though the majority of international trade research uses a constant elasticity of substitution demand system. However, there is a nice link between CES demand systems and the discrete-choice logit demand systems, as first described by Anderson et al. (1992) and elaborated by De Loecker (2011).

Assume that downstream product demand takes the form:

$$D(p) = \left(\frac{p}{P}\right)^{-\rho} \xi \frac{Y}{P} = (p)^{-\rho} \xi \frac{Y}{P^{1-\rho}}$$

Where Y is total spending, ξ is a demand shifter, ρ is the elasticity of substitution, and the price index P takes the form:

$$P = \left(\int \xi p^{1-\rho}\right)^{\frac{1}{1-\rho}}$$

Wholesaler profit maximization takes the following form:

$$\pi = \max_{p} (p-c) D(p),$$

which p denoting the price and c denoting wholesaler marginal cost. Assuming Nash-in-prices competition, the optimization is as follows:

$$\begin{aligned} D(p) &= -(p-c) D'(p) = \sigma \frac{(p-c)}{p} D(p) \\ p &= c\frac{\rho}{(\rho-1)} \end{aligned}$$

So then higher/lower prices due to ξ only operate through its correlation to c. Then wholesaler revenues R are:

$$R = (p)^{1-\rho} \xi \frac{Y}{P^{1-\rho}}$$

Taking a log transform of the wholesaler revenue function produces the relationship:

$$\log R = (1-\rho)\log p + \log \xi + \log \frac{Y}{P^{1-\rho}} \tag{16}$$

Now since revenues are related to market share s and total market size Y as $R = sY$, equation (16) can be rewritten as:

$$\log s = (1-\rho)\log p + \log \xi - \log P^{1-\sigma}$$

This estimating equation is almost identical to the logit estimating equation, with $\alpha^p = (1-\rho)$. The difference between these models, as noted by Anderson et al. (1992), is clearly in the economic interpretation, but the use of log prices forces identical substitution patterns. Note this model is not directly used in the empirical application, rather I use an aggregation of a nested logit framework. Further work can show this is equivalent to a two-level nested-CES demand aggregated across a variety of heterogenous downstream buyers. Both the two-level nested structure of demand and the heterogenous downstream buyers produce substantially more complex aggregate substitution patterns between wholesalers allowing much richer analysis. Critically, the difference between my model and most international trade papers is on the supply-side. Firms do not compete monopolistically, they are allowed to exert variable market power.

B.5 Demand Estimation

B.5.1 Discrete Choice Estimation Routine

Estimation follows a Generalized Method of Moments technique in the vein of Petrin (2002) and matches both aggregate national market shares and moments derived from the micro-level data.[55]

Assuming away buyer heterogeneity and allowing for one level of nests (the full model follows Bresnahan et al. (1997) and allows for two non-nested levels of nests), I can derive the standard Berry (1994) estimation equation for the relative market share of wholesaler w, selling variety i, that belongs to product nest n:

$$\log s_{w,i} / \log s_0 = \delta_{w,i} + \sigma_n \log s_{w,i|n}, \tag{17}$$

where s_0 represents the share of the outside option, sourcing directly from a manufacturer.[56]

With buyer heterogeneity, the aggregate market share equation is more elaborate:

$$\log s_{w,i} = \log \sum_{j \in \mathcal{J}} \left[s_{0|j} \cdot s^{\sigma}_{w,i|j,n} \cdot \exp\left(\delta_{w,i,j} / \left(1 - \sigma_n\right)\right)\right] \mu_j \tag{18}$$

Variable $s_{0|j}$ represents the share of direct sourcing from manufacturing by buyers of type j, and $s_{w,i|j,n}$ represents the conditional share of a wholesaler w selling variety i in nest n to customer j. With downstream buyer heterogeneity, alongside wholesaler heterogeneity (that is different wholesalers serve different markets), the demand system provides for flexible substitution patterns and greater variety in markups.

In practice the estimation uses a finite number of buyer types j, each with overall mass μ_j. Mean utility $\delta_{w,i,j}$ can be decomposed $\delta_{w,i,j} = \delta_{w,i} + \tilde{\delta}_{w,i,j}$. The first component is common across all downstream buyers and the second is specific to downstream buyers of type j. Solving for $\xi_{w,i}$, equation (18) is operationalized with one level of nests as:

$$\xi_{w,i} = \log s_{w,i} - \log \sum_{j \in \mathcal{J}} \left[s_{0,j}\left(\vec{\delta}\right) \cdot s^{\sigma}_{w,i|j,n}\left(\vec{\delta}\right) \cdot \exp\left(\frac{\tilde{\delta}_{w,i,j}}{1-\sigma}\right)\right] \mu_j - \Bigg(\alpha^p \log p_{w,i} + \alpha^q \log q_j + \sum_{l \in \{state, region\}} \alpha^l \mathbb{I}_{l_w = l_d} + \tag{19}$$

[55] Estimation proceeds sequentially, starting with demand estimation before moving to estimating the marginal cost and market entry parameters.

[56] If I assume that the unobserved parts of $\delta_{w,n}$ are mean zero, I can run a linear regression and recover $\xi_{w,n}$. However, this means that a wholesaler based in New York will face the same demand in California as in New York, thus the model without buyer heterogeneity is a baseline for the full model.

This defines a contraction mapping from $\mathbb{R}^N \to \mathbb{R}^N$. By recursively solving for $\xi_{w,i}$, I can solve this system of equations. Multiple levels of nests simply generalize this setup. Unlike the most general form in equation (18), the vector of parameters for unobservable coefficients is set such that $\alpha_j = \alpha$ for all $j \in J$.

In practice, this contraction mapping is the lengthiest step, as it is difficult to parallelize and requires weeks-long processing time in the confidential census computing cluster. Alternative computation methods such as Mathematical Programming with Equilibrium Constraints (MPEC) are similarly slow as they require equality constraints for all 600,000 firms to be individually computed and checked.

Aggregates Shares Using observed market shares, a candidate parameter estimate θ, observed prices p, and downstream market characteristics, estimation computes $\xi_{w,i}(\theta)$ for each wholesaler. As shown in Section 4, $\xi_{w,i}$ is uncorrelated with a series of instruments z, so the identifying restriction is

$$E\left(\xi_{w,i} z_{w,i}\right) = 0$$

whose empirical analogue is $Z'\xi(\theta)$, where observations are stacked by wholesaler. This set of assumptions will serve to pin down the price coefficient α and substitution σ.

Micro-Level Moments To pin down the coefficients for quantities and geographic indicators, estimation uses a series of moments that use estimated data and compares them with various facets of the survey data. In particular, the estimation routine matches the shares of within metro-area, within state, and within Census region wholesale shipments along with wholesale shipment shares by shipment size. I denote the vector of moments produced by the data as $\mathbf{m}_{data}$ and the estimated moments as $\mathbf{m}(\theta)$.

Moment Function Estimation obtains the parameter estimate $\hat{\theta}$ from minimizing the following criterion equation:

$$\hat{\theta} = \arg_{\theta} \min G(\theta)' W G(\theta), \tag{20}$$

where

$$G(\theta) = \begin{bmatrix} Z'\xi(\theta) \\ \mathbf{m}_{data} - \mathbf{m}(\theta) \end{bmatrix}$$

and W is a weighting matrix. First stage identification uses the identity matrix. But in a two-step procedure, estimation is iterated with the weighting matrix taking the form $W_2 = \left[G\left(\hat{\theta}_1\right) G\left(\hat{\theta}_1\right)'\right]^{-1}$ with $\hat{\theta}_1$ denoting the estimates obtained using the identity weighting matrix.

By using the relation, $\delta_{w,i}(\sigma) = x_{w,i}\alpha + \xi_{w,i}$, estimation can be simplified. Thus conditional on σ, the GMM routine can use the estimation:

$$\hat{\alpha}_{IV}(\sigma) = \left(X'Z\Phi Z'X\right)^{-1} \left(X'Z\Phi Z'X\right)^{-1} \delta_w\left(\sigma; \alpha_l, \alpha_q\right)$$

Then I can use a GMM estimator to find σ, α_l ,and α_q that minimize:

$$J_w(\sigma;\alpha_l,\alpha_q) = [\delta_w(\sigma;\alpha_l,\alpha_q) - x\alpha_w(\sigma;\alpha_l,\alpha_q)]' Z\phi Z' [\delta_w(\sigma;\alpha_l,\alpha_q) - x\alpha_w(\sigma;\alpha_l,\alpha_q)].$$

B.5.2 Demand Estimation

Formally, I identify the demand parameters α and σ using a modification of Berry and Haile (2014). Define X as the set of attributes defined in the first-stage of the entry game, before the realization of wholesaler quality ξ. This means that a wholesaler has chosen whether they will participate in globalized trade, and what dimension their domestic geographic footprint takes. Define Z as a set of variables that shift marginal cost, but not downstream buyer valuations of wholesaler products. Define $M(\alpha,\sigma)$ as a set of aggregate moments, such as the predicted share of local wholesale shipments, and where M_d is the observed realization of these moments. I make the following assumptions:

Assumption 1 *For every parameter (α,σ) there is at most one vector ξ such that $s_{w,i}(\xi_{w,i},\alpha,\sigma) - s^0_{w,n} = 0$ for all $(w,o)\in\mathcal{W}$.*

Assumption 2 $E[\xi_{w,i}|Z,X] = 0$ *for each* $(w,i)\in\mathcal{W}$

Assumption 3 $E[M(\alpha,\sigma) - M_d] = 0$

These assumptions are standard from Berry et al. (1995) and Petrin (2002); a demand invertibility condition, an instrumental variable condition, and a set of aggregate moments. The first condition allows us to invert the observed market shares, conditional on X, and obtain mean valuation $\delta_{w,i}$ for each wholesaler-variety combination $w,i\in\mathcal{W}$.

Assumptions 1, 2, and 3, along with the the structure imposed from the model and set of regularity conditions, identify $\xi_{w,i}$ with probability 1 and the function $s_{w,i}(\chi)$ is identified on χ. Formally, even without assuming a functional form for $s_{w,i}(\cdot)$, demand identification stems from a modification of Berry and Haile (2014) to allow for aggregate moments.

C Demand Robustness

Table A4 reports results from the estimation of a simplified model of downstream buyer choices from Equation 20. The single nest coefficient σ relates to the substitutability between internationally sourced and domestically sourced goods. Columns (1)-(4) present results from a simplified model without observable buyer heterogeneity and are estimated without the use of the aggregate moments. They are presented with and without appropriate instruments to highlight the importance of controlling for endogeneity. Column (1) omits buyer heterogeneity and neither instruments the wholesaler price nor the correlation coefficient σ. Column (2) instruments for just wholesaler prices and column (3) instruments for just the nest coefficient. Column (4) instruments for both wholesaler prices and the nest coefficient σ.

Table A4: **Downstream Firm Choice (2nd Demand Stage)**

	(1) OLS	(2) Partial IV (Price)	(3) Partial IV (σ)	(4) Full IV
log (Price)	-0.152	-3.204	-0.231	-2.876
	(0.038)	(0.229)	(0.044)	(0.231)
σ_i (Varieties)	0.928	0.808	0.880	0.689
	(0.006)	(0.013)	(0.014)	(0.019)
Controls	Number of Varieties, Number of Warehouses			
Fixed Effects	6-Digit Industry × Variety, Year × Variety			

Notes: Robust standard errors presented. Columns (1)-(4) show the results without localized market power, nor downstream firm heterogeneity. Columns (1) and (2) omit instruments for $\log(price)$. Column (1) and (3) omit instruments for σ. See text for full regression specification.

Columns (1) and (3) do not instrument for wholesaler prices. While downstream buyers appear to value low margins, buyer demand is inelastic. There is a weak relationship between higher prices and lowered sales. This is extremely odd as wholesaling appears to be a low-margin and extremely competitive industry. Instrumenting for wholesaler margins, as in columns (2) and (4), produce much larger (in absolute terms) coefficients and imply that wholesalers all face elastic buyer demand.

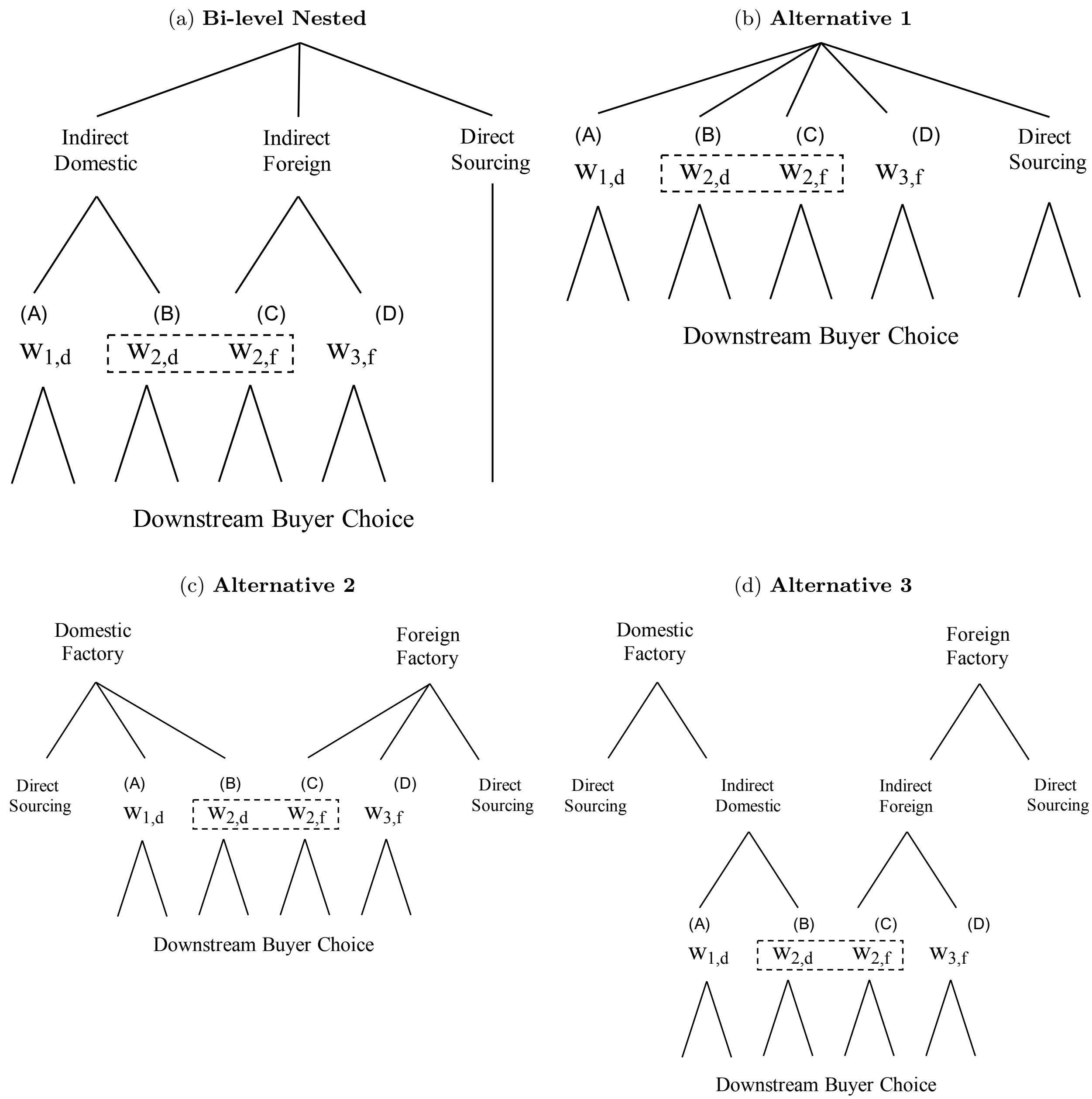
The nest coefficient σ relates to the substitutability between internationally sourced and domestically sourced goods. A value of 1 implies zero substitutability between these two categories and a value of 0 implies no differentiation in the substitutability between categories. Without instrumentation, this term will be biased towards 1, as within-type shares will be highly correlated with with total-market shares. This bias is evident in specification (1) and (2), but not in specification (3) and (4).

C.1 Demand Robustness

I consider two further robustness exercises regarding my demand specification; (a) I compress and expand my multi-level nested logit specification and (b) I consider parameter heterogeneity across product-markets. In general, I find that results are largely unchanged.

Multi-level Logit Demand In Figure 8, I show a series of alternative nesting patterns for the error term ϵ. Panel (a) shows a classic nested bi-level logit, simplifying the approach in Goldberg (1995). The downside of this model is it implies the substitution between wholesaler types is stronger than between sourcing patterns, which the model in the main paper avoids. Panel (b) compresses the top nesting structure into the second nest. This implies that foreign-sourced products sold by multi-source wholesalers are similarly substitutable between foreign-sourced products sold by single-source wholesalers and domestically-sourced products sold by multi-source wholesalers. Estimates from such a model are shown in Table A5. In general, this simplified model produces estimates

Figure 8: **Downstream Buyer Sourcing Choice Trees**



(a) **Bi-level Nested**

(b) **Alternative 1**

(c) **Alternative 2**

(d) **Alternative 3**

Notes: (A) refers to wholesalers that only source from domestic manufacturers. (B) and (C) refer to wholesalers that buy from both domestic and foreign sources, where (B) refers to their domestic purchases and (C) refers to their foreign purchases. (D) refers to wholesalers that only source from abroad. The full model allows for two different types of foreign sources, those from high-income countries and from low-income countries. Additionally, all direct sourcing in lumped together in an outside option.

Table A5: **Single-Level Logit Downstream Firm Choice Estimates**

	est/se		est/se		est/se
log (price)	-2.564	Within State Shipment	3.367	log {Shipment Size}	-0.333
	0.023		*0.045*		*0.003*
$\mathbb{I}_{\{\# \text{ Locations}>1\}}$	0.199	Within Region Shipment	1.340		
	0.005		*0.082*		
σ	0.632	South Imports × log (HS-8 lines)	0.704	North Imports × log (HS8 lines)	0.739
	0.002		*0.010*		*0.009*
Fixed Effects	Market × Source, Year × Source				

Notes: Results from optimizing generalized method of moments (GMM) routine using a gradient search. Robust GMM standard errors presented. See text for full regression specification. North refers to high-income country sources. South refers to low-income country sources.

slightly different from the baseline model, as the coefficient estimates α change to rationalize the data to difference in σ. I omit estimation of ψ in this example.

Future projects could further explore the nesting structure in Panels (b) and (c). However, this would require better data on the direct import-share of manufactured goods not at the national level, but at the local (state) level. This variation on the state-level import shares would help identify the substitution parameter σ_{direct} that would govern the top-most nesting structure. This current project aggregates all direct imports at the national level for a data-driven reason. The used import data often lists only the port of landing, not the final destination of an imported product. (As a hypothetical, a disproportionate number of auto parts land in New Jersey, relative to the share auto plants located in the state.) Further work and assumptions are required allocate this import data to downstream users.

Parameter Heterogeneity In Table A6 I repeat the estimation of my model within each of my 56 product-markets. I use 2-stage least squares estimation, but generalize away from buyer heterogeneity. This produces 56 estimates for the parameter vector (α, σ). I report the average of three critical values for my model and markup calculations, the price coefficient (α^p), and the two parameters governing substitution between nests (σ_i and σ_n).

D Markup Calculations

For simplicity in this Appendix, I assume one level of nests and derive markups when wholesalers exert market power. In terms of notation, $Q_{w,i}$ denotes total sales by wholesaler w selling product i, $s_{w,i|j}$ is the market share conditional on downstream buyer type j, $s_{w,i|j,i}$ is the share conditional on sourcing the same variety i from a different wholesaler, M_j is the mass of downstream buyer type j, and $p_{w,i}$ is the wholesaler's price. Parameters α^p and σ are recovered from demand estimation,

Table A6: **Industry-Level Downstream Firm Choice Estimates**

	(1) mean/sd/sem	(2) mean/sd/sem	(3) mean/sd/sem
log (Price)	-1.65	-2.95	-1.44
	[3.70]	[5.75]	[3.75]
	(0.49)	(0.77)	(0.50)
σ_i (Varieties)	0.84		0.88
	[0.40]		[0.43]
	(0.05)		(0.06)
σ_n (Wholesaler Breadth)		0.51	0.80
		[0.34]	[0.69]
		(0.05)	(0.09)
Controls	Number of Varieties, Number of Warehouses		
Fixed Effects	Year × Variety		
Markets	56		

Notes: Results from a 2-stage least squares routine. Robust standard errors presented.

and respectively reflect the price sensitivity and substitution elasticities.

I first differentiate the total market size with respect to the wholesaler margin:

$$\begin{aligned}\frac{\partial Q_{w,i}(\mathbf{p})}{\partial p_{w,i}} &= \sum_j \left[\frac{\partial s_{w,i|j}(\mathbf{p})}{\partial p_{w,i}} M_j(\mathbf{p})\right] \\ &= \frac{\alpha^p}{p_{w,i}} \underbrace{\sum_j M_j s_{w,i|j}\left[\frac{1}{1-\sigma}\left[1-\sigma s_{w,i|j,i}-(1-\sigma)\, s_{w,i|j}\right]\right]}_{\mathfrak{s}_{w,i}} = \frac{\alpha^p}{p_{w,i}} \mathfrak{s}_{w,i}\end{aligned}$$

The new variable $\mathfrak{s}_{w,i}$ summarizes the portion of the demand elasticity that does not directly use any pricing-related terms.

Marginal cost $c_{w,i}$ are as follows for a single product wholesaler:

$$\begin{aligned}c_{w,i} &= p_{w,i} + Q_{w,i}\left(\frac{\partial Q_{w,i}}{\partial p_{w,i}}\right)^{-1} \\ c^*_{w,i} &= p_{w,i} + Q_{w,i}\frac{p_{w,i}}{\alpha^p \mathfrak{s}_{w,i}} = p_w \underbrace{\left(1+\frac{Q_{w,i}}{\alpha \mathfrak{s}_{w,i}}\right)}_{1/\mu_{w,i}}\end{aligned}$$

I denote multiplicative markups as $\mu_{w,i}$.

For a multi-product wholesaler, the price set for varieties i can also have implications for the sales of varieties i' where $i \neq i'$:

$$\begin{aligned}\frac{\partial Q_{w,i'}(\mathbf{p})}{\partial p_{w,i}} &= \sum_j \left[\frac{\partial s_{w,i'|j}(\mathbf{p})}{\partial p_{w,i}} M_j(\mathbf{p}) + s_{w,i'|j}(\mathbf{p}) \frac{\partial M_j(\mathbf{p})}{\partial p_{w,i}}\right] \\ &= \frac{\alpha^p}{p_{w,i}} \underbrace{(-1)\sum_j M_j s_{w,i'|j} s_{w,i|j}}_{\mathfrak{s}_{i',i}} = \frac{\alpha}{p_{w,i}} \mathfrak{s}_{i',i}\end{aligned}$$

For a multi-product wholesaler selling varieties $i_1, i_2, ...$, consider the matrix of partial derivatives of sales of each sold with respect to to the prices of both the same product and other products sold:

$$\mathbf{\Delta} = \begin{bmatrix} \frac{\partial Q_{w,i_1}}{\partial p_{w,i_1}} & \frac{\partial Q_{w,i_2}}{\partial p_{w,i_1}} & \cdots \\ \frac{\partial Q_{w,i_1}}{\partial p_{w,i_2}} & \frac{\partial Q_{w,i_2}}{\partial p_{w,i_2}} & \cdots \\ \vdots & \vdots & \ddots \end{bmatrix} = \alpha \begin{bmatrix} \mathfrak{s}_{i_1,i_1} & \mathfrak{s}_{i_2,i_1} & \cdots \\ \mathfrak{s}_{i1,i_2} & \mathfrak{s}_{i_2,i_2} & \cdots \\ \vdots & \vdots & \ddots \end{bmatrix} \begin{bmatrix} 1/p_{w,i_1} & 0 & \cdots \\ 0 & 1/p_{w,i_2} & \cdots \\ \vdots & \vdots & \ddots \end{bmatrix}$$

Solving the system of first order conditions implies that costs are:

$$\begin{pmatrix} c_{w,i_1} \\ c_{w,i_2} \\ \vdots \end{pmatrix} = \begin{pmatrix} p_{w,i_1} \\ p_{w,i_2} \\ \vdots \end{pmatrix} + \Delta^{-1} \begin{pmatrix} Q_{w,i_1} \\ Q_{w,i_2} \\ \vdots \end{pmatrix}$$

E Factory-less good manufacturers

Recent research (Bernard and Fort, 2015; Bernard et al., 2016) and anecdotal evidence suggest that the rise in wholesalers may be due to an economy-wide trend in former manufacturing firms closing domestic production operations and only retaining design and distribution facilities. It appears the trends captured in this paper are largely independent and highly complementary to the findings in Bernard and Fort (2015); Bernard et al. (2016). I address this research in three different ways. First, the residual quality term ξ may capture a portion of this change. Second, a large proportion of these former manufacturing firms are removed in the raw data. Third, the evidence from international sourcing patterns is inconsistent with common formulations of this outsourcing theory.

In the demand analysis the residual term ξ_w captures the quality of a wholesaler w that rationalizes its price and market shares. If these wholesalers use contract manufacturing and these contract manufacturers produce products with higher qualities, then the trend towards factory-less good manufacturing is captured in this analysis. This is plausibly one of the underlying mechanisms that deserves further study. However, it is not clear that these firms dominate the data.

The Census of Wholesalers includes categorizations such as "own-brand marketer" and "single-brand marketer". If these wholesalers market only their own brand, then they are excluded from the sample of wholesalers and treated as manufacturers. A possible example could be the electronic firm Apple, that markets its own products but outsources manufacturing.[57] In addition, the analysis also excludes manufacturer owned sales and branch offices. These locations exist to distribute

[57] The exact categorizations of firms cannot be disclosed outside of the U.S. Census Bureau, it is unclear where firms such as Apple stand and the textual discussion is purely hypothetical.

products manufactured by a parent or sister firm. The elimination of these establishments does reduce the observed growth in the wholesale sector, providing a conservative approach to measuring the wholesaler market shares gains.

The behavior of the growth of these wholesalers takes a very particular form. As shown in tables A1 and A3, the largest wholesalers are importing many more varieties from new foreign sources and simultaneously increasing their distribution network within the United States. A common formulation of the factory-less good manufacturer theory is that these manufacturers close down production in the United States and move manufacturing abroad, with little to say about designing new varieties for production or expanding local distribution networks. As the benefit from wholesaling primarily derives from both sourcing new international varieties, not just moving production overseas, and expanding domestic distribution, it is unclear that the shift to factory-less production is driving the entirety of the trend towards wholesaling.

Finally, while this trend may be new for some firms, with Apple closing manufacturing lines in the United States and outsourcing manufacturing to Foxconn in China, such 'factory-less' producers have existed for a long time. Historically, when IBM produced personal computers, they did not produce all components sold with the IBM brand; the printer was simply a rebadged Epson device imported from Asia.[58]

F Endogenous Market Size

In the main model, the number of buyers of type j: $M_j \equiv M \times \mu_j$ is exogenous. This section endogenizes this aspect.

Generally, discrete choice models assume that the total mass of possible purchasers remains constant. However, this assumption may not be plausible across all intermediate good markets. If a set of new wholesalers, perhaps supplying goods from a new foreign market enter, we expect there to be increase in the overall downstream market size. We consider the elasticity of a market size for a customer j with respect to the valuation of all wholesaler options. While adopting a slightly different functional form, this stage follows Hausman et al. (1995), where consumers first choose quantity before choosing among a set of discrete choices. The quantity choice incorporates information from the choice set in a parsimonious manner and models a situation where customers must pick their purchase quantities before receiving their idiosyncratic cost draws ϵ.[59]

The number of purchases of type j varies with the set of available wholesalers $\mathbf{x}$. This allows for an increase in the number of purchases following increases in aggregate wholesale supplier quality.

$$\mu_j = M(\mathbf{x})$$

[58] The IBM 5152 printer was a version of the Epson MX-80 printer

[59] In Hausman et al. (1995), vacationers choose the number of trips to take, which follows a poisson process that uses the inclusive values D from an earlier stage.

This relationship is parameterized by:

$$M_j = A_j \left(\underbrace{\sum_{g \in T} (D_g)^{1-\sigma}}_{D_W} \right)^{\phi} \tag{21}$$

Where M_j is the number of purchasers of type j, $D_{w,j}$ is the aggregate inclusive valuation of sourcing from a wholesaler of type t for a customer of type j relative to directly buying from a manufacturer, and ϕ is the elasticity of the number of purchasers relative to the aggregate valuation of purchases. In particular, as shown earlier, this form of two stage decision making is consistent with simple forms of cost minimization. As we only vary the quality and quantity of wholesalers, we normalize the valuation of buying from a manufacturer to 1. Denoting the term within brackets as D_w and taking logs:[60]

$$\log M_j \quad = \quad \phi \log [D_W] + A_j. \tag{22}$$

Our discrete choice setup, allows us to directly estimate D_W using the market share of direct manufacturer shipments:

$$s_{0|j} = (D_W)^{-1}.$$

Thus we obtain the relationship:

$$\log M_j = -\phi \log \left[s_{0|j} \right] + A_j. \tag{23}$$

F.1 Estimating Market Size

I seek to (a) estimate the elasticity ϕ of the number of downstream purchasers with respect to the aggregate mean utility from wholesalers and (b) recover the the size of the market without wholesalers, $\mathbf{A}$.

Estimation uses equation (23), reproduced below:

$$\log M_j = -\phi \log \left[1 - S_j^W \right] + \log [A_j].$$

This equation shows that the relative value of wholesalers compared to direct sourcing is entirely captured by aggregate wholesaler market shares.[61] The object of the estimation is to provide A_j for use as an instrument in the discrete choice estimation and parameter ϕ to identify the elasticity of aggregate demand. To better explain the identification strategy, I first elaborate on the level of observation. Each j is composed of three elements: downstream product category c (which is defined at the year-product level), downstream location l, and downstream purchase quantity q. Denoting $M_{c,q,l}$ as the total observed downstream purchases and $S_{c,q,l}^W$ as the aggregate wholesaler purchase share for product c, in region l, where the shipment size is q units, I estimate the following

[60] This functional form is useful in that $\delta_{w,j}$ is only defined up to an additive constant. Since D_w is a summation of $\exp(\delta_{w,j})$, $(D_W)^{\phi}$ is defined up to a multiplicative constant.

[61] The expected utility in such discrete choice models is simply the inverse market share of the choices: $EU_j = 1/\left(1 - S_J^W\right)$.

relationship:

$$\log M_{c,q,l} \quad = \quad -\phi \log\left[1 - S^W_{c,q,l}\right] + \lambda_{c,l} + \lambda_{c,q} + \lambda_{l,q} + \lambda_{c,q,l}. \tag{24}$$

The covariate $\lambda_{c,l}$ represents a fixed effect for a particular product c sold in region l, $\lambda_{c,q}$ represents a fixed effect for a particular product c sold at quantity q, and $\lambda_{l,q}$ represents a fixed effect for shipments of quantity q in a given region l. These covariates represent the local demand for certain products, the general nature of that demand, and the market size of that downstream location. The last term $\lambda_{c,q,l}$ represents the **deviation** of a particular (c, q, l) from the three previous fixed effects. The residual term A_j equals $\exp\left(\lambda_{c,l} + \lambda_{c,q} + \lambda_{l,q} + \lambda_{c,q,l}\right)$, where the first three linear terms are controlled for, but the last term is unobserved. I then collect the set of residual demand shifters in vector $\mathbf{A} = \{A_j\}$.

Estimation assumes that $E\left[X_D \lambda_{c,q,l}\right] = 0$, where X_D includes share of goods sourced from wholesalers and the three fixed effects. Econometrically, the last lambda, $\lambda_{c,q,l}$ is not controlled for and may be correlated with wholesaler market shares. A related econometric risk is reverse causation: higher demand M may induce more wholesaler entry. Due to the timing assumptions made, structure of demand and explicit product-location fixed effects controlling for wholesaler and overall downstream demand presence, I explicitly rule this out. An alternative view of this assumption is that aggregate demand shocks affect both large and small purchases similarly; the difference between large and small purchases is entirely accounted for by wholesalers.[62]

F.2 Market Size Results

Estimates for the elasticity of the downstream market size with respect to expected utility from wholesaling are reported in Table A7. Columns (1) - (4) report results across various specifications. Shipments are binned in the same nine size categories as in the demand choice estimates. Locations consider the fifty U.S. states as well as the District of Columbia. Product-year categories consider Standard Classification of Transported Goods (SCTG) good classifications, which are more disaggregated than the wholesaler NAICS categories used in the demand choice estimation. Columns (1) and (2) consider 4-digit SCTG categories, while columns (3) and (4) consider 5-digit SCTG classifications. In general, more disaggregated classifications lead to more fixed effects and higher R^2 values, even though the parameter estimates do not significantly change. Columns (2) and (4) weight results based on market size.

In general, all four specifications find precise parameter estimates for the elasticity ϕ between .25 and .30. I will use estimates from specification (4) in the counterfactual analysis as well as

[62]Identifying variation can be summarized as follows. Consider the sales of industrial chemicals in Connecticut. Estimation looks at the deviation in the number of large and small orders from both the Connecticut averages for those orders, as well as at the deviation within industrial chemicals. Additionally, in contrast to the sixty product markets (over three years) used in the discrete choice estimation, a more refined set of over 400 products are used in this estimation.

An alternative instrumentation strategy would be to use geographic variables exploiting changes in wholesaler costs across regions, as done in the last demand stage. For robustness, data is aggregated up to the product-location level and the suggested instrumentation strategy is used, dropping product-location fixed effects. While the magnitude of ϕ is slightly larger, results are broadly similar.

Table A7: **Market Size Estimation (1st Demand Stage)**

	(1)	(2)	(3)	(4)
Elasticity $-\ \phi$	0.241	0.214	0.245	0.281
	(0.020)	(0.041)	(0.019)	(0.032)
Weighted	N	Y	N	Y
Aggregation Level	SCTG-4		SCTG-6	
Fixed Effects	Product-Year × Location			
	Product-Year × Shipment Size			
	Location × Shipment Size			

Notes: Regression results use the logarithm of total market size as the dependent variable. Robust standard errors clustered by product-year. See text for full regression specification. Aggregation by Standard Classification of Transported Goods (SCTG).

subsequent estimation as it is robust to the greatest number of fixed effects and includes the finest level of disaggregation.

G Endogenous Quality

In the main model, quality deviations ξ are exogenous. I propose a mechanism whereby ξ is endogenously chosen by firms. Suppose between Stage 1 and Stage 2, firms choose ξ. Call this Stage 1.5. While theoretically easy to add, this stage presents estimation challenges and requires a modified estimation technique. In particular, this restricts the parameters estimated in the demand estimation stage. Instead of finding valuations for firm attributes $a_{w,i}$, all attributes are subsumed in a single vertical quality dimension ξ. Therefore now:

$$\delta_{w,i} = \alpha p_{w,i} + \xi_{w,i}.$$

G.1 Model Changes

Now, firms choose market entry in two stages. First, wholesalers choose their domestic distribution locations entering as a firm with domestic sources, international sources, or with both domestic and international sources. In the second stage, firms choose the quality of their products, and their internationally and domestically sourced varieties. This includes the variety of products a wholesaler offers as well as the consumer service provided by the wholesaler. In terms of the model, a firm must optimally choose $\xi_{w,i}$ for both their domestically and globally sourced products.

Conditioning on a firm's type and location choices, the model assumes wholesaler w optimally chooses $\xi_{w,i}$ for each product i. In particular they must invest $f_w(\xi)$ to receive product attributes $\xi_{w,i}$, which realize in operating profits $\pi_w(\xi_{w,i})$. If a firm only participates in domestic sourcing, they maximize the following problem by choosing their optimal firm quality $\xi_{w,i}$:

$$\max_{\xi=\left[\xi_{w,D},0,0\right]} \pi_w(\xi) - f_w(\xi) \tag{25}$$

If firms participate in both first-world global and domestic markets, a firm w must choose two parameters, $\xi_{w,n}$ for $n \in \{F_H, D\}$, where $n = F_H$ represents first-world imports and $n = D$ represents domestically sourced products:

$$\max_{\xi=\left[\xi_{w,D},\xi_{w,F_H}\right]} \pi_w\left(\xi\right) - f_w\left(\xi\right) \tag{26}$$

For simplicity, I now present results involving a single firm only involved in domestic sourcing and suppress firm subscript w and product type subscript i. Conditional on location choices (market entry), a firm's profit maximization produces first order conditions:

$$\frac{d\pi\left(\xi\right)}{d\xi} = \frac{df\left(\xi\right)}{d\xi} \tag{27}$$

Without any errors, this solution concept implies that any two ex-ante identical firms will choose the same ξ. As firms are only differentiated on an extremely limited set of dimensions in the market entry stage, this setup will not fully rationalize the data. To better rationalize the data and account for the heterogeneity present in the world, the model allows for firm-specific investment cost shocks. Before wholesalers choose their market position, but after entering the market, each wholesaler receives shocks to the marginal costs of investing. Call these shocks η_ξ.

Given these shocks, two ex-ante firms will no longer make the same investment choices and thus fully rationalize the observed data. Given a form for a time-varying investment function $f\left(\cdot\right)$, parameterized by the vector χ, the econometrician can recover changes in the return to investment. In particular, in the context of wholesaling, are the returns to investing in domestic and international quality differentially changing for large and small firms?

G.2 Estimation

Unobserved downstream consumer valuations ξ are not exogenous shocks as in standard discrete choice models. They are the product of wholesale firm investments. This ξ is better written as $\xi\left(a\right)$. In this case, all fixed effects and ξ are all subsumed by the new measure $\xi\left(a\right)$. $\xi\left(a\right)$ is no longer a residual, it is a complete measure of quality. Regardless, the coefficient α^p can be identified as a cost shock hits a particular firm following their choice of a and $\xi\left(a\right)$. In terms of α^q, α^l, and σ, they are identified from aggregate moments. As α^p is the only coefficient required to derive demand elasticities, estimation can proceed in a more restricted fashion.

Having made these assumptions, identification of this investment function proceeds directly from the first order conditions in equation (27). For any given company configuration a (that is conditional on a company type s and location choices l), assume that the fixed costs of market positioning are:

$$f_w^a\left(\xi,\eta\right) = \left(\frac{\chi_1^a}{\chi_2^a}\eta_{w,\xi}\right)\exp\left(\chi_2^a\xi\right) + E_a$$

The function $f_w^a\left(\xi\right)$ measures the cost of investing in quality ξ for wholesaler of configuration a. There are scalar fixed costs E_a and two parameters, χ_1^a and χ_2^a. Finally there is a wholesaler specific shock $\eta_{w,\xi}$. This structural investment cost shock is known to the firm, but not the econometrician.

Conditional on entry, a wholesale firm of configuration a seeks to maximize profits $\pi_w\left(\xi\right)$ net of investment $f_w^a(\cdot)$. As both $\pi_w(\cdot)$ and $f_w^c(\cdot)$ are smooth linear functions, computation of the optimal profits requires solving the firm's first order conditions. Marginal investment costs are:

$$\frac{df_w^a(\xi,\eta)}{d\xi} = (\chi_1^a \eta_{w,\xi}) \exp(\chi_2^a \xi)$$

and marginal profits stem from the first derivative of equation (3) with respect to ξ, $d\pi_w(\xi)/d\xi$. As all the parameters in $\pi(\cdot)$ are known, the optimal marketing costs in equilibrium solve:

$$\frac{d\pi_w(\xi)}{d\xi} = \frac{df_w^a(\xi,\eta)}{d\xi} = (\chi_1^a \eta_{w,\xi}) \exp(\chi_2^a \xi). \tag{28}$$

Taking the logarithm of this equation produces the following relationship:

$$\log \frac{d\pi_w(\xi)}{d\xi} = \log \chi_1 + \chi_2 \xi + \log \eta_{w,\xi}. \tag{29}$$

The relationship should be theoretically estimated by ordinary least squares, however the shock $\eta_{w,\xi}$ likely is correlated with the choice of ξ. This echoes the endogeneity problem with ξ and h_w in estimating equation (14). Estimation of χ requires a shifter of ξ that is uncorrelated with η. This leads to an assumption required for identification.

Assumption 4 *There exist Z_η such that $E[\eta Z_\eta] = 0$.*

Thus, under this model's demand and supply systems, investment cost parameters χ are identified.

What is a plausible exogenous shifter of ξ? Estimation could use a combination of two shifters, one using the timing of the game and the second using geographic differentiation. The first shifter is similar to the cost shifters in the demand estimation. Wholesale firms are likely to choose higher levels of ξ when similar wholesale firms in nearby, but unrelated markets choose higher levels of ξ. So the average ξ in New Haven for importing chemical wholesalers can be used as an instrument for New Haven electronic wholesalers. The second shifter exploits the timing of the game. Firms choose their attributes a before investing in ξ, thus the number of firms of type a' at the state, regional, and national level shift the choice of ξ independently of η.

In computation, $\pi_w(\xi)$ is not fully known by a firm before the investment decision ξ is made. There is an unobserved cost shock ν from equation (15) that shifts profits. I assume the distribution of ν is known and firms maximize their expected profit. To aid in computation, instead of numerically integrating over ν, simulated draws of ν are used to compute $E[\pi_w(\xi)]$. For simplicity, I omit the expectation in what follows.

Investment function $f_w^a(\cdot)$ is identified up to some fixed entry constant E_c. Following estimation of χ_1^a and χ_2^a , this step generates the distributions $G_\eta^a(\cdot)$ for investment shocks of $\eta_{w,\xi}$. I denote ξ_w^* as the optimal choice for firm w with investment cost shocks η.[63]

Second-stage net profits for a firm of configuration c are

$$n_a(\eta) = \pi_w^a(\xi^*(\eta)) - \bar{f}_w^a(\xi^*(\eta), \eta),$$

[63] The chosen functional form for $f_w^a(\cdot)$ and the estimation equation (29) imply that $\chi_1 \eta$ is greater than zero, thus as long at χ_2 is greater than zero, $f_w^a(\xi^*)$ will be always greater than zero.

Table A8: **First Order Estimates (2nd Supply Stage)**

Product Type	(1) Domestic Variety	(2) International Variety
$\xi \times 1997$	1.143	2.656
	(0.0036)	(0.1668)
$\xi \times 2002$	1.187	2.822
	(0.0028)	(0.2008)
$\xi \times 2007$	1.223	2.189
	(0.0025)	(0.1360)
Complementarity	-0.336	1.476
	(0.0045)	(0.1949)
Controls	Number of Locations	
Fixed Effects	Year $\times$ Variety	

Notes: Robust standard errors do not reflect errors in demand estimates. See text for full regression specification.
Source: 1997, 2002 and 2007 Commodity Flow Surveys, Censuses of Wholesalers and Manufacturers and Longitudinal Firm Trade Transactions Database.

where $\bar{f}_w^a(\cdot) = f_w^a(\cdot) - E_c$.

Note that $f(\cdot)$ is only identified up to some constant E_a, $\bar{f}(\cdot)$ subtracts this constant. The function $n_a(\eta)$ is used in the next stage to identify this entry cost E_a. For tractability, I assume that fixed cost E_a is not paid in this stage, as firms in this stage have already entered into the market and that an infinitesimally small investment in ξ (that is $\xi \to -\infty$) will realize a investment cost of 0.[64]

G.3 Market Positioning Estimation

Table A8 presents estimation results for χ, which parameterizes the relationship between fixed costs and product quality ξ. The table presents the results from two different regressions. The first column presents the results for investment in quality regarding domestically sourced products and the second column presents estimates for investment in sourcing internationally sourced products. All regressions control for year, industry, and the domestic distribution networks of firms. This estimation uses a simplified demand system with only nesting at the product-source level and only two types of products: domestically and internationally sourced.

The first three rows of Table A8 illustrate year-specific coefficients for χ_2 from equation (29). These estimates measure the cost in investing in quality $\xi_{domestic}$ and $\xi_{international}$. The first column shows that it becomes more costly to invest in domestic sourcing quality over time. One interpre-

[64] Additionally, under a free entry condition for counterfactuals, estimates from this step are not needed to compute alternative equilibria. Due to free entry, firms will reenter until $\pi'(\xi) = F'(\xi)$. This step does matter for when the fixed costs of entry change, but market positioning costs are unaltered. This step is mostly critical for understanding the role of 'business' stealing arising from competition.

tation would be that there are fewer domestic manufacturers, and thus it is more difficult to find new and better domestic sources. Coefficient $\chi_2^{domestic}$ increases 7% from 1997 to 2007. The second column shows that it has become less costly to invest in the quality of international sourcing, with $\chi_2^{international}$ decreasing 20% from 1997 to 2007. This may reflect both lowered trade barriers and increases in the quality of foreign manufactured good sources, both of which make it easier to increase the quality of imported products.

These regression estimates also reveal the degree of complementarity between investment in domestic and international sourcing. The fourth row reflects estimates for $\log \chi_1$ for instances where wholesale firms participate in both domestic and international sourcing. The negative estimate in the first column shows that participating in international sourcing makes it slightly cheaper to increase the quality of the domestically sourced product. The opposite is true for participating in domestic sourcing, which makes it much more expensive to invest in the quality of the internationally sourced product.