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THE MODERN WHOLESALER: GLOBAL SOURCING, DOMESTIC DISTRIBUTION, AND SCALE ECONOMIES

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ABSTRACT

Nearly half of all transactions in the $5 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. Buyers gain access to globally sourced varieties, nationwide distribution networks, and increased quality while wholesalers decrease their marginal costs.

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Scale economies can quickly change a competitive marketplace. Large fixed investments allow the biggest firms to develop better products and reduce marginal costs. A new warehouse and logistics network, enabling a globalized supply chain and coordinated by new IT systems, can cost billions to develop. However, there is a payoff, as these fixed costs generate lowered marginal costs. A firm that develops such a network can easily dominate its competitors, simultaneously increasing markups, growing market shares, and providing a more valuable service or product to their customers.[1] Such forces are instrumental in the US wholesale trade sector, which intermediates $5 trillion in sales from upstream manufacturers to downstream firms.

What are the welfare effects of the fixed costs of globalization and technology? Some firms may grow and exert market power. At the same time, these fixed investments may provide consumer benefits. As illustrated by Bresnahan (1989) and Sutton (1991), market power is an endogenous outcome in markets with fixed costs. However, outside of narrowly defined industry studies, aggregate studies focus on market power and do not evaluate welfare or the nature of these fixed costs.

This paper has two goals and themes. First, I study the aggregate implications of a largely hidden sector responsible for the distribution of half of all manufactured good purchases. I consider the role of globalization and of scale economies to rationalize the growth of markups and market power, even if output expands. This offers a high-level view, balancing macroeconomic analysis that may make unpalatable market power assumptions, generalizing smaller case studies of individual markets.

Second, I use large administrative datasets to extend standard industrial organization techniques for demand and entry analysis, trading off detailed product data for administrative data on markups and cost shifters. Without great market definition or detailed price data, I use a combination of administrative sales and cost data to adjust demand estimation. Principally, I retain the ability to do counterfactuals to understand the roles played by underlying economic developments.

To accomplish these goals, the paper first establishes a series of facts to characterize the nature and growth of the US wholesale sector. Nearly all growth comes from the largest wholesale firms that extract large and increasing markups. These facts are fed into a model where wholesalers endogenously enter, select attributes, and choose prices in the face of heterogenous demand to reveal marginal and fixed costs. Structural estimation directly quantifies the changing trade-off between fixed costs and marginal costs. Large firms make increasing large fixed investments in distribution and sourcing.

This estimated model is used for counterfactual estimation to understand the implications for the growth in concentration in terms of welfare. The aggregate shift in wholesale technologies from 1997 to 2007 allowed the largest wholesalers to increase markups and market concentration while reducing costs for downstream buyers. In one context, the expansion of wholesalers into international trade in 2007 saved downstream buyers 10.4-10.5% per year in procurement costs as a percentage of purchase value ($442-449 billion). However, due to large fixed costs, the largest 1% of wholesalers were able to increase their overall market shares and their variable profits.

[1] This notion of scale entangles both traditionally defined scale and scope economies in which a large fixed cost creates a more attractive or cheaper product.

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 intranational or localized competition between firms. This paper explicitly corrects for these gaps.[2] Academic and public discourse (The Economist, 2016; Autor et al., 2020) have highlighted both increasing market power and market concentration across the economy as areas of general interest. Possible explanations include technological innovation, firm consolidation, and the influence of large, diversified shareholders.[3] This paper emphasizes another mechanism: the increasing returns to scale introduced by the fixed costs of international trade and their interaction with domestic investments, dovetailing with evidence from De Loecker et al. (2016); Hsieh and Rossi-Hansberg (2023) and theoretical trade models since Krugman (1980). Berry et al. (2019) note that most work concerning aggregate competition levels avoids 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 and the ability to conduct counterfactuals.

There is an extensive theoretical literature on intermediation. Rubinstein and Wolinsky (1987) endow intermediates with a special matching ability to connect buyers and sellers. Spulber (1999) notes intermediaries can provide liquidity, facilitate transactions, guarantee quality, be market-making price setters, and match buyers with sellers. This paper empirically addresses these purposes, with wholesaler-paid fixed costs for facilitating transactions and ensuring quality leading to markups.[4]

The comprehensive empirical study of wholesaler markets is sparse. In industrial organization, Salz (2022) 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 price levels and dispersion, largely holding market participants fixed. This paper focuses on the market conduct of the middlemen themselves and allow for endogenous entry, quality, and markups.[5]

In international trade, wholesalers are documented by Feenstra and Hanson (2004), Bernard et al. (2010), Bernard et al. (2011), and Abel-Koch (2013), who find the enduring presence of such intermediaries. Others place wholesale exporters within general equilibrium and validate cross-sectional predictions (Akerman, 2018; Ahn et al., 2011; Felbermayr and Jung, 2011; Crozet et al., 2013). Gopinath et al. (2011) and Atkin and Donaldson (2012) study prices and pass-through, but do not consider the market structures that lead to their findings. These papers all point to the importance of wholesalers, but consider their market structure to be a black box.

[2] Feenstra and Weinstein (2017) allows variable markups from demand elasticity variation, not through competition.

[3] For example see Azar et al. (2018); De Loecker et al. (2020); Gutiérrez and Philippon (2017); Barkai (2016).

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

[5] Papers such as Villas-Boas (2007), and Nakamura and Zerom (2010) treat retailers and wholesalers similarly.

1 Data and Sector 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 which are defined by the US 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 [...], (b) capital or durable non-consumer goods, and (c) raw and intermediate materials and supplies...

Within this category, I focus on merchant wholesalers. Such firms are independent of manufacturers and physically maintain possession of goods between a manufacturer and downstream buyer. This definition excludes warehouses that are vertically integrated with manufacturing or consumer retailing, as those facilities are integral parts of their parent firms.[6] For 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 manufacturers for downstream users and then resell at an endogenously determined price.[7]

Wholesale trade can affect many economic segments: the choice of manufacturer location, the creation or destruction of value chains, and the value of agglomeration economies. This paper focuses on a specific outcome - the role of intermediary market power on downstream buyer costs and intermediary profits in physical good markets. To fix ideas and guide analysis, I start with an industry case study.

1.1 Wholesaler Case Study

Consider the case of manufactured industrial chemicals. This sector, which covers a set of intermediate goods used in manufacturing, grew 28% between 2008 and 2013. However, the share of products indirectly distributed by independent wholesalers increased 37% as downstream firms increasingly stopped sourcing goods directly from upstream manufacturers. Industry reports (Jung et al., 2013, 2014) highlight three observations, (a) why downstream firms increasingly use intermediaries, (b) what differentiates successful and unsuccessful wholesalers, and (c) downstream market segmentation leading to possible market power.

Downstream buyers may need any of a variety of chemicals, and they may source these chemicals directly from manufacturers such as DuPoint or indirectly through a variety of wholesalers. However, 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 a wholesaler do this for them.

[6] I exclude own-brand marketers to separate firms that design, market and sell, but that do not manufacture. 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. Facilities for within-firm distribution are excluded.

[7] I simplify many aspects of the wholesale sector for tractability. In reality, there are other business structures. However, I implicitly incorporate exclusive contracts into my model through residual quality. As for brokers, I conservatively consider sales aided by such agents as direct sales from manufacturers to downstream users, and thus part of the outside option.

In the industrial chemical market, wholesalers sources varieties from various chemical manufacturer and ship to a convenient loading bay for a markup over the manufacturers' price. 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 inputs for production.

The global market for chemical distributors is experiencing rapid consolidation, with the three largest companies holding 39% of the North American market in 2011. 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."

Consider one of the large speciality chemical distributors, Univar (Lukach, 2015), with \$10.4 billion North American shipments in 2014. Today, it sources 30,000 varieties of chemical products from over 8,000 internationally distributed suppliers.

Crucially, such firms do not compete in a single national market, but sell to many types of buyers. Downstream buyers are differentiated by how much they purchase and by their geographic location. These buyers then choose a particular source based on attributes such price, quality, and globally sourced varieties.

Downstream buyers face heterogenous barriers to directly purchasing chemicals from a manufacturers. Over 80% of downstream buyers with small purchases (under 100,000 Euros) sourced goods indirectly through wholesalers, while larger purchasers sourced directly from a manufacturer (Elser et al., 2010). Wholesalers emphasize that proximity to local markets is important. Univar runs a distribution network spanning hundreds of locations to supply 111,000 downstream buyers.[8]

Such wholesalers are expanding with globally distributed varieties, providing substantial benefits to downstream users who are located near their distribution facilities. Wholesaling itself has subject to consolidation with hints of underlying scale economies, as firms increase product variety and local distribution networks. Even if market concentration isn't evident at the national level, markets and customers are highly segmented, potentially allowing for market power across customer types and regions. I now turn to administrative data to show that this case study is representative of the \$5 trillion US manufactured good market.

1.2 Data Description

I use administrative data from the U.S. covering international trade, domestic shipments, and both the manufacturing and wholesale sectors from 1992 to 2012. This involves merging the Census of Wholesale Trade, Census of Manufacturers, Longitudinal Firm Trade Transaction Database, Commodity Flow Survey, and the Longitudinal Business Database. I focus on 1997-2007, as firm-level

[8]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 flexibility and speed of delivery, which are highly correlated with geographic proximity (Jung et al., 2013).

data from 1992 and 2012 are not comparable due to industry reclassifications.[9] All data is in 2007 dollars using the BEA price deflater for materials inputs.

These databases are linked every five years at the firm level and provide data on wholesale distribution in 56 distinct markets for manufactured goods, corresponding to North American Industry Classification System (NAICS) 6-digit industries. I look at wholesalers independent of manufacturing, and collect details on aggregate sales, physical locations, operating expenses, and imports. Survey data provides statistics on the distribution of the origins, destinations, and sizes of shipments across wholesalers and manufacturers. See Appendix A for details.

There are limitations in taking such administrative data to conduct demand analysis. First is in defining markets, second is in accounting for buyer heterogeneity, and third is in determining prices. All three problems can be alleviated with detailed data on tightly defined markets. However, administrative data lacks these features. I preview the empirical fixes here, with full implementation details in Section 3.

1.2.1 Market definition

Aggregate studies of market power typically treat administrative data categories as distinct markets. For example, De Loecker et al. (2020) primarily use NAICS 2-digit industries to define markets. But this makes it difficult to conduct counterfactuals, as alternative markups depend on market characteristics. In the wholesaling data, a large category is "Industrial Machinery and Equipment Merchant Wholesalers". This encompasses firms that sell both pumps for crude oil and food processing machinery. These broad categories include firms that do not compete with each other.

I instead assume that administrative NAICS 6-digit industries are an upper-bound for an industry. In practice, firms may only compete with a subset of firms within their administrative category. Empirically, I assume that firms will compete with only proportion ψ of the competition.[10]

As administrative data is often limited on the identities of customers and detailed products, I turn to accounting data, which is often available. I identify ψ by comparing changes to model-derived markups to administrative data on operating margins over time.

But this is just one problem with administrative datasets and market definitions. Instead of assuming that markets are national (Autor et al., 2020), I adapt the approach that markets have geographic overlap in space. Markets are often neither entirely local or national, which brings me to the next issue.

1.2.2 Buyer heterogeneity

The next problem faced in using administrative datasets in demand analysis is in the identification of buyer heterogeneity. I adapt Petrin (2002) and identify observable buyer heterogeneity with survey data. While many earlier studies use these techniques on industries with detailed product data, these fixes are also suitable for aggregated administrative data.

[9] 1992 data uses micro-data, 2012 data is estimated using publicly available reports on aggregate values.

[10] Hoberg and Phillips (2021) use machine learning to define industries for large public firms.

This data on buyer heterogeneity links directly to the market definition issue above. As noted in Ganapati (2021); Rossi-Hansberg et al. (2020), national market shares are highly misleading. Local markets do overlap (Davis, 2006; Houde, 2012). Firms compete over space, but distance attenuates competition (Head and Mayer, 2014). My approach allows both local and distant competitors and is disciplined by data on purchasing patterns, the quantity purchased, and the buyer's geographic location.

In addition, I allow for econometrician-unobserved heterogeneity in preferences for domestically and internationally sourced products, as well as heterogeneity for firms that sell multiple varieties from different countries. These preferences are highlighted by the trade literature (Broda and Weinstein, 2006), but also alleviate the lack of repeat purchase data. These repeat purchases may be for different variety and a wholesaler with many varieties will be preferred. Following McFadden (1973); Hausman et al. (1995), I assume that these preferences take an extreme value distribution and identify the distribution using variation in market participant characteristics.

1.2.3 Price information

Administrative data often lacks transaction prices. For example, both Autor et al. (2020) and De Loecker et al. (2020) use aggregate market-level price indices. I turn to accounting data to reconstruct a synthetic price.

In wholesaling, data is collected on the total value of goods bought for resale and the value for which these goods are resold. 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:

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

where $\tilde{p}_m$ and $\tilde{p}_w$ represent the (econometrician-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) and can be extended to other sectors such as retail (Smith and Ocampo, 2022). One caveat of this interpretation is that is generalizes away from quantity discounts for larger wholesalers versus smaller wholesalers. This would imply that $\tilde{p}_m$ varies across wholesale firms and that I mis-measure price. The empirical strategy will rely on an instrumental variable strategy to account for accurately estimating demand elasticities. In counterfactuals, this mis-measurement will show up in a residual, and thus I will not allow such quantity discounts to endogenously change.[11]

Additionally, this is a single price for a firm, but firms may sell multiple product varieties, and for those firms, I only observe a weighted average of their prices. Empirically this raises challenges on

[11] In the United States, the Robinson-Patman Act prevents price discrimination against downstream buyers, but does allow quantity discounts. This statute has a long and complex history and its enforcement is not consistent (Ross, 1984). I loosen this requirement in Appendix (B.3).

estimating supply and demand without full knowledge of prices. I leverage the supply side, summing restrictions, and assume a common within-firm cost shock in a demand-side implementation of De Loecker et al. (2016).

1.3 The Evolution of Wholesaling

The administrative wholesaling data echos the case study and guides the model.

First, the data shows the rise of wholesalers both in aggregate and within intermediate goods sectors over time. This coincides with wholesalers increasing operating markups while simultaneously decreasing marginal costs. Second, the largest wholesalers gained market share while expanding globalized sourcing and increasing the number of domestic distribution outlets. Third, wholesale markets are not national. Wholesalers disproportionally serve geographically proximate buyers that request low-valued shipments.

1.3.1 Aggregate Wholesale Trends

Manufactured products are shipped via one of two modes, (a) directly from a manufacturer to a downstream user or (b) indirectly through a wholesaler.

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

Table 1 lists aggregate data on all manufactured goods consumed in the US, as well as the share distributed by the wholesale industry from 1992 to 2012. In 1992, wholesalers accounted for the distribution of 31.7% of all manufactured goods to downstream uses. In 2012, they accounted for 47.4% of all such goods.

Consistent market level data is available for 56 wholesale markets defined at the NAICS 6-digit level. While there is heterogeneity across NAICS 6-digit sectors, I focus on average changes across time.

Table 1 reports wholesaler attributes in two different manners. The middle panel in Table 1 aggregates across all 56 sampled markets (weights by the time-varying market size) and the bottom panel averages across the 56 sampled markets.

Aggregating across sampled markets, wholesalers increased their market share from 43.1% to 54.9% from 1997 to 2007. Averaging across markets, the market share similarly increased from 45.1% to 52.3%.

Such aggregate trends may be caused by compositional shifts across product types. Using commodity-level survey data, I regress wholesaler market shares with yearly and commodity fixed effects for 1997, 2002 and 2007 across 400 product types, with standard errors clustered at the commodity type.

$$\text{wholesale share}_{i,t} = \underset{(.01)}{.33} + \underset{(.01)}{.05} \times \mathbb{I}_{2002} + \underset{(.02)}{.09} \times \mathbb{I}_{2007} + \vec{\beta}\mathbb{I}_i + \epsilon_{it}$$

Table 1: **Aggregate and Market-Level Statistics**

	Year				
	1992	1997	2002	2007	2012*
All Domestic manufactured goods purchases					
($ Bil in 2007 prices)	$4,097	$4,653	$5,095	$5,389	$5,314
Wholesaler delivery share					
(Percent of all domestic deliveries)	31.7%	31.9%	37.1%	42.5%	47.4%
Sampled Markets ($ Bil)					
Product Markets		56	56	56	
Approx. Wholesalers		222,000	218,000	214,000	
Aggregating All Sampled Markets					
Aggregate Wholesale Share		43.1%	49.0%	54.9%	
Wholesaler, from domestic sources		37.3%	41.4%	44.6%	
Wholesaler, from international sources		5.9%	7.5%	10.3%	
from low income sources		2.5%	3.5%	5.4%	
from high income sources		3.4%	4.1%	4.9%	
Share that Source Internationally		16.9%	20.6%	23.2%	
International Country Source-Varieties		3.83	5.18	6.43	
Physical Locations		1.21	1.26	1.30	
Price (sales/merchandise purchases)		$1.324	$1.318	$1.311	
Average Operating Costs		$1.212	$1.188	$1.163	
Accounting Markups		1.092	1.109	1.127	
Averaging Across All Sampled Markets					
Mean Wholesale Share		45.1%	49.5%	52.3%	
Wholesaler, from domestic sources		38.2%	41.1%	41.4%	
Wholesaler, from international sources		6.9%	8.4%	11.0%	
from low income sources		3.0%	4.4%	6.7%	
from high income sources		3.9%	4.0%	4.3%	
Share that Source Internationally		17.5%	20.6%	22.9%	
International Country Source-Varieties		4.08	5.23	6.51	
Physical Locations		1.23	1.29	1.36	
Price (sales/merchandise purchases)		$1.387	$1.396	$1.408	
Average Operating Costs		$1.269	$1.250	$1.240	
Accounting Markups		1.093	1.117	1.135	

Notes: Quantities in producer prices. Data on 2012 estimated from aggregate public-use Census data. All data in 2007 Dollars using the BEA price deflator for material inputs. The top panel aggregates all manufactured good sales. The second panel highlights the markets used in the empirical analysis. Wholesale NAICS codes with more than 50% of distribution from agricultural or natural resource industries are excluded. As some markets include partial use of non-manufactured goods, the total volume distributed in those markets may exceed the total for just manufactured goods. The third panel averages data across all the entire sampled wholesale sector. The bottom panel equally weights each of the 56 sampled wholesale markets. See text for details.

Regressors $\mathbb{I}_t$ are dummy indicators by years, and $\mathbb{I}_i$ are indicators for commodity types. Wholesale distribution shares increased on average by 5 percentage points from 1997 to 2002 and 9 percentage points from 1997 to 2007, broadly reflecting the change in aggregate market shares.

In most demand systems with normal demand curves or elasticities, an increase in output or share can either imply increased relative demand or increased or improvements in aggregate supply. Is indirect sourcing increasing due to either force, or is it the result of a combination of the two? Aggregate data on the aggregate attributes of wholesalers can shed light on the two. While the model in Section 2 will discipline these forces, I start by looking at the supply explanation - indirect sourcing is getting better relative to direct sourcing.

One plausible story is that the trend is driven by the outside option getting worse, as domestic manufacturing is supplanted by expensive and low-quality international sources. However, Feenstra and Weinstein (2017) shows that the outside option is directly improving due to improved international sourcing. Second, within both domestically and globally sourced goods, wholesalers are increasing their market share relative to the outside option.

The bottom of Table 1 highlights trends in wholesaler sourcing. The proportion of goods distributed by wholesalers and acquired abroad has similarly increased. Considering the source of these goods, wholesalers increased both the distribution of goods sourced in the US, as well as those sourced abroad. In 1997, 38.2% of domestic deliveries in the average sampled market were conducted by wholesale firms with product varieties sourced in the US. In 2007, that share increased to 41.4.%. Similarly in 1997, 6.9% of domestic deliveries where conducted by wholesale firms with varieties sourced from abroad. By 2007, that share increased to 11.0%. I now turn to trends in wholesaler quality and price.

Fact 2 *Average wholesaler prices are stable, accounting markups are increasing, and reported operating costs are falling.*

In 1997, averaging across industries, wholesalers charged downstream customers \$1.387 for \$1 worth of manufactured goods. In 2007, wholesalers charged \$1.408 for the same service. However, wholesaler accounting operating costs fell substantially from \$1.269 to \$1.240 per dollar of resold manufactured output, leading to implied an aggregate markup increases from 9.3% to 13.5% (1.093 to 1.135), after accounting for the cost of goods sold. Aggregating across markets, prices slightly decreased from \$1.324 to \$1.311. Operating costs fell from \$1.212 to \$1.163. Accounting markups increased from 9.2% to 12.7% (1.092 to 1.127).

This aggregate trend is confirmed at the industry level. I regress accounting profits on year and industry fixed effects and allowing for industry-clustered standard errors:[12]

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

Compared to 1997, wholesale industry-level accounting profit rates were 31 percent higher in 2002 and 48 percent larger in 2007.

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

Overall, there are small changes in wholesaler prices, but these relatively small changes seem unlikely to account for increases in wholesaler demand. To increase market shares, there must be improvements in wholesaler technology, products, or reach, to compensate downstream firms. Are these increased markups and lowered accounting costs reflected in the attributes of wholesalers?

Fact 3 *Wholesale non-price attributes have significantly improved, with domestic distribution and international varieties increasing.*

From 1997 to 2007, the average wholesaler in a typical market increased the number of distribution facilities from 1.23 to 1.36, increased the probability of foreign sourcing from 17.5% to 22.9%, and increased the number distributed foreign product lines at the Harmonized System (HS) 10-digit level from 4.08 to 6.51. Aggregating, the number of distribution facilities increased from 1.23 to 1.36, foreign sourcing increased from 16.9% to 23.2%, and distributed varieties increased from 3.83 to 6.43. While the increase in international varieties speaks to wholesalers improving direct sourcing from abroad, the increase in domestic distribution facilities speaks to improvements for wholesalers indirectly distribution both domestic and internationally sourced varieties. In particular, increases in distribution facilities are associated with lowered marginal costs (Houde, Newberry and Seim, 2023).

Taken together, increased sales, increased markups, and decreasing operating costs are consistent with a decrease in variable costs driven from fixed investments in non-price attributes. A change in wholesaling technologies allow larger wholesalers to invest in warehouses and foreign sources, enabling higher markups with lower marginal costs. I explore this possibility by summarizing heterogeneity across wholesalers.

1.3.2 Within-Wholesaler Heterogeneity

What is linked to the growth of the largest wholesalers? As shown in Table 2, there is substantial heterogeneity in wholesalers.

Fact 4 *Market share and observable quality gains are concentrated in the largest 1% of wholesalers, who are increasing their prices and improving their product.*

The typical NAICS-6 market contains about 4,000 wholesale firms (222,000/56), a relatively stable figure across the sample period. The average wholesaler in the 99th percentile of a sector by sales controls nearly 1% of the national market, a share hundreds of times larger than the smallest wholesaler. In aggregate, such large firms had a 20.2% market share in 1997, rising to 26.7% in 2007. The wholesalers in the bottom 90th percentiles saw their aggregate market shares fall from 10.6% to 9.8%.

Equally important are inter-temporal trends across wholesaler characteristics. The 99th percentile of wholesalers increased their aggregate market shares, while increasing the average number of imported product sub-varieties from 98.3 to 142.9 and the number of distribution locations by from 9.5 to 17.8. In contrast, wholesalers in the bottom 90th percentiles only increased the number

Table 2: **Wholesaler Heterogeneity**

	Year		
	1997	2002	2007
Market Shares			
Smallest 90% Wholesalers	10.6%	10.3%	9.8%
Middle 90-99% Wholesalers	14.4%	14.9%	15.9%
Largest 1% Wholesalers	20.2%	24.3%	26.7%
Herfindahl-Hirschman Index	65.5	65.5	104.7
Average Number of Imported Varieties			
Smallest 90% Wholesalers	1.9	2.3	3.2
Middle 90-99% Wholesalers	14.6	19.2	24.3
Largest 1% Wholesalers	98.3	138.3	143.0
Average Number of Domestic Locations			
Smallest 90% Wholesalers	1.1	1.1	1.1
Middle 90-99% Wholesalers	2.0	2.2	2.3
Largest 1% Wholesalers	9.5	14.1	17.8
Wholesaler Price			
Smallest 90% Wholesalers	$1.531	$1.520	$1.511
Middle 90-99% Wholesalers	$1.391	$1.409	$1.407
Largest 1% Wholesalers	$1.315	$1.342	$1.374

Notes: International product sub-varieties measured at the Harmonized System 10-digit level (HS-10). Prices and average costs computed averaging over each of the 56 markets.

of international product lines from 1.9 to 3.2, with no change in the 1.1 average domestic distribution locations. See further details in the Online Appendix.

Substantial heterogeneity may imply that larger wholesalers make strategic competitive decisions, while the smallest wholesalers are too small to exert market power. Price data indicates the smallest 90% of wholesalers decrease their prices from $1.531 to $1.511. The opposite is true of the largest wholesalers, who increase their prices rise from $1.315 to $1.374. While aggregate traditional measures of market power, such as a national-level Herfindahl-Hirschman Index, are low, such measures may obscure downstream buyer market segmentation and mis-measure market power.

1.3.3 Downstream Customer Heterogeneity

Having focused on the upstream aspect of the data, I shift to describing buyers. The variety and distribution of downstream buyers shows the importance in modeling market shares and valuations within many local and specific markets, as opposed to considering aggregate market shares. Who is buying goods from wholesalers? Does this give me any information on the sources of their market power?

Fact 5 *Wholesalers, unlike manufacturers, predominantly ship to nearby destinations.*

Wholesalers specialize in local availability and form a middle link in getting goods from a factory

Table 3: **Geographic Spread**

	2002 Share of Domestic Shipments	
Source/Destination	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.

to retailers and downstream producers. This fact is illustrated in Table 3. Wholesalers conduct 54.2% of sales within the same state, while manufacturers only do so for 32.3% of sales. The dominance of local shipments allows wholesalers with distribution centers in relatively isolated locations to exert local market power.

Fact 6 *Smaller purchases predominantly originate with wholesalers, instead of manufacturers.*

Potential scale economies in wholesaling are not isolated, as there appear to be scale economies in downstream purchasing. 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 14.9% of total wholesaler shipments, but only 3.9% of manufacturer shipments. In contrast, shipments of over $1,200,000 account for only 1.3% of wholesaler shipments, but 9.5% of manufacturer shipments. Certain wholesalers may exert market power in small shipments, even if they exhibit smaller overall market shares. This puts the wholesale market in context. Wholesaling doesn't deal with large downstream purchasers, particularly those of large downstream retailers and manufacturers, who purchase goods directly from manufacturers.

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.[13]

[13]Even though downstream purchases may consolidate, the rise of wholesaler market share may mean that improvements in wholesalers more than offset the tendency of large buyers to use direct sourcing.

1.3.4 Data Summary

Prices either slightly increased or were stable through the time period (depending on the metric used), yet aggregate market shares and sales increased, especially for the largest firms. One potential demand-side reason is the types of purchases that wholesalers specialize in increased, but there is little evidence of that. If anything, the types of purchasers wholesalers specialize in also decreased. That leaves supply-side explanations, where a higher quality product offsets increased prices, especially by the largest wholesalers. Can I quantify the role of economies of scale and changing fixed costs? To do this, I recover the cost structure of different types of wholesale firms across time after modeling downstream preferences.

2 Model

To evaluate welfare and compute counterfactuals, I construct a demand system paired with a wholesaler supply and entry model. The demand model determines downstream valuations for prices and various wholesaler attributes, such as international sourcing. The supply model considers the relationship of prices with marginal costs and market competition. The wholesaler market entry game relates markups and attributes to fixed entry costs. The model is flexible enough to be estimated with limited administrative data, accurately capture potential market power, and recover marginal and fixed costs.

I estimate a series of static games at 5-year intervals using detailed data from 1997, 2002, and 2007. Each firm makes a one-time sunk-cost decision to enter the market in each time period. This paper does not reflect on the identity of the firms, allowing for tractability without restrictive assumptions on entry or forward looking expectations. The estimated model allows for two types of analyses. First to quantify the welfare gains (as in Goldberg (1995)) and second to investigate the race between welfare and market power (as in Wollmann (2018)).

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 from whom to buy.

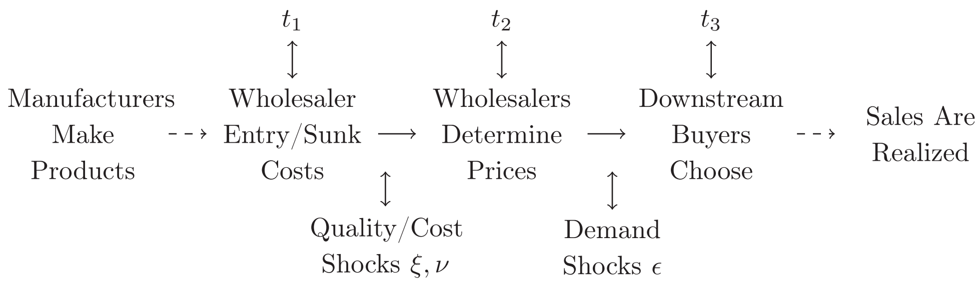
In a pre-period t_0, the characteristics of upstream manufacturers are chosen, and they determine what to produce and how much to charge for it. This empirical strategy will take decisions made at t_0 as exogenous; the focus will be on estimating and solving stages t_1 through t_3.

At t_1, wholesalers decide to enter a market and choose their fixed investments. Conditional on these investments, wholesalers pay fixed costs, and receive marginal cost and product quality shocks.

At t_2, wholesalers choose prices after accounting for expected buyer characteristics and their competitor attributes. I assume Bertrand competition with differentiated firms. Capacity constraints are relatively easy to solve in the medium-run. Trucks can be quickly and easily leased and inventory can be readily acquired.

At t_3, each downstream buyer makes a discrete choice to source a variety indirectly from a particular wholesaler or directly from a manufacturer. Each individual downstream buyer realizes a

Figure 1: Model Timing



wholesaler-specific preference shock and makes their purchasing decision. [14]

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

2.1 Stage 3: Downstream Demand

In the final stage, heterogenous downstream buyers choose an optimal source for a given purchase. The downstream demand model reflects facts from Section 1.2 where heterogenous downstream buyers seek to minimize procurement costs. This model captures differentiated sellers and buyers, even with coarse administrative data.

There are two ways for downstream firms to source goods, either directly from a manufacturer or indirectly through a wholesaler. A buyer chooses to buy a domestic variety or a particular foreign variety. Buyers may systematically prefer sources with either a specific variety, or wholesalers that carry multiple varieties, implicitly allowing multiple purchases to be correlated. Differentiated downstream buyers of type $j \in \mathcal{J}$ can buy a product variety $i \in \mathcal{I}$ from a wholesaler $w \in \mathcal{W}$ or they can buy directly from a mass of manufacturers m.

If a downstream buyer of type j buys indirectly from wholesaler w, a product variety i costs:

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

Indirectly sourcing variety i through a wholesaler incurs three components. First, q_j represents the number of units (in manufacturer prices) bought. Second, $\delta_{j,w,i}$ represents a common wholesaler-buyer-variety valuation (including price $p_{w,i}$). Lastly, buyers realize an idiosyncratic $\epsilon_{j,w,i}$ draw.

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

$$C_{j,m} = \log q_j + F_m\left(q_j\right) + \epsilon_{j,m}. \tag{1}$$

Direct sourcing from a manufacturer costs the number of units bought (q_j), an amortized fixed cost $F_m\left(q_j\right)$, and an idiosyncratic direct-buy match value ϵ.[15] The function $F_m\left(\cdot\right)$ captures downstream

[14] I omit the the number or size of downstream purchases. In Appendix G, I endogenize market sizes and qualitatively similar parameter estimates, with aggregate welfare effects by 10%. An data-intensive alternative can embed endogenous quantity as in Hendel (1999) or Bjornerstedt and Verboven (2016).

[15] There is no price p_m as prices are denoted in manufacturer prices. I consolidate choices over the set of manufacturer varieties. Appendix C relaxes this step.

scale purchasing economies (separate from scale economies in wholesaling itself). This directly links to the last fact in Section 1 and allows wholesalers to only have market shares when q_j is small.

Downstream buyer j is observably differentiated in two dimensions: their purchase quantity q_j, which shows up in both the manufacturer and wholesaler choices, and their relative wholesaler-specific preferences $\delta_{j,w,i}$. Downstream buyers are unobservably differentiated in two dimensions: their valuation for a particular variety (differentiated by countries of origin) and their valuation for using a wholesaler with a broad or narrow set of varieties, all relative to a manufacturer.

Normalizing by the cost of sourcing directly from a manufacturer for each type of buyer j produces a standard discrete choice problem:

$$\arg \max_{w,s \in \{\mathcal{W} \times \mathcal{S}\}} \left\{0, \delta_{j,w,i} + \epsilon_{j,w,i}, ..., \delta_{j,W,I} + \epsilon_{j,W,I}\right\}. \tag{2}$$

Note that $F_m(q_j)$ from equation 1 is now subsumed into the valuation $\delta_{j,w,i}$. All valuations are relative to direct sourcing from manufacturing. Estimating this would require a model of t_0, requiring data for all global manufacturers.

Common Valuation The common value $\delta_{j,w,i}$ is parameterized as a function of of both wholesaler and buyer attributes:

$$\delta_{j,w,i} = \alpha \log p_{w,i} + \beta_j x_{w,i} + \xi_{w,i}.$$

Valuation δ is a function of buyer and seller preferences and attributes and is dependent on parameters α and β. The first term indicates the price sensitivity of buyers and depends on α. The second term determines buyer valuations of econometrician-observed wholesaler attributes $x_{w,i}$ and vary on buyer preferences β_j. The last term $\xi_{w,i}$ captures residual wholesaler attributes.

Idiosyncratic Valuation Following McFadden (1980) and Bresnahan et al. (1997), the distribution of the vector of $\overrightarrow{\epsilon}$ for a buyer is drawn from a "principals of differentiation" (PD) logit model. This is a variant of the standard nested logit specification, however there is no predefined hierarchy between product nests, rather I take a weighted average of standard nested logit models.

Econometrician-unobserved differentiation in buyer preferences has two dimensions. First, buyers have unknown preferences between varieties 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 within $\epsilon_{j,w,i}$. See Appendix B.5 for full details.

Wholesaler market share Conditional on σ and common valuation $\delta_{j,w,i}$, I aggregate over the idiosyncratic draws of ϵ across buyers of econometrician-observed type j to recover market share of wholesaler w selling variety i:

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

However, the underlining data does not measure this market share, so I aggregate over buyer types. The overall market shares of a wholesaler w for variety i aggregates across buyer types j:

$$s_{w,i} = \sum_{j\in\mathcal{J}} s_{w,i|j} b_j, \tag{3}$$

where b_j denotes the share of total purchases by buyers of type j. Total sales $Q_{w,i}$ is simply the share of buyers times the total mass of purchases B:

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

Accounting for broad market definitions While the model above has some market segmentation, the administrative dataset may still experience significant limitations. Markups are reliant on market definitions.

Small firms will charge a fixed markup that does not vary due to their size, while large 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. Such market definitions may be overly broad and should be adjusted to account for hypothetical sub-markets.

While the fully estimated model does recover some degree of market power, it is unable to replicate the changes in accounting markups from Table 1. Markets are simply too large. I introduce a new term ψ that considers the "addressable" market size. Firms compete with proportion ψ of the competition. See Appendix B.5.2 for more details.

For example, in a simple logit specification, I could define the adjusted market share $s^{\psi}_{w,i|j}$ of wholesaler w selling variety i to buyer of type j as:

$$s^{\psi}_{w,i|j} = \frac{\exp\left(\delta_{w,i|j}\right)}{\psi\sum_{w,i}\exp\left(\delta_{w,i|j}\right)}. \tag{4}$$

where ψ is the share of competitors in a particular submarket. The downside is that I cannot directly know which firm is a direct competitor versus a firm that participates in a different "submarket". This prevents me from considering the direct effect of a particular firm on another and evaluate only aggregate statistics in the counterfactuals. Previewing the empirical strategy, the term ψ will be disciplined directly by the use of establishment-level accounting data, which I now describe.

2.2 Stage 2: Wholesaler Prices

I model the supply side of a wholesale firm with a fixed cost and a constant marginal costs. A wholesale firm $w \in \mathcal{W}$ sets prices $\mathbf{p}_w$ for each variety $i \in \mathcal{I}_w \subseteq \mathcal{I}$ they sell and maximizes expected variable profits, subject to constant marginal costs and sales across their varieties:

$$\pi_w(\mathbf{p}_w) \equiv \sum_{i \in \mathcal{I}_w} (p_{w,i} - c_{w,i}) Q_{w,i}(\mathbf{p}_w). \tag{5}$$

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 $c_{w,i}$. The set $\mathcal{I}_w \subseteq \mathcal{I}$ represents the varieties wholesaler w sells. Wholesalers can change their marginal cost only through their original fixed investments. This assumes that economies of scale can stem from ex-ante investments.

This maximization takes into account the attractiveness of other firms, the viability of direct sales from a manufacturer, as well as the cannibalization 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. I assume these wholesaler marginal costs $c_{w,i}$ are a function of wholesaler-source attributes:

$$c_{w,i} = c(\tilde{\mathbf{x}}_{w,i}, \nu_{w,i}) = \tilde{\mathbf{x}}_{w,i}\gamma + \nu_{w,i}. \tag{6}$$

The vector $\tilde{\mathbf{x}} = [\mathbf{x}\ \xi]$ includes wholesaler observables, such as the extent of international sourcing and number of domestic distribution locations, as well as the quality attribute ξ. With limited wholesaler attribute data, I allow ξ to be related to marginal costs.

2.3 Stage 1: Wholesaler Market Entry

Wholesale firms enter with attributes $\mathbf{x}$ after paying sunk entry costs $E_{\mathbf{x}}$. These attributes are the same attributes that are valued downstream by buyers. Once a wholesaler pays this sunk entry cost, they receive a vector of qualities ξ that shifts a downstream buyer's valuation for each of their varieties, and vector ν that shifts wholesaler marginal costs for each variety.[16] The draws ξ and ν are conditional on attributes $\mathbf{x}$ and drawn from some joint distribution $G(\xi, \nu|\mathbf{x})$.

How many wholesalers of each type $\mathbf{x}$, $N_{\mathbf{x}}$ enter each market? 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 in an equilibrium (Berry et al., 2016). Two conditions must hold: (1) wholesalers will only enter if their expected variable profits are greater than entry costs, and (2) additional wholesalers will not not earn expected variable profits greater than entry costs.

Returning to the equilibrium, the upper bound of entry cost $\bar{E}_{\mathbf{x}}$ is:

$$E_{\mathbf{x}} \leq \mathcal{E}^N_{\xi,\nu}[\pi(\mathbf{x})|N_{\mathbf{x}}] = \bar{E}_{\mathbf{x}}. \tag{7}$$

The notation $\mathcal{E}^N_{\xi,\nu}[\cdot]$ denotes the expected profit over random draws (ξ, ν) conditional on $N_{\mathbf{x}}$ observed wholesalers with attributes $\mathbf{x}$ participating, holding all other types of wholesalers constant.

If the current market configuration is an equilibrium, then it would be unprofitable for one

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

additional wholesaler to enter with attributes $\mathbf{x}$. The second condition means the lower bound of the entry cost $\underline{E}_{\mathbf{x}}$ is:

$$\underline{E}_{\mathbf{x}} = \mathcal{E}_{\xi,\nu}^{N+1}\left[\pi\left(\mathbf{x}\right)|N_{\mathbf{x}}+1\right] \leq E_{\mathbf{x}}. \tag{8}$$

These bounds do not require a market entry equilibrium to be computed. Rather, they only require that the current configuration of firms is an equilibrium.[17]

The draws of ξ and ν are conditional on the discrete choice $\mathbf{x}$, allowing for the distribution to change over time, along with the costs for $\mathbf{x}$. In particular, this allows for firms that have large global distribution networks to have both lower marginal costs ν and quality ξ, with both the benefits and costs increasing over time.

3 Estimation

There are three sets of parameters to estimate: buyer demand parameters $\theta = (\alpha, \beta, \psi, \sigma)$, marginal cost parameters γ, and fixed entry costs $E_{\mathbf{x}}$. Estimation and identification details are described in reverse chronological order, starting with demand, then supply, and finally entry.

3.1 Stage 3: Choice of Downstream Buyer

Demand parameters 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:

$$\delta_{j,w,i} = \alpha \log p_{w,i} + \beta_q \log q_j + \sum_{l\in\{state,region\}} \beta_l \mathbb{I}_{l_w=l_j} + \mathbf{x}_{w,i}\beta_x + \xi_{w,i} \tag{9}$$

These preferences are a function of a wholesaler's price for a variety $(p_{w,i})$, the size of a downstream buyer's purchase (q_j) to capture the relative difference from the outside option, if the wholesaler has a warehouse near a downstream buyer $\left(\mathbb{I}_{l_w=l_j}\right)$, a vector of wholesaler characteristics $(\mathbf{x}_{w,i})$, and a residual wholesaler-variety shifter $\xi_{w,i}$. 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 $\mathbf{x}$ includes characteristics of the wholesaler, such as the number of international sources (number of HS-10 sub-products), the total number of warehouses, and indicators for multi-variety wholesalers, as well as market-level observables, which include market-variety fixed effects as well as indicators for the source of the good and wholesaler type. All these characteristics are

[17] Extensions consider the fixed costs of changing the configuration of a particular wholesaler. Such approaches are in Eizenberg (2014); Pakes et al. (2015). I allow firms to endogenously choose ξ and ν in the appendix.

endogenous, though they are determined earlier in the game and are taken as fixed in this stage. The residual $\xi_{w,i}$ denotes the econometrician-unobserved quality.

The parameter α captures a downstream buyer's sensitivity to prices. The parameter β_q captures the benefit of buying q units from a wholesaler versus directly sourcing from a manufacturer. The parameter β_l captures the benefit of sourcing from a local wholesaler versus a distant wholesaler. The vector β_x captures all other observable valuations. Data on the mass of buyers (b_j) in equation (3) comes from the Commodity Flow Survey, which surveys purchases by location and quantity.

3.1.1 Demand Identification

The price coefficient α is identified from a set of geographic-based cost-shifters. The geographic and quantity based buyer valuations β_l and β_q are identified using aggregate moments. The parameters β_x are identified from the set of observed wholesaler attributes. Market competition parameter ψ is estimated using changes in accounting markups. Parameter σ is identified using geographic variation in the wholesaler choice set for downstream buyers.

Price Instruments Identification issues arise from the correlation between the econometrican-unobserved quality ξ and price p. In addition, prices are only reported on average for multi-variety wholesalers, and may suffer from an error-in-variables issue, as each variety may have a different price.

I adapt wholesaler-level accounting cost data $\tilde{c}$. As marginal costs c are a function of quality ξ, direct use can cause endogeneity issues, I adapt the geographic nature of Hausman et al. (1994) and Nevo (2001) instruments. If marginal costs c_w for wholesaler w have 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 cost of doing business in a particular location l. While these costs are unobserved, I use the observed average operating costs of other wholesalers in different wholesale markets within the same geographic region. I use accounting cost data and form instruments by aggregating across wholesalers in unrelated wholesale markets at the ZIP code, county, and state levels. I collect these shifters as instruments Z_1.

Aggregate Shipment Moments Large purchases tend to be sourced directly from manufacturers and small purchases tend to be sourced indirectly through wholesalers. The parameter β_q is identified using the overall wholesaler market share for a given quantity q, $s_{W|q}$which denotes the total market share of all wholesalers versus direct sourcing conditional on buyer purchase size q. The desirability of a local wholesaler versus a distant wholesaler (parameter β_l) is identified by the observed share of local, regional, and national shipments, $s_{W|l}$.

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 parameter σ, along with β_l. Collectively, I denote these moments as $\mathbf{m}_1$.

Aggregate Markup Moments While the literature has historical shied away from using firm-reported markup or cost data, I adapt and link this data with insights from production function estimation. I leverage accounting cost data to discipline changes in markups over time. I assume that accounting markups are consistently biased across time

Under this assumption, industry trends in accounting markups will help identify ψ. For each period t and market combination W, I compute aggregate accounting markups $\mu_{W,t}^{accounting}$ dividing firm revenues by all operating costs.

Allowing for the constant marginal cost assumption from the supply-side of Section (2), 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 step is crucial for matching aggregate data on accounting markups from Table (1). A typical wholesale NAICS code has 4,000 firms. Even with the nesting structure and segmented geographies, market concentration is minimal (see Table (2)), with average HHI only increasing from 65.5 to 104.7. With low concentration, competition will realize markups only as a function of the demand elasticity and not of competition. To reconcile the accounting markups and concentration data without time-varying demand elasticities, along with the broad nature of NAICS codes, markets are segmented using ψ. This parameter simply is the proportion of firms that must compete against each other to rationalize changes in accounting markups over time. As the level of markups without variable market power is pinned down by α, this moment helps pin down effective market size ψ from the changes in markups over time. I denote these moments $\mathbf{m_2}$.

Correlation Coefficients Estimation uses instruments to identify the nested logit correlation parameters σ. Buyers have similar preferences, but different choice sets, due to regional variations in wholesaler networks. Following the logic of Berry et al. (1995), a wholesaler's entry choices are made before quality $\xi_{w,i}$ is drawn, allowing the number and attributes of competitors to identify σ. Estimation generalizes this to include the number of wholesalers with the same sourcing strategy (single-source or multiple-source) and sourcing particular varieties at the regional and state level. I collect these instruments as Z_2.

Empirical Implementation Estimation adapts Petrin (2002). Equations (3) and (9) produce estimates for quality ξ and aggregate moments $\mathbf{m}$. A generalized method of moments objective function is constructed using the following 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, X), where X are wholesaler attributes determined at entry. The vector $\mathbf{m}_{data}$ consists of the empirical analogs of estimated moments. See Appendix B.5

Table 5: **Downstream Firm Choice Estimates**

Parameter	Estimate	Parameter	Estimate
log (Price)	-2.744 (0.0707)	Within State Shipment	3.228 (0.2372)
log (Shipment Size)	-0.422 (0.0006)	Within Region Shipment	1.226 (0.1358)
log (# Warehouses)	0.349 (0.0037)	σ_i (Varieties)	0.517 (0.0579)
South Imports × log (HS lines)	0.726 (0.0077)	σ_n (Wholesaler Breadth)	0.666 (0.0942)
North Imports × log (HS lines)	0.733 (0.0071)	ψ (Submarket Size)	0.220 (0.0024)
Multi-variety Wholesaler × 1997	0.127 (0.008)	Multi-variety Wholesaler × 2002	0.183 (0.0075)
Multi-variety Wholesaler × 2007	0.329 (0.0069)		
Fixed Effects	6-Digit Industry × Variety Multi-product Wholesalers × 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.

for details on the instruments and robustness.

3.1.2 Downstream Buyer Demand Estimates

Table 5 reports the demand estimates. Fixed effects control for market-variety and year-variety valuations. All coefficients, except for σ, are relative to direct purchases from manufacturers.

Buyers are price sensitive, with an estimated price coefficient α of -2.744. Wholesalers with multiple locations are more appealing than those with few locations, and this appeal grows over time. A wholesaler in the same state, and to a lesser extent in the same region, is valuable for downstream buyers. The benefit to indirect sourcing versus direct sourcing declines in shipment size. Wholesalers provide minimal benefit to downstream buyers receiving the largest shipments.

Estimates for ψ show that market size is five times smaller than ($\approx .220$) that implied by naive use of administrative data (Ganapati, 2021). Administrative data would effectively imply minimal market concentration, however $\psi = .220$ means that HHI indices in administrative data need to be multiplied by 20 $\left(1/\psi^2 = 20.66\right)$ to reflect market behavior.

Nest coefficients σ reflect substitutability between internationally and domestically sourced goods, as well as between a wholesaler with different variety availabilities (single-source versus multi-source). I find imperfect substitutability between varieties produced domestically, in the global "South", and in the global "North" ($\sigma_i = .517$), as well as between wholesalers with different sourcing strategies

Table 6: **Marginal Cost Regressions**

Parameter	Estimate	Std err.	Parameter	Estimate	Std err.
log (Plants)	-0.016	(0.0009)	ξ x 1997	0.219	(0.0008)
			ξ x 2002	0.185	(0.0008)
South Imports × log (HS lines)	-0.035	(0.0018)	ξ x 2007	0.164	(0.0009)
North Imports × log (HS lines)	-0.027	(0.0016)	ξ x South Imports x 1997	-0.066	(0.0026)
			ξ x South Imports x 2002	-0.044	(0.0024)
Multi-variety Wholesaler × 1997	-0.081	(0.0019)	ξ x South Imports x 2007	-0.026	(0.0022)
Multi-variety Wholesaler × 2002	-0.064	(0.0018)	ξ x North Imports x 1997	-0.059	(0.0022)
			ξ x North Imports x 2002	-0.038	(0.0024)
Multi-variety Wholesaler × 2007	-0.061	(0.0013)	ξ x North Imports x 2007	-0.024	(0.0024)
Fixed Effects	6-Digit Industry × Variety, Year × Variety				

Notes: Dependent variable is log (marginal cost). North refers to high-income country sources. South refers to low-income country sources. See text for full regression specification and standard error methodology.

($\sigma_n = .666$). Internationally sourced varieties are imperfect substitutes for domestically sourced varieties and multi-source wholesalers are imperfect substitutes for single-source wholesalers.

3.2 Stage 2: Wholesaler Pricing and Marginal Costs

Wholesaler marginal cost identification proceeds in two steps. First, demand estimates and price-competition assumptions back out implied marginal costs, $\hat{c}_{w,i}$. Second, marginal cost parameters γ are estimated.

Marginal costs are derived by inverting equation (5). They are a function of the demand parameters θ, conditional on characteristics $\mathbf{x}$ and price $\mathbf{p}$. Wholesaler attributes $\tilde{\mathbf{x}} = [\mathbf{x}\ \xi]$ are then projected onto marginal costs: $\hat{c}$:

$$\log \hat{c}_{w,i}(\theta; \mathbf{x}, \mathbf{p}) = \tilde{\mathbf{x}}_{w,i}\gamma + \nu_{w,i}. \tag{10}$$

Departing from standard methodology, marginal costs are also a function of quality ξ. Varieties with higher qualities ξ, are 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.[18] However there is one complication in estimation, due to prices for multiple-variety wholesalers being only known in aggregate. Appendix D.1 details how I correct for this under the assumption that all varieties sold by a single wholesale have the same unobservable quality.

Wholesaler Marginal Costs Estimates Table 6 regresses marginal cost on a set of covariates with market-variety and variety-year fixed effects. Economies of scale are evident.

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

The top line in the first column implies that as the number of distribution facilities doubles, marginal costs decrease by 1.6%, echoing Houde et al. (2023). Wholesalers with many domestic distribution locations have lower marginal costs, perhaps reflecting better optimization technology. It is helpful to put this estimate in perspective. Referring back to Table 1, the aggregate accounting marginal costs fell by 2.3% from 1997 to 2007. Referring back to Table 2, the largest 1% of wholesaler doubled the number of distribution facilities from 9.5 to 17.8 over the same period, while increasing their market share.

The two rows in the first column highlight that even within each international variety, additional sub-varieties (HS-10 sub-products) further decrease marginal costs. A doubling of sub-varieties decreases marginal costs by 3.5% and 2.7% if they are sourced from the global "South" and "North" respectively.

These marginal cost estimates are indicative of scale economies in wholesaling. The attributes valued by downstream firms (local sourcing, international varieties, carrying multiple varieties, and quality ξ), are the same ones that are reflected in lower marginal costs for wholesalers. The wholesalers that sell the most appear to have the lowest marginal costs.

Implied Costs and Markups To gauge the importance of the modeling assumptions, Table 7 compares implied markups and marginal costs across five scenarios that sequentially drop model elements. 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 variable profits from equation 5.

In each panel there are five rows. The first presents results from the full demand model (with the benefit of local shipping, submarkets ψ, and strategic pricing for multi-variety firms). The second dispenses with the assumption that firms know their own varieties are partial substitutes. The third assumes away local market heterogeneity, but reduces the size of national markets at the NAICS-6 level with $\psi = .22$, The fourth assumes a single national market and that the administrative data accurately measures market size with $\psi = 1$. The last line assumes a model with monopolistic competition, where markups are invariant to wholesaler size. To conduct each step, I do not re-estimate the model, rather I simply re-estimate markups under different assumptions in equation (5). This allows comparison with previous rows when I combine this with price data to compare marginal costs.

In Panel A of Table 7 using the full model, marginal costs fell from \$1.104 to \$1.081. Assuming a manufacturer's price of \$1, this implies marginal cost fell from 10.4 cents to 8.1 cents, or decrease of 28%. In contrast, all other scenarios find an increase in marginal costs. For example, if I only allow national market power with $\psi = .22$, the marginal cost rose from 15.1 cents to 16.7 cents. Dispensing from strategic interactions and heterogeneity in a standard monopolistic competition models used in international trade (in the spirit of Dixit and Stiglitz (1977)), marginal costs would have increased from 16.3 cents to 18.1 cents.

Panel B takes the aggregate prices from Table 1 and puts the model-derived marginal costs into

Table 7: **Supply Estimation Statistics**

Panel A: Average Wholesaler Marginal Costs ($ per $1 of producer output)	1997	2002	2007
Full Model With Local Market Power	1.104	1.088	1.081
No Multi-Variety Differentiation	1.135	1.137	1.141
National-Level Submarkets ($\psi = .22$)	1.153	1.159	1.167
National-Level Market Power Only ($\psi = 1$)	1.151	1.157	1.166
Monopolistic Competition	1.163	1.170	1.181

Panel B: Average Markups (Price/Marginal Cost across markets)	1997	2002	2007
Full Model With Local Market Power	1.256	1.283	1.303
No Multi-Variety Differentiation	1.222	1.228	1.234
National-Level Submarkets ($\psi = .22$)	1.203	1.205	1.207
National-Level Market Power Only ($\psi = 1$)	1.205	1.207	1.208
Monopolistic Competition	1.193	1.193	1.192

Panel C: Aggregate Wholesaler Operating Profits (Real 2007 Billon USD)	1997	2002	2007
Full Model With Local Market Power	401	579	749
No Multi-Variety Differentiation	356	484	606
National-Level Submarkets ($\psi = .22$)	327	439	553
National-Level Market Power Only ($\psi = 1$)	335	433	530
Monopolistic Competition	317	408	498
Implied Average Herfindahl Hirschman index	1691	2492	3059

Notes: In each panel there are five rows. The first presents results from the full demand model (with the benefit of local shipping, submarkets ψ. and strategic pricing for multi-variety firms). The second dispenses with the assumption that firms assume that markets for different varieties of internationally sourced products are partial substitutes. The third assumes away local market heterogeneity, but reduces the size of national markets at the NAICS-6 level with $\psi = .22$, The fourth assumes a single national market and that the administrative data accurately measures market size with $\psi = 1$. The last line assumes a model with monopolistic competition, where markups are invariant to wholesaler size.

context. A markup of one denotes sales at marginal cost. With the fully estimated model, markups rise from 25.6% to 30.3% (1.256 to 1.303 in the price/marginal cost ratio). With national markets, there is a much more modest rise from 20.5% to 20.8%; reflecting the low increase in the HHI index in Table 2. Finally, markups are relatively consistent at 19.3% under monopolistic competition, as demand elasticities only reflect changes relative to the outside option.

Without all model elements, estimated marginal costs would increase and estimated markups cannot rationalize accounting data on operating costs. Essentially, a wholesaler may have a small localized monopoly 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 wholesaler market shares across markets and attenuate any market power findings.

Assuming constant marginal costs, I translate these markups and marginal costs to aggregate variable profits in Panel C. From 1997 to 2007, in the fully estimated model, variable profits increased

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

Wholesaler category / # of Locations	1997 Domestic Only	1997 Domestic + International Importer	2007 Domestic Only	2007 Domestic + International Importer
One State	[636 643]	[2,846 3,002]	[812 828]	[3,744 3,989]
Two States	[4,055 4,157]	[13,321 14,865]	[5,359 5,565]	[16,240 17,850]
Three States	[5,811 5,949]	[24,960 28,050]	[11,360 11,960]	[59,800 73,410]
Four-Six States	[11,970 12,430]	[36,140 40,260]	[20,640 21,840]	[95,560 116,700]
Seven+ States	[57,740 62,730]	[209,000 243,800]	[64,730 72,110]	[326,100 394,100]

Notes: For each wholesaler in the data, I compute equation 11 for upper and lower bounds of estimate sets. I then aggregate and average each of these values across all firms to the ten aggregate observed wholesaler types. Each cell displays estimated bounds for fixed entry costs and are not a confidence interval. Results are averaged across the 56 wholesale markets. See text for full details.

87% (from \$401 to \$749 billion). In contrast, under monopolistic competition, variable profits only increase 57% (from \$317 to \$498 billion). However, these aggregate variable profits have two critical components. First, they may represent returns on fixed ex-ante investments. Second, they mask substantial heterogeneity across wholesalers.

3.3 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 ($E_{\mathbf{x}}$) for a wholesaler with configuration $\mathbf{x}$ use two equilibrium conditions: (1) wholesalers will only enter if their expected variable profits are greater than entry costs, and (2) additional wholesalers of the same configuration will not earn expected variable profits greater than entry costs. Equations (7) and (8), imply upper bounds $\bar{E}_{\mathbf{x}}$ and lower bounds $\underline{E}_{\mathbf{x}}$ on entry costs. The following empirical analogs are computed:

$$\bar{E}_{\mathbf{x}} = \mathbb{E}_{\xi,\nu}\left[\pi\left(\mathbf{x}\right)|N_{\mathbf{x}}\right] \quad \text{and} \quad \underline{E}_{\mathbf{x}} = \mathbb{E}_{\xi,\nu}\left[\pi\left(\mathbf{x}\right)|N_{\mathbf{x}}+1\right], \tag{11}$$

where $\mathbb{E}_{\xi,\nu}$ is the expectation over the distribution of quality ξ and marginal cost ν draws, with a joint distribution $G^{\mathbf{x}}_{\xi,\nu}$ for wholesalers of configuration $\mathbf{x}$. The upper-bound takes the expectation of variable profits for the number of wholesalers N_x as observed in the market. The upper bound is the average variable profit of a wholesaler with attributes $\mathbf{x}$. The lower-bound takes the expectation of variable profits when an extra wholesaler of type $\mathbf{x}$, or $N_{\mathbf{x}}+1$ wholesalers, are present in the market. See Appendix E for details.

Table 8 considers the lower and upper bounds of fixed entry costs $E_{\mathbf{x}}$. While the underlying calculations are done by wholesaler market and industry, displayed results are averaged across markets. These results are further binned by broad groupings $\mathbf{x}'$. 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 between \$636,000 and \$643,000. Similarly, wholesalers that participate in international trade and operate in at least seven states have annualized fixed costs between \$209.0 and \$243.8 million. This difference is even greater for wholesalers in 2007. While the smallest wholesalers have fixed costs between \$812,000 and \$828,000, the largest wholesalers have fixed variable costs between \$326.1 and \$394.1 million. Moreover, the biggest absolute gains in variable profits accrue to wholesalers that both participate in international trade and have extensive domestic distribution networks.

The gap between the upper and lower estimates also bound "super-normal" profits, the difference between variable profits and the bar for entry for new firms that is rationalized by the payoff functions. This gap is smallest for small wholesalers; reflecting extremely small profit margins. For the largest wholesalers that operate in 7+ states and sell domestic and international varieties, this gap grows from 16.7% in 2007 to 20.9% in 2007. This substantial shift also highlights how scale may translate to more profitable firms as monopolistic competition diminishes and a small number of firms effectively prevent new entrants due to high entry costs.

These figures are not just estimates for configuration $\mathbf{x}$, but the associated draws of marginal costs ν and quality ξ. As such, I do 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, with higher quality and lower marginal cost. Essentially, the underlying technology of wholesale trade has changed. Firms that provide benefits to downstream customers (from Table 5), realize lower marginal costs (from Table 6), and realize higher variable profits, that are rationalized by higher entry costs (here in Table 8).

4 Model Implications

The probability of a buyer sourcing from a wholesaler in a typical market increased from 45% to 52% from 1997 to 2007, even though the number of wholesalers has fallen. If the outside option is time-invariant, buyer welfare increases by \$319 billion, representing 7.5% of the total value of sourced manufactured goods. These gains stem from changes in wholesaler varieties, prices, economies of scale and quality (further decomposed between domestic and international sourcing strategies), and local availability. What is the relative importance of each of these channels?

I compute the following statistic with my demand estimates:

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

where $s_W(\cdot)$ is the market share of wholesalers averaged across all 56 markets, $\mathbf{x}^{2007}$ 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 and standard deviation in 1997 across all wholesalers. I then do this for wholesalers of different size ranks.

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

	All Firms	Wholesale Firm Size Percentile		
		0-90%	90-99%	Top 1%
Gains Due To Price Effects	-4%	7%	5%	-4%
Gains Due to Distribution Network	26%	0%	-1%	25%
Gains Due to Sourcing Quality	90%	11%	14%	28%
Due to Domestic Sourcing	55%	11%	16%	20%
Due to International Sourcing	14%	2%	10%	7%
Gains Due To Firm Choices	-3%			

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. See text for full details.

Table 9 nets out differences in the distribution of downstream buyers[19] 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 averaged across 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 welfare enhancing for buyers, and negative numbers indicate changes that are welfare reducing from 1997 to 2007.

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 4 percent larger.

The second channel reflects changes in domestic distribution networks due to more regional warehouse locations, which places the largest wholesalers closer to more downstream customers. This accounts for 26% 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). This gain is only attributed to the very largest wholesalers, as all wholesalers outside the largest 1% have had very little change in their distribution networks (see Table 2).

The third channel considers the changes to the quality of domestic sourcing and international sourcing through wholesalers. Changes in domestic sourcing account for 55% of the aggregate change, and changes to international sourcing account for the 14%. This may reflect better customer service for downstream buyers or more comprehensive procurement strategies from wholesalers. Wholesalers may offer more product lines within aggregate varieties. As with the other channels, changes are largely driven by the largest 1% of wholesalers. This channel partially reflects on changes to quality, through the ξ term. It is important to note that ξ is a modeled as a quality draw and it is conditional

[19] I consider buyer composition in 2007; changes from 1997 are netted out. Decompositions do not sum up to 100% as effects can interact.

of the firm choice of $\mathbf{x}$ in a given year. Thus, firms with appealing attributes, having made choices of $\mathbf{x}$ and to pay $E_{\mathbf{x}}$, may receive higher ξ draws in 2007 than in 1997.

From 1997 to 2007, small wholesalers have deceased their prices and increased attributes valued by downstream buyers. However, this change is swamped by the increase in the downstream valuation of the largest wholesalers, even though it comes at a higher price.

The last channel examines the presence of idiosyncratic downstream buyer-wholesaler preference shocks. As the number of wholesalers decreases, market share mechanically falls, as downstream buyers receive fewer draws of ϵ. If the number of wholesalers in 2007 was at 1997 levels, the change in their market share would be 3% smaller.

This decomposition only leverages demand estimates, I now turn to two fully fledged counterfactuals that account for entry costs and changes in variable profits.

5 Counterfactuals Market Power Analysis

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

5.1 Counterfactual: Wholesaler Technology Changes

What is the net benefit to downstream buyers and wholesalers due to aggregate market changes from 1997 to 2007? Section 4 parses 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.

5.1.1 Scenario 1: Fixed Set of Wholesalers

Table 10 computes a variety of market outcomes by placing the universe of 1997 wholesalers in a 2007 environment and recomputing prices, marginal costs, downstream welfare, and changes in profits after accounting for fixed costs. The first column lists a variety of relevant market outcomes, and the second column presents baseline data from 2007.

The third column of Table 10 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; but those only minimally change (due to changes in the distribution of downstream buyer types). 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 (reflecting Section 4). The average wholesaler market share decreases from 52% to 45%. Analogously, the welfare of downstream buyers (reflecting changes in their total procurement costs)

Table 10: **Scenario 2: Inter-temporal Comparison Statistics**

		Wholesalers with 1997 Technology in 2007	
	2007 Data	Scenario: Fixed Entry	Scenario: Free Entry
Number of Wholesalers	210,000	220,000	[270,000 290,000]
Number of Wholesalers/Market	3,750	3,929	[4,821 5,179]
Mean Wholesaler Share	52%	45%	[46% 47%]
Wholesaler Mean Prices	1.408	1.387	[1.394 1.394]
Wholesaler Mean Markups	1.303	1.256	[1.251 1.251]
Mean Adjusted Herfindahl index (HHI)	3060	1688	[1,217 1,305]
Welfare Relative to 1997 ($ bil)			
Δ Downstream Welfare (bil)		-$319	[$-247 -223]
Δ Wholesaler Profits (bil)		$152	[$0 0]
Δ Profits + Δ Welfare(bil)		-$166	[$-247 -223]

Notes: Market shares computed using the value of distributed goods in producer prices. Scenario 1 considers wholesale markets without wholesaler entry and exit. Scenario 2 allows wholesalers to enter/exit. Herfindahl indices computed over localized markets that with downstream customer heterogeneity and estimated submarkets ψ. Shares and markups are averaged over all NAICS-6 national markets. Welfare aggregated over all markets. See text for details.

decreases by $319 billion. Market power decreases, with both the implied average market-level HHI (adjusting for ψ and consumer heterogeneity) 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 entry costs of wholesalers are at their lower 1997 levels, the remaining wholesalers are able to increase their profits by $152 billion. By offsetting the decrease in downstream welfare (through increased costs) with wholesaler profits, total surplus (and thus welfare) decreases by only $166 billion. This total figure is equivalent to 1% of 2007 gross domestic product. To further refine this calculation, I allow for a simplified form of wholesaler entry in the next section.

5.1.2 Scenario 2: Allowing Wholesaler Entry/Exit

In this scenario there is only one type of wholesaler, those that are present in 1997, and does not require an equilibrium selection procedure. Potential wholesalers draw types, qualities, and marginal costs from the observed distribution of existing wholesalers in 1997. Wholesalers choose to enter if the expected variable profits from entry are greater than fixed costs, and exit otherwise.

It is possible to play this as a game with the different types of firms, with entry costs estimated from Table 8, but I keep consumer preferences identical across time, with only slight changes in the geographic distribution of downstream firms. Empirically, the profit margin ($\Delta\pi(\mathbf{x})/E_{\mathbf{x}}$) is similar across time for all type $\mathbf{x}$. The role played by scale is only seen over time. The observed distribution moves towards bigger and more international firms, with better draws of ξ and ν.

If there are N wholesalers in the market, the following two conditions hold:

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

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

The third column of Table 10 computes changes in market outcomes relative to the observed set of wholesalers in 2007. I run two simulations for each of the 56 wholesaler markets, one using estimates of $\bar{E}_{\mathbf{x}}$ and the other using $\underline{E}_{\mathbf{x}}$ computed at the firm-level in Section 3. In each market, I re-sample the distribution of existing firms in 1997 and add additional firms until average variable profits after paying entry costs are negative.

If wholesaling technology from 1997 was placed in 2007 - with correspondingly larger market size, free entry would allow more wholesalers to enter due to high potential variable profits; from 220,000 firms to between 270,000 and 290,000 firms. This entry would result in market power (markups and HHI) falling substantially. In terms of wholesalers, aggregate wholesale market share would decrease from the 2007 baseline to between 46% and 47%, but each wholesaler would have smaller market shares. Downstream welfare would also fall by $223-247 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.

This highlights how equilibrium wholesale firm scale has changed in just 10 years. As the overall market for manufactured goods increased from 1997 to 2007, the number of wholesalers actually decreased; fewer firms distributed greater quantities of product. The counterfactual also exhibits how the wholesale firm distribution from 1997 exhibits excessive entry. Comparing the "fixed entry" and "free entry" scenarios, the "fixed entry" scenario has 22-31% fewer firms, yet it has a lower aggregate welfare loss. The fixed entry scenario has a larger downstream welfare loss, but substantially higher wholesaler profits ($152 billion) partially offset the loss due to excessive free entry.

Changes in both domestic and imported manufacturing prices and varieties in Feenstra and Weinstein (2017) imply that US welfare rose by nearly 0.86% from 1992-2005. Relative to that, I find that gains in wholesaling technology and attributes imply welfare gains that together represent 2% of real gross domestic product from 1997 to 2007.

While the 2007 marketplace is larger than the 1997 marketplace; wholesale technology from 1997 doesn't mean that biggest wholesalers necessarily expand in size. In particular, if the market size doubles, the sales of both small and big firms mechanically double as there is no scope for differential entry. To better understand this interplay, I turn to a second counterfactual; one that investigates scale economies from the linkage between the international and domestic sources in utilizing a distribution network.

5.2 Counterfactual: Role of International Trade

Two large changes to the underlying nature of manufactured good distribution in the US were the implementation of NAFTA and the ascension of many economies to the World Trade Organization, including China. Many studies consider the direct effect of these policies, as well as the aggregate gains from trade (See Caliendo and Parro, 2022). However, the role of intermediation in trade

Table 11: **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	[340,000 340,000]	[350,000 360,000]	[390,000 380,000]
Number of Wholesalers/Market	3929	3929	3750	3929	3929	3750	[6,071 6,071]	[6,250 6,429]	[6,964 6,786]
Mean Local Herfindahl Index	1,688	2,496	3,060	1,379	1,395	1,777	[421 437]	[577 600]	[675 774]
Wholesaler Mean Market Share	45%	50%	52%	42%	45%	47%	[37% 37%]	[40% 41%]	[42% 42%]
Wholesaler Mean Markups	1.26	1.292	1.311	1.219	1.218	1.226	[1.193 1.193]	[1.194 1.195]	[1.196 1.198]
Panel B: Changes from the Loss of International Trade									
Δ Downstream Costs (bil)				-$123	-$161	-$194	[$-328 -333]	[$-384 -389]	[$-442 -449]
Δ Wholesaler Profits (bil)				-$55	-$127	-$177	[$0 0]	[$0 0]	[$0 0]
Δ Profits - Δ Costs(bil)				-$177	-$288	-$371	[$-333 -328]	[$389 -384]	[$-449 -442]
Δ Costs/Purchased Value				-3.6%	-4.1%	-4.5%	[-9.6% -9.7%]	[-9.9% -10.0%]	[-10.4% -10.5%]

Notes: Static gains computed as the compensating variation needed for 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 changes in demand composition. Entry/Exit gains allow wholesale firms to enter or exit the market caused by variations in fixed costs or variable profits due to changes in international sourcing. All figures in 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. Welfare computed by aggregating over all markets. See text for computational details.

liberalization episodes has been typically overlooked.

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. The first scenario fixes the current set of wholesalers, 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. I allow for wholesalers to keep their draws of of ξ and ν, wrapping up the entire investment decision in the choice of $\mathbf{x}$.[20]

Table 11 summarizes the market effects of indirect international sourcing under the two counterfactuals. The first set of columns presents baseline results. The second set of columns, labeled "Scenario 1," summarizes changes due to indirect international sourcing, including wholesaler price responses, but not wholesaler entry/exit. The third set of columns labeled "Scenario 2" allows for wholesaler entry/exit. Panel A displays the results of each counterfactual in levels. I interpret downstream "welfare" as cost savings from savings on procurement costs. Panel B considers changes in wholesaler profits and downstream buyer costs.

5.2.1 Scenario 1: Fixed Set of Wholesalers

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

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 3,060 to 1,777, as international sourcing is concentrated in the largest wholesalers. This also causes a decrease in markups, as the largest wholesalers lose a significant amount of market power.

Panel B considers the changes in market outcomes. In 2007, the loss would reflect a $194 billion decrease in downstream welfare, or 4.5% of downstream expenditures. 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

[20] 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.

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

(a) **1997** (b) **2007**

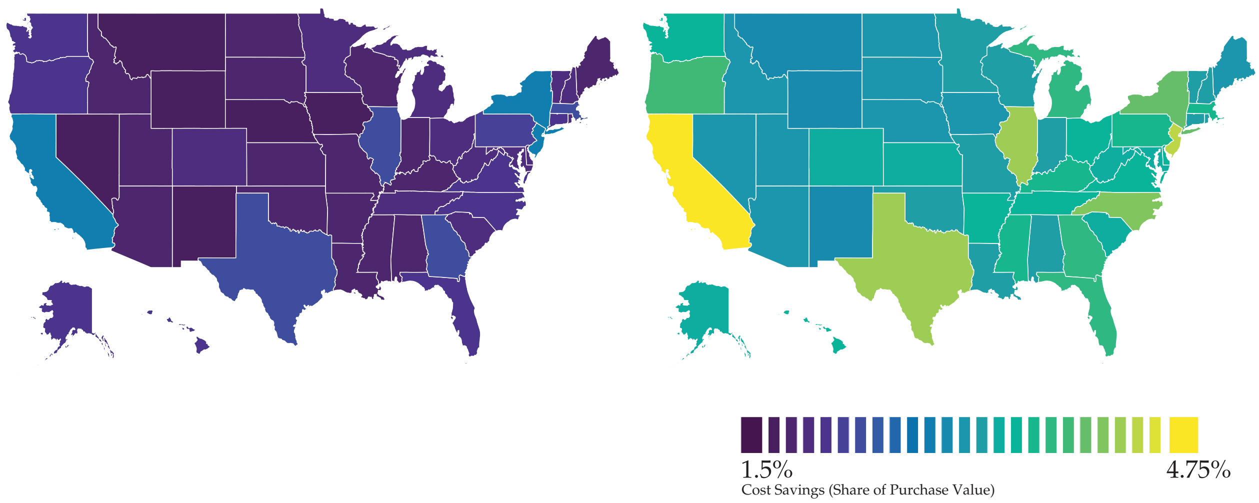


Table 12: **Variable Profit Change from Limiting International Trade**

	Wholesaler Size		
	Smallest 90%	90-99%	Largest 1%
1997	3%	-4%	-34%
2002	6%	2%	-42%
2007	9%	6%	-50%

Notes: Variable profits re-computed after resolving iteratively for best-response prices, holding fixed the number of wholesalers. See text for details.

to buyer costs (as a share of total expenditures) in 1997 and 2007. In 2007, California, New Jersey, and Texas face a 5% change in downstream costs. In contrast, the inland states of Wyoming, New Mexico, and Montana show approximately half this effect. 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 variable profits from facilitating international sourcing. Table 12 computes the aggregate changes in variable profits across wholesalers by size. In 1997, by limiting indirect international trade, the smallest wholesalers benefit with variable profits rising 3%, as some downstream buyers switch from using international to domestic varieties. The largest wholesalers see a 34% decrease in variable profits as they are no longer able to source 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 9% gain in variable profits, while the largest wholesalers face a 50% decline.

5.2.2 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.

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. I denote the count of domestic wholesalers N_d and hybrid wholesaler N_h.

Empirically I take the estimates for $E_{\mathbf{x}}$ from Section 3 and construct two bins for the two types of wholesalers for each market, averaging to create E_d and E_h (for both upper and lower bounds). As hybrid firms no longer source products internationally, I subtract the average entry cost of international-only wholesalers from E_h.

I then randomly re-sample existing firms to construct counterfactuals. In particular, I compute the average profit margin across the simulated sample. An equilibrium is where an increase in either N_d or N_d is unprofitable for either type.

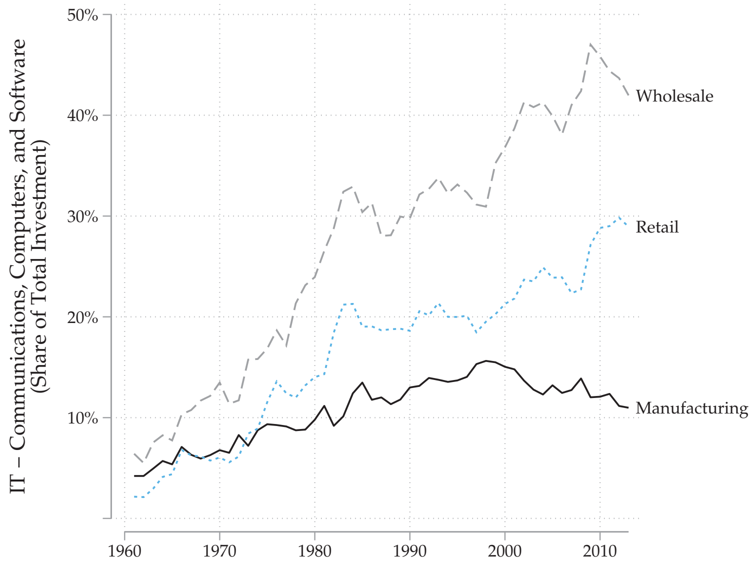
This analysis picks the equilibrium with the greatest number of domestic-only wholesalers. I start with $N_d = \bar{N}$ and $N_h = 0$, with $\bar{N}$ as an extremely large number. I then increase N_d until such "d" type firms are unprofitable. I then increase N_h until an equilibrium is found. If not, I further decrease N_d by one and repeat. As domestic wholesalers have low barriers to entry, such wholesalers are considered large first-movers.[21]

In the third set of columns in Table 11, I show changes after allowing for this wholesaler entry/exit. The elimination of international trade leads to net losses of between $442-449 billion in 2007. Market forces drive out the best wholesalers (i.e. those with internationally sourced products). However, free entry allows more domestic-only wholesalers to enter the market, partially compensating for the loss of wholesalers that source globally. Market power (measured by concentration and markups) substantially decreases. The HHI reflects un-concentrated markets and markups that resemble monopolistic competition. However, this does not lead to downstream gains as customers both lose access to national distributors and must source international products directly.

This scenario show how linked product attributes are; the combination of either domestic and international varieties allow for better wholesalers. There may be large fixed costs in the background,

[21] An equilibrium is always found. Alternative results are calculated with equilibria that provide for the greatest number of hybrid wholesalers. While different in some of the wholesaler count statistics, results are roughly similar. In a subset of markets, I search over the state space and find other equilibria (see Eizenberg (2014)), but results are minor deviations. In general, hybrid wholesalers lose both the ability to sell products from abroad, while retaining very large fixed costs and are unprofitable.

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



Source: BEA Investment Data

but the gains for downstream welfare and costs outstrip the losses due to increased markups and market concentration. Downstream firms may not like upstream concentration, but there are clear benefits to it as fixed costs can be spread across many locations, varieties, and consumers.

6 Discussion and Conclusion

All wholesaler estimates are relative to the outside option. 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 wholesaling versus direct sourcing. Further work, using both international trade data and domestic production data could provide new insights. Other research (Bernard and Fort (2015) and Bernard, Smeets and Warzynski (2017)) point out a trend in former manufacturing firms closing domestic production operations, and only retaining design and distribution facilities (see Appendix F). Aggregate data from Feenstra and Weinstein (2017) shows that the direct sourcing option, combining domestic and international trade has itself improved welfare (by about 1% of GDP), meaning that these estimates are a lower bound on welfare improvements during this period of globalization. I consider measures of welfare in this paper as additive to such estimates. Naively, this represents a 2% gain to GDP.

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 are initially at similar levels in 1960, the path diverged. Today, IT accounts for 45% of all investment by wholesale firms, but only 10% of investment by manufacturers.

This paper uses the tools of industrial organization, leveraging demand and supply data to understand why competition is decreasing. 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 varieties. I find fixed-cost induced market power, where wholesaler market power would be 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. Globalization and distribution networks are a wedge that allow for (a) more market power and (b) widespread benefits. In the context of wholesaling, the benefits dominate changes in market power. Other industries, time periods, or contexts may provide different results.

References

Abel-Koch, Jennifer, "Who Uses Intermediaries in International Trade? Evidence from Firm-level Survey Data," *The World Economy*, 2013, *36* (8), 1041–1064.

Ahn, JaeBin, Amit K Khandelwal, and Shang-Jin Wei, "The role of intermediaries in facilitating trade," *Journal of International Economics*, 2011, *84* (1), 73–85.

Akerman, Anders, "A theory on the role of wholesalers in international trade based on economies of scope," *Canadian Journal of Economics/Revue canadienne d'économique*, 2018, *51* (1), 156–185.

Anderson, Simon P, Andre De Palma, and Jacques François Thisse, *Discrete choice theory of product differentiation*, MIT press, 1992.

Antràs, Pol and Arnaud Costinot, "Intermediated Trade," *Quarterly Journal of Economics*, 2011, *126* (3), 1319–1374.

Atkin, David and Dave Donaldson, "Who's getting globalized? the size and nature of intranational trade costs," *mimeo*, 2012.

Autor, David, David Dorn, Lawrence F Katz, Christina Patterson, and John Van Reenen, "The fall of the labor share and the rise of superstar firms," *The Quarterly Journal of Economics*, 2020, *135* (2), 645–709.

Azar, José, Martin C Schmalz, and Isabel Tecu, "Anticompetitive effects of common ownership," *The Journal of Finance*, 2018, *73* (4), 1513–1565.

Barkai, Simcha, "Declining labor and capital shares," *Stigler Center for the Study of the Economy and the State New Working Paper Series*, 2016, (2).

Bernard, Andrew B. and Teresa C. Fort, "Factoryless Goods Producing Firms," *American Economic Review: Papers and Proceedings*, May 2015, *105* (5), 518–23.

Bernard, Andrew B, J Bradford Jensen, Stephen J Redding, and Peter K Schott, "Wholesalers and retailers in US trade," *American Economic Review*, 2010, *100* (2), 408–413.

—, **Marco Grazzi, and Chiara Tomasi**, "Intermediaries in international trade: Direct versus indirect modes of export," *National Bureau of Economic Research Working Paper*, 2011.

—, **Valerie Smeets, and Frederic Warzynski**, "Rethinking deindustrialization," *Economic Policy*, 2017, *32* (89), 5–38.

Berry, Steven, Alon Eizenberg, and Joel Waldfogel, "Optimal product variety in radio markets," *The RAND Journal of Economics*, 2016, *47* (3), 463–497.

—, **James Levinsohn, and Ariel Pakes**, "Automobile prices in market equilibrium," *Econometrica: Journal of the Econometric Society*, 1995, pp. 841–890.

—, **Martin Gaynor, and Fiona Scott Morton**, "Do increasing markups matter? lessons from empirical industrial organization," *Journal of Economic Perspectives*, 2019, *33* (3), 44–68.

Berry, Steven T, "Estimating discrete-choice models of product differentiation," *The RAND Journal of Economics*, 1994, pp. 242–262.

Berry, Steven T. and Philip A. Haile, "Identification in Differentiated Products Markets Using Market Level Data," *Econometrica*, 2014, *82* (5), 1749–1797.

Bjornerstedt, Jonas and Frank Verboven, "Does merger simulation work? Evidence from the Swedish analgesics market," *American Economic Journal: Applied Economics*, 2016, *8* (3), 125–64.

Bresnahan, Timothy F, "Empirical studies of industries with market power," *Handbook of industrial organization*, 1989, *2*, 1011–1057.

—, **Scott Stern, and Manuel Trajtenberg**, "Market Segmentation and the Sources of Rents from Innovation: Personal Computers in the Late 1980s," *The RAND Journal of Economics*, 1997, *28*, S17–S44.

Broda, Christian and David E Weinstein, "Globalization and the Gains from Variety," *The Quarterly journal of economics*, 2006, *121* (2), 541–585.

Caliendo, Lorenzo and Fernando Parro, "Lessons from US–China Trade Relations," *Annual Review of Economics*, 2022, *15.*

Crozet, Matthieu, Guy Lalanne, and Sandra Poncet, "Wholesalers in international trade," *European Economic Review*, 2013, *58*, 1–17.

Davis, Peter, "Spatial competition in retail markets: movie theaters," *The RAND Journal of Economics*, 2006, *37* (4), 964–982.

De Loecker, Jan, "Product differentiation, multiproduct firms, and estimating the impact of trade liberalization on productivity," *Econometrica*, 2011, *79* (5), 1407–1451.

— **and Johannes Van Biesebroeck**, "Effect of International Competition on Firm Productivity and Market Power," February 2016, (21994).

—, **Pinelopi K. Goldberg, Amit K. Khandelwal, and Nina Pavcnik**, "Prices, Markups, and Trade Reform," *Econometrica*, 2016, *84* (2), 445–510.

Dixit, Avinash K and Joseph E Stiglitz, "Monopolistic competition and optimum product diversity," *The American economic review*, 1977, *67* (3), 297–308.

Eizenberg, Alon, "Upstream innovation and product variety in the us home pc market," *The Review of Economic Studies*, 2014, *81* (3), 1003–1045.

Elser, Bernd, Udo Jung, and Yves Willers, "Opportunities in Chemical Distribution," Technical Report, The Boston Consulting Group 2010.

Feenstra, Robert C and David E Weinstein, "Globalization, markups, and US welfare," *Journal of Political Economy*, 2017, *125* (4), 1040–1074.

_ **and Gordon H Hanson**, "Intermediaries in Entrepot Trade: Hong Kong Re-Exports of Chinese Goods," *Journal of Economics & Management Strategy*, 2004, *13* (1), 3–35.

Felbermayr, Gabriel and Benjamin Jung, "Trade Intermediation and the Organization of Exporters," *Review of International Economics*, 2011, *19* (4), 634–648.

Ganapati, Sharat, "Connecting Production and Distribution: Linking Manufacturing and Wholesaling Data," Technical Report, Yale University 2015.

_ , "Growing Oligopolies, Prices, Output, and Productivity," *American Economic Journal: Microeconomics*, August 2021, *13* (3), 309–27.

Gavazza, Alessandro, "The role of trading frictions in real asset markets," *The American Economic Review*, 2011, *101* (4), 1106–1143.

Goldberg, Pinelopi Koujianou, "Product differentiation and oligopoly in international markets: The case of the US automobile industry," *Econometrica: Journal of the Econometric Society*, 1995, pp. 891–951.

Gopinath, Gita, Pierre-Olivier Gourinchas, Chang-Tai Hsieh, and Nicholas Li, "International prices, costs, and markup differences," *The American Economic Review*, 2011, *101* (6), 2450–2486.

Gutiérrez, Germán and Thomas Philippon, "Declining Competition and Investment in the U.S.," Working Paper 23583, National Bureau of Economic Research July 2017.

Hausman, Jerry A., Gregory K. Leonard, and Daniel McFadden, "A utility-consistent, combined discrete choice and count data model Assessing recreational use losses due to natural resource damage," *Journal of Public Economics*, 1995, *56* (1), 1 – 30.

Hausman, Jerry, Gregory Leonard, and J Douglas Zona, "Competitive analysis with differenciated products," *Annales d'Economie et de Statistique*, 1994, pp. 159–180.

Head, Keith and Thierry Mayer, "Gravity equations: Workhorse, toolkit, and cookbook," in "Handbook of international economics," Vol. 4, Elsevier, 2014, pp. 131–195.

Hendel, Igal, "Estimating multiple-discrete choice models: An application to computerization returns," *The Review of Economic Studies*, 1999, *66* (2), 423–446.

Hoberg, Gerard and Gordon M Phillips, "Scope, scale and competition: The 21st century firm," *Tuck School of Business Working Paper*, 2021, (3746660).

Houde, Jean-François, "Spatial differentiation and vertical mergers in retail markets for gasoline," *The American Economic Review*, 2012, pp. 2147–2182.

__ , **Peter Newberry, and Katja Seim**, "Nexus Tax Laws and Economies of Density in E-Commerce: A Study of Amazon's Fulfillment Center Network," *Econometrica*, 2023, *91* (1), 147–190.

Hsieh, Chang-Tai and Esteban Rossi-Hansberg, "The industrial revolution in services," *Journal of Political Economy Macroeconomics*, 2023, *1* (1), 3–42.

Jung, Udo, Rob Wolleswinkel, Christian Hoffman, and Adam Rothman, "Specialty Chemical Distribution-Market Update," Technical Report, The Boston Consulting Group 2014.

__ , **Stefan Scholz, Christian Hoffman, and Anna Sinemus**, "The Growing Opportunity for Chemical Distributors," Technical Report, The Boston Consulting Group 2013.

Krugman, Paul, "Scale economies, product differentiation, and the pattern of trade," *The American Economic Review*, 1980, *70* (5), 950–959.

Loecker, Jan De, Jan Eeckhout, and Gabriel Unger, "The Rise of Market Power and the Macroeconomic Implications*," *The Quarterly Journal of Economics*, 01 2020, *135* (2), 561–644.

Lukach, Carl, "Univar Presentation - 2015 Barclays Industrial Distribution Forum," 2015.

McFadden, Daniel, "Conditional logit analysis of qualitative choice behavior," 1973.

__ , "Econometric models for probabilistic choice among products," *Journal of Business*, 1980, pp. S13–S29.

Nakamura, Emi and Dawit Zerom, "Accounting for Incomplete Pass-Through," *The Review of Economic Studies*, 2010, *77* (3), 1192–1230.

Nevo, Aviv, "Measuring market power in the ready-to-eat cereal industry," *Econometrica*, 2001, *69* (2), 307–342.

Pakes, A., J. Porter, Kate Ho, and Joy Ishii, "Moment Inequalities and Their Application," *Econometrica*, 2015, *83* (1), 315–334.

Petrin, Amil, "Quantifying the Benefits of New Products: The Case of the Minivan," *Journal of Political Economy*, 2002, *110* (4), 705–729.

Petropoulou, Dimitra, *Information costs, networks and intermediation in international trade*, Centre for Economic Performance, London School of Economics and Political Science, 2008.

Pierce, Justin R and Peter K Schott, "A concordance between ten-digit US Harmonized System Codes and SIC/NAICS product classes and industries," *Journal of Economic and Social Measurement*, 2012, *37* (1-2), 61–96.

Rauch, James E. and Joel Watson, "Network Intermediaries in International Trade," *Journal of Economics & Management Strategy*, 2004, *13* (1), 69–93.

Ross, Thomas W, "Winners and Losers under the Robinson-Patman Act," *Journal of Law and Economics*, October 1984, *27* (2), 243–71.

Rossi-Hansberg, Esteban, Pierre-Daniel Sarte, and Nicholas Trachter, "Diverging Trends in National and Local Concentration," April 2020.

Rubinstein, Ariel and Asher Wolinsky, "Middlemen," *The Quarterly Journal of Economics*, 1987, pp. 581–594.

Salz, Tobias, "Intermediation and competition in search markets: An empirical case study," *Journal of Political Economy*, 2022, *130* (2), 310–345.

Smith, Dominic A. and Sergio Ocampo, "The Evolution of U.S. Retail Concentration," 2022.

Spulber, Daniel F, *Market microstructure: intermediaries and the theory of the firm*, Cambridge University Press, 1999.

Stepner, Micheal, "State Mapping Shapefiles."

Sutton, John, *Sunk costs and market structure: Price competition, advertising, and the evolution of concentration*, MIT press, 1991.

The Economist, "Business in America - Too much of a good thing," 2016.

US BEA, "Chain-Type Price Indexes for Materials Inputs by Industry," 1997.

_ , "Composition of Gross Output by Industry," 2014.

_ , "GDP By Industry," 2014.

_ , "Investment in Private Nonresidential Fixed Assets," 2014.

_ , "GDP (implicit price deflator)," 2023.

U.S. Census, "Census of Manufactures," 1992-2012.

_ , "Census of Wholesale Trade," 1992-2012.

_ , "Longitudinal Business Database," 1992-2012.

_ , "Longitudinal Firm Trade Transaction Database," 1992-2012.

_ , "Commodity Flow Survey," 1993-2012.

_ , "A Profile of U.S. Importing and Exporting Companies 2011-2012," 2014.

_ , "Exports and Imports by NAICS Commodities," *USA Trade Online*, 2022.

Villas-Boas, Sofia Berto, "Vertical relationships between manufacturers and retailers: Inference with limited data," *The Review of Economic Studies*, 2007, *74* (2), 625–652.

Wollmann, Thomas G, "Trucks without bailouts: Equilibrium product characteristics for commercial vehicles," *American Economic Review*, 2018, *108* (6), 1364–1406.

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.[22] This dataset is central to the analysis and provides administrative data on operating costs, merchandise purchases, total sales, goods sold, and buyer types.[23] 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

[22]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.

[23]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. (2017) 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 A1 (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 A1, 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 A1.

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

Figure A1: 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 about filling out this form?

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.)

0600
Merchant wholesaler, buying and selling on own account
- 12 ☐ Importer
- 13 ☐ Exporter
- 11 ☐ Merchant wholesale distributor or jobber
- 14 ☐ Own-brand importer and marketer
- 20 ☐ **Manufacturers' sales branch or office**

0600
Agent, broker, or commission merchant
- 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**

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firms that participate in multiple NAICS wholesale sectors. I allocate imports proportionally by the cost of goods sold between the multiple sectors.

A.3 Outside Share (Direct Sourcing) Data Construction

Both the summary statistics in Section 1 and the estimation routine in Section 3, 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. All prices for manufactured goods are deflated by the BEA series for "Chain-Type Price Indexes for Materials Inputs"

Domestic absorption 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 A1: **Number of Source Countries and Products by Market Share Quantile**

Multi-location Firms by Quantile			
Share	Year		
Quantile	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

Multi-location Firms by Quantile			
Share	Year		
Quantile	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

A.4 Detailed Wholesaler Statistics

Tables A1-A3 highlight additional wholesaler statistics by wholesaler size rank. These are aggregates across all wholesalers.

A.5 Distribution of Buyer Types

Data on the mass of buyer types m_j comes from the Commodity Flow Survey, combing purchases from wholesalers and manufacturers. Product codes (SCTG classifications) from wholesaler shippers (with NAICS Codes) are used to convert shipments from manufacturer NAICS codes to wholesaler NAICS codes.

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

Fact 7 *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 A2; Downstream buyers have slightly increased the average size of their orders over time.[24]

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

Table A2: **Market Shares and Import Probabilities by Market Share Quantile**

Multi-location Firms by Quantile			
Share	Year		
Quantile	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%

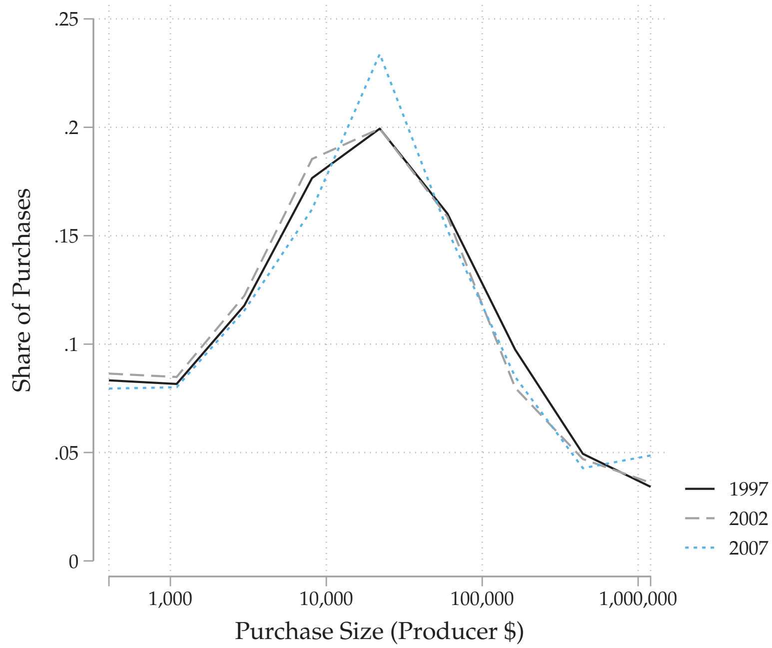
Multi-location Firms by Quantile			
Share	Year		
Quantile	1997	2002	2007
0-10	5%	6%	8%
10-20	6%	9%	10%
20-30	9%	10%	13%
30-40	11%	13%	16%
40-50	13%	16%	19%
50-60	15%	18%	22%
60-70	19%	22%	26%
70-80	23%	26%	30%
80-90	27%	31%	36%
90-99	39%	42%	48%
99-99.5	60%	62%	67%
99.5+	74%	78%	81%

Table 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%

Multi-location Firms 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

Figure A2: **Distribution of Buyers**



Figures in real 2007 dollars.

A.6 Geographic Differentiation

In lieu of a continuous distance measure, this project discretizes downstream buyer location by U.S. state[25], 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 A3 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 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 3 and 4 are largely consistent and the aggregate estimates in Section 5 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

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

Figure A3: **U.S. Census Regions and Divisions**

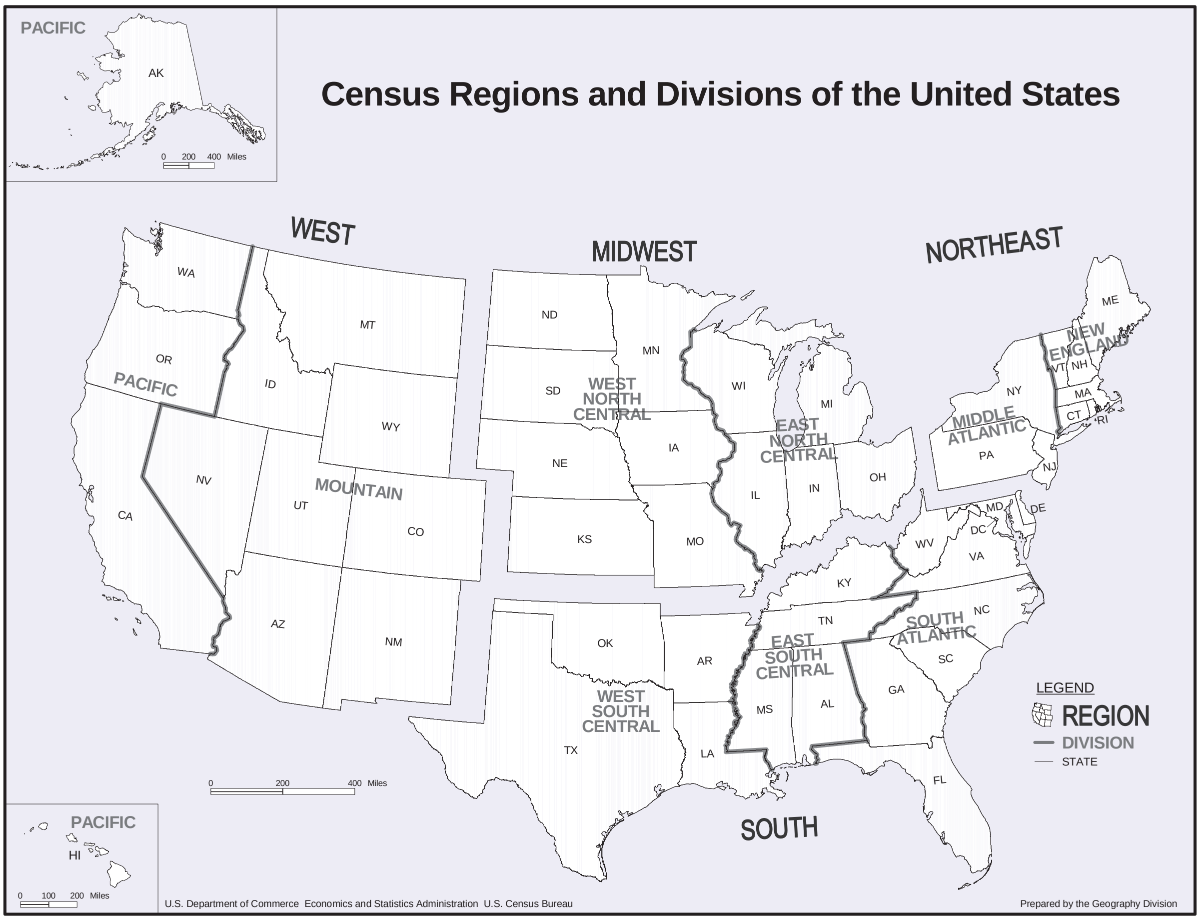
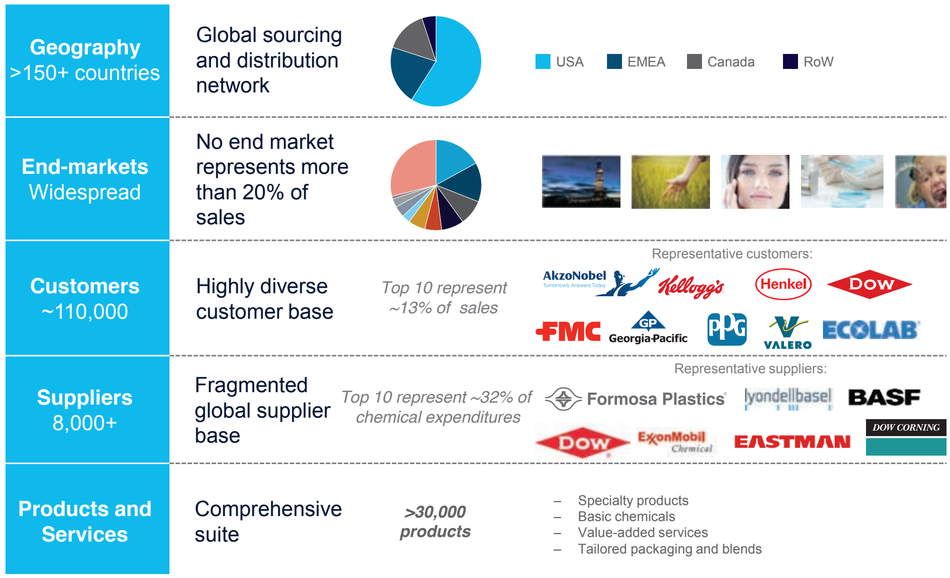


Figure A4: **Univar Presentation at 2015 Barclays Industrial Distribution Forum**



Source: Univar Investor Relations

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 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.[26]

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

[26]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.

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 A4. 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.[27]

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, 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.[28]

B Demand Systems

This section provides micro-foundations for the indirect downstream profit functions used in Section 2. 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).[29]

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 $F(\cdot)$.

[27] Univar's business plan is summarized in a slide presented as Appendix Figure A4.

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

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

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:

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

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 while allowing 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 $(\mu \cdot mc)^{-\sigma}$.

Revisiting fixed cost f, expected profits are:

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

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.[30] 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 $\mathbb{E}(mc)$ falls, then the mass of M_q will shift upwards. In my model $\mathbb{E}(mc)$ is directly related to $\mathbb{E}(\bar{U})$, the expected utility of indirectly sourcing from a 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 the 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.

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

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 (9) for any wholesaler selling to a buyer purchasing q units produces:

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

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:

$$\log R = (1-\rho)\log p + \log\xi + \log\frac{Y}{P^{1-\rho}} \tag{12}$$

Now since revenues are related to market share s and total market size Y as $R = sY$, equation (12) 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 $\alpha = (1-\rho)$. 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 shows that 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 Bresnahan et al. (1997) Demand Structure

Following McFadden (1980) and Bresnahan et al. (1997), I assume the distribution of the vector of $\overrightarrow{\epsilon}$ for a given buyer (i,j) is drawn from a "principals of differentiation" (PD) nested logit model.

Formally ϵ is drawn from the distribution $F\left(\overrightarrow{\epsilon}_{i,j}\right) = exp\left(-G\left(e^{-\epsilon_{i,j,0}},...,e^{-\epsilon_{i,j,W,I}}\right)\right)$, where $G(\cdot)$ takes the functional form:

$$G\left(e^{\vec{\delta}_{i,j}}\right) = e^{\delta_{i,j,0}} + \alpha_o\left[\sum_{i\in\mathcal{I}}\left(\sum_{w\in\mathcal{S}_i} e^{\delta_{w.i,j,}/(1-\sigma_i)}\right)^{1-\sigma_i}\right] + \alpha_n\left[\sum_{n\in\mathcal{S}_n}\left(\sum_{w\in\mathcal{W}} e^{\delta_{w,i,j}/(1-\sigma_n)}\right)^{1-\sigma_n}\right]$$

where weights $\alpha_i = \sigma_i/\left(\sigma_i+\sigma_n\right)$ and $\alpha_n = 1-\alpha_i$. Set $\mathcal{S}_i$ includes all wholesaler-source combinations of of variety i and set $\mathcal{S}_n$ includes all wholesaler-source combinations from wholesaler classification n, which correspond to different types of multi-variety wholesalers. The parameter $\sigma = (\sigma_i, \sigma_n)$ must lie inside the unit circle. As either σ goes to zero, the corresponding weight goes to zero, rendering that dimension of product differentiation irrelevant. The first σ_i denotes the correlation of ϵ between direct sourcing, indirectly sourcing from high-income foreign countries, and indirectly sourcing from low-income foreign countries. This allows for products sourced from abroad to be imperfect substitutes for domestically sourced products. The second σ_n denotes the correlation of ϵ of multi-source and single-source wholesalers. This allows for domestic products sourced by globalized wholesalers to be imperfect substitutes for products sourced by domestic-only wholesalers.

B.5.2 Addressing market size

While the structure above allows for significant market segmentation, administrative dataset may still highly limited in available attributes. Markups are heavily reliant on market definitions. In practice equation 4 requires parameter ψ. Empirically this works as a wholesaler-variety shifter $\psi_{w,i}$

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

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

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

Identification of this term leverages administrative data. Without this term, estimation of all other demand side parameters is marginally changed.

This step is crucial for matching aggregate data on accounting markups from Table (1). A typical wholesale NAICS code has 4,000 firms. Even with the nesting structure and segmented geographies, market concentration is minimal (see Table (2)), with average HHI measures only increasing from 65.5 to 104.7. With low concentration, competition will realize markups as a function of the demand elasticity and not of competition. To reconcile the accounting markups and concentration data in the underlying data and a model without time-varying demand elasticities, along with the broad nature of NAICS codes, markets must be segmented, using ψ. This parameter simply is the proportion of firms that must compete against each other to rationalize changes in accounting markups over time. As the level of markups without variable market power is pinned down by α, this moment helps pin down effective market size ψ from the changes in markups over time.

Alternatively we could do away with cost shifters to identify the price elasticity and simply use accounting markups to estimate α, as is done in international trade and macroeconomics. But this would produce time-varying estimates of α and complicate measurements of downstream valuation of quality over time.

To illustrate the importance of this step, I conduct a series of Monte Carlo simulations with a simplified set up. I simulate N firms. I see the price, a cost-shifter, and the total sales of all N firms. In addition, I see the aggregate, sales-weighted markup in the market.[31] Crucially, the

[31] This is a simplification from the paper, where I assume that I can only see the aggregate markup change over

Table A4: Monte Carlo Simulation for ψ

	Simulation Type			
	1	2	3	4
	Full Data	Single Market S=1	Multiple Markets S	Estimated S
Panel A: $N = 500$, $S = 10$, $\psi = 0.10$				
Markups	2.61	2.96	2.62	2.60
Markup Error (%)		13.57	0.43	-0.11
Markets (S)	10.0	1.0	10.0	10.4
Implied ψ	0.1	1.0	0.1	0.1
Panel B: $N = 500$, $S = 1$, $\psi = 1.0$				
Markups	2.96	2.96	2.96	2.96
Markup Error (%)		0.00	0.00	0.00
Markets (S)	1.0	1.0	1.0	1.0
Implied ψ	1.0	1.0	1.0	1.0

econometrician may not see how many markets S there are, or which firms belong to which market. I have consumer valuation $\delta_i = -\alpha \cdot p$, where p is drawn from a log-normal distribution with mean 0 and $\sigma = 3$ and where the consumer distaste for price is $\alpha = 3$.

In Table (A4), I conduct four types of simulations and standard IC regressions over 50 runs. First, I assume complete knowledge of which firms are in which markets S. Second I assume that all firms compete in the same market and that $S = 1$. Third I assume I know how many markets S there are. Fourth, I estimate $S = 1/\psi$ using the method above, minimizing the difference between the implied markup and the observed aggregate markup. I do this in Panel A with $N = 500$ and $S = 10$ and then in Panel B with $N = 500$ and $S = 1$. Panel A shows the importance of using ψ when I lack precise data on the makeup of market or market segments. In column two, markups are off by 14%. In column three and four, markups are within 1%. In the last column, I relatively accurately recover ψ and S. Panel B, shows that if this facet is not important, then my estimation will still recover the true parameters.

B.5.3 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.[32]

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:

$$\log s_{w,i} / \log s_0 = \delta_{w,i} + \sigma_n \log s_{w,i|n}, \tag{13}$$

time, however the same logic carries though.

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

where s_0 represents the share of the outside option, sourcing directly from a manufacturer.[33]

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

$$\log s_{w,i} = \log \sum_{j\in\mathcal{J}} \left[s_{0|j} \cdot s^{\sigma}_{w,i|j,n} \cdot \exp\left(\delta_{w,i,j}/\left(1-\sigma_n\right)\right)\right] b_j \tag{14}$$

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 b_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 (14) is operationalized with one level of nests as:

$$\begin{aligned} \xi_{w,i} = \log s_{w,i} - \log \sum_{j\in\mathcal{J}} \left[s_{0,j}\left(\vec{\delta}\right) \cdot s^{\sigma}_{w,i|j,n}\left(\vec{\delta}\right) \cdot \exp\left(\frac{\tilde{\delta}_{w,i,j}}{1-\sigma}\right)\right] b_j \\ - \left(\alpha \log p_{w,i} + \beta_q \log q_j + \sum_{l\in\{state,region\}} \beta_l \mathbb{I}_{l_w=l_d} + \mathbf{x}_{w,i}\alpha_{\mathbf{x}} \right) \end{aligned} \tag{15}$$

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 (14), the vector of parameters for unobservable coefficients is set such that $\beta_j = \beta$ 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 3, $\xi_{w,i}$ 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.

[33] 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.

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.

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

$$s_{W|q} = \sum_{w \in \mathcal{W}} \sum_{i \in \mathcal{I}} \sum_{j \in J} s_{w,i|j} b_j \mathbb{I}\{q_j = q\},$$

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 $s_{w,i|j}$ and buyer weights m_j. Additionally, $\mathcal{W}$ represents the set of all wholesalers, $\mathcal{I}$ represents the set of wholesaler varieties, and $\mathcal{J}$ represents the set of buyer types j . Data on b_j in equation (3) comes from the Commodity Flow Survey, which details the share of purchases by location and quantity.

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

$$s_{W|l} = \sum_{w \in \mathcal{W}} \sum_{i \in \mathcal{I}} \sum_{j \in J} s_{w,i|j} b_j \mathbb{I}\{l_j = l_w\}$$

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

I denote the vector of moments produced by the data as $\mathbf{m}_{data}$ and the estimated moments as $\mathbf{m}(\theta)$.

Correlation Coefficients Estimation uses instruments to identify the nested logit correlation parameters σ. Buyers have similar preferences, but different choice sets, due to regional variations in wholesaler networks. Following the logic of Berry et al. (1995), a wholesaler's entry choices are made before quality $\xi_{w,i}$ 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:

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

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 at the regional and state level. I collect these instruments as Z_2.

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

$$\hat{\theta} = \arg_{\theta} \min G(\theta)' W G(\theta), \tag{16}$$

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, $\delta_{w,i}(\sigma) = \alpha \log p_{w,i} + x_{w,i}\beta_{\mathbf{x}} + \xi_{w,i}$, estimation can be simplified. Thus conditional on σ, the GMM routine can use the estimation:

$$\hat{\beta}_{IV}(\cdot) = \left(X'Z\Phi Z'X\right)^{-1} \left(X'Z\Phi Z'X\right)^{-1} \delta_w(\sigma, \psi, \beta_l, \beta_q)$$

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

$$J_w(\sigma, \psi, \beta_l, \beta_q) = \left[\delta_w(\sigma, \psi, \beta_l, \beta_q) - x\alpha_w(\sigma, \psi, \beta_l, \beta_q)\right]' Z\phi Z' \left[\delta_w(\sigma, \psi, \beta_l, \beta_q) - x\beta_{\mathbf{x}}(\sigma, \psi, \beta_l, \beta_q)\right].$$

B.5.4 Demand Estimation

Formally, I identify the demand parameters α, β, ψ 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 $M(\alpha, \beta, \psi, \sigma)$ 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 $(\alpha, \beta, \psi, \sigma)$ there is at most one vector ξ such that $s_{w,i}(\xi_{w,i}, \alpha, \beta, \psi, \sigma) - s^0_{w,i} = 0$ for all $(w,i) \in \mathcal{W} \times \mathcal{I}$.*

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

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

Table A5: **Downstream Firm Choice (2nd Demand Stage)**

	(1) OLS	(2) Partial IV (Price)	(3) Partial IV (σ)	(4) Full IV
log (Price)	-.153	-2.019	-.423	-1.791
	(0.0038)	(0.0197)	(0.0048)	(0.0203)
σ_i (Varieties)	.92	.851	.76	.694
	(0.0006)	(0.001)	(0.0018)	(0.0018)
Controls	Number of Varieties, Number of Warehouses			
Fixed Effects	Year $\times$ 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.

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 $s_{w,i}(\cdot)$ is identified. 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 A5 reports results from the estimation of a simplified model of downstream buyer choices from Equation 16. 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.

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.

Table A6: **Single-Level Logit Downstream Firm Choice Estimates**

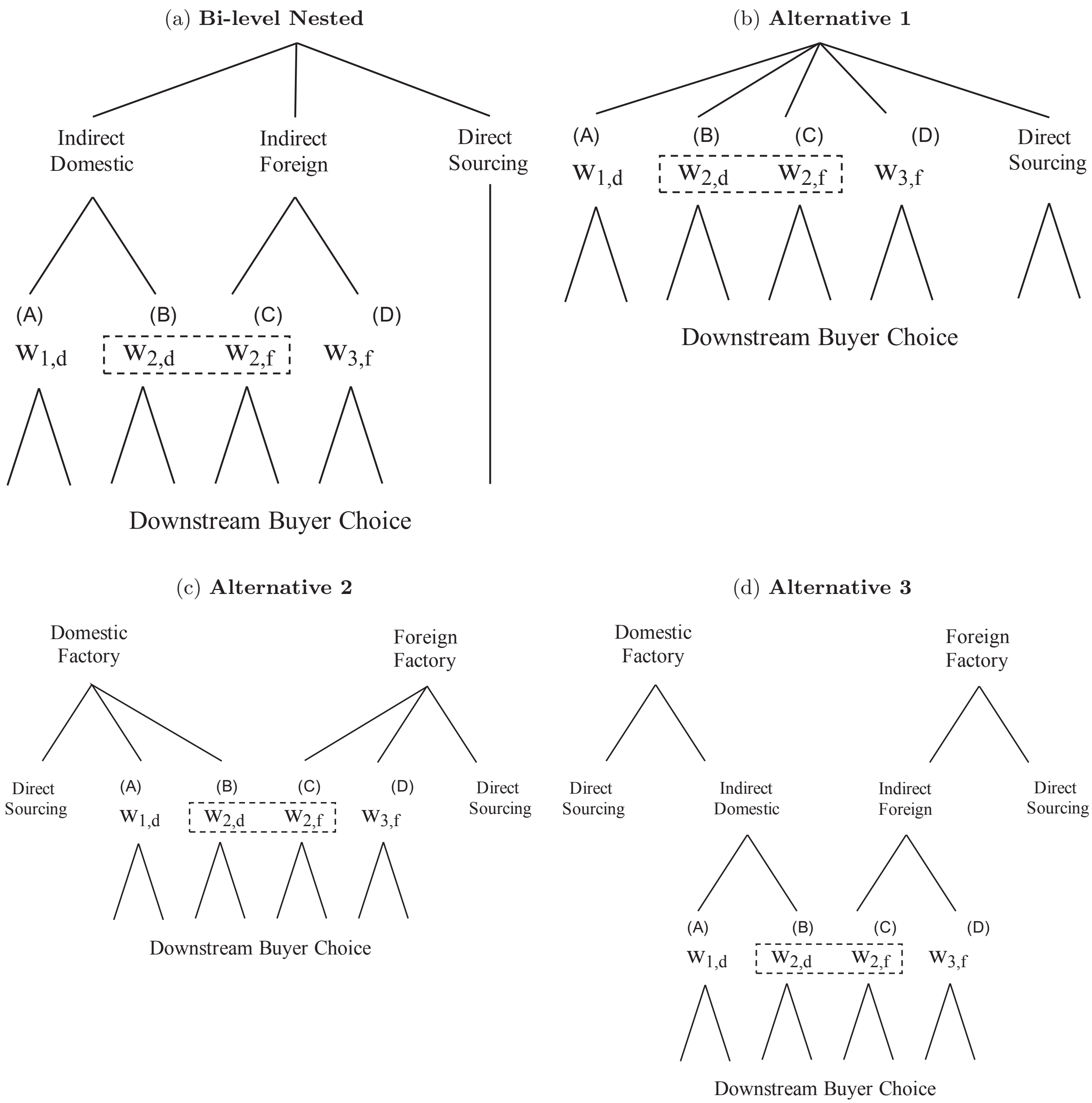
	est/se		est/se		est/se
log (price)	-2.507	Within State Shipment	3.335	log {Shipment Size}	-.314
	(0.023)		(0.145)		(0.054)
log (# Warehouses)	.197	Within Region Shipment	1.356	International Operations	.075
	(0.005)		(0.253)		(0.004)
σ	.636	South Imports × log (HS lines)	.695	North Imports × log (HS lines)	.73
	(0.055)		(0.01)		(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.

Multi-level Logit Demand In Figure A5, 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 A6. In general, this simplified model produces estimates 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

Figure A5: **Downstream Buyer Sourcing Choice Trees**



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.

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.

Table A7: **Industry-Level Downstream Firm Choice Estimates**

	(1) mean/sd/sem	(2) mean/sd/sem	(3) mean/sd/sem
log (Price)	-1.58	-2.89	-1.45
	[3.66]	[5.93]	[3.75]
	(0.49)	(0.79)	(0.50)
σ_i (Varieties)	0.87		0.89
	[0.40]		[0.44]
	(0.05)		(0.06)
σ_n (Wholesaler Breadth)		0.51	0.81
		[0.34]	[0.70]
		(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.

Parameter Heterogeneity In Table A7 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, b_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, and respectively reflect the price sensitivity and substitution elasticities.

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

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

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 $i \neq i'$:

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

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:

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

D.1 Linking the Model to Data: Multi-Variety Wholesalers

I use a two-step estimator. The underlying data only provides true prices for wholesalers that source a single variety. Prices for multi-variety wholesalers are reported in aggregate. Estimation first recovers cost parameters γ from single-source wholesalers, then recovers marginal costs for all wholesalers. I then re-run estimation across all firms.

The underlying data only provides prices for wholesalers that source a single variety. Prices for multi-variety wholesalers are reported in aggregate. In demand estimation, the instrumental variable strategy can recover price elasticities α, solving the error-in-variables issue for prices. Using summing restrictions, I recover parameters for multi-variety wholesalers that source both domestically and 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 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-variety wholesalers on $c_w(\cdot)$.

Generalizing away from downstream buyer heterogeneity, this produces the following relations governing prices and costs[34]:

$$\bar{p}_w = M_{w,D}p_{w,D} + M_{w,F}p_{w,F} \tag{17}$$

$$p_{w,D} = \mu_{w,D}c_{w,D} \tag{18}$$

$$p_{w,F} = \mu_{w,F}c_{w,F}. \tag{19}$$

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 (6) as:

$$\log c_{w,F} - \log c_{w,D} = \tilde{\mathbf{x}}_{w,F}\gamma_F - \tilde{\mathbf{x}}_{w,D}\gamma_D \tag{20}$$

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

Equations (17) - (20) can be combined to solve for $p_{w,D}$, $p_{w,F}$, $c_{w,D}$ and $c_{w,F}$. This technique generalizes to the three high-level varieties used in the estimation.

E Fixed Cost Details

I can compute this for every observed type in the data, however even with the limited data available, I may effectively only observe a few draws for ξ and ν. In particular, the locations of warehouses and different importing configurations makes a very large state space. As an alternative, I aggregate

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

the state space to create ten options. For each wholesaler w in the data, I compute:

$$\pi_w(\mathbf{x}_w)\,|\mathcal{W} \quad \text{and} \quad \pi_w(\mathbf{x}_w)\,|\mathcal{W}' \tag{21}$$

where $\mathcal{W}$ is the set of wholesalers observed and $\mathcal{W}'$ is this set, plus an identical copy of the wholesaler w. I then aggregate and average each of these values across all firms to the ten aggregate observed wholesaler types in Table 8. The table displays estimated sets of upper and lower bounds and are not confidence intervals.

These bounds are empirically implemented by simulating counterfactual net variable profits $\pi_{\mathbf{x}}$ for each wholesaler configuration $\mathbf{x}$. 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.[35]

Table 8 considers the lower and upper bounds of fixed entry costs $E_{\mathbf{x}}$ for various wholesaler configurations $\mathbf{x}$. While the underlying calculations are done by wholesaler market and industry, displayed results are averaged across markets. These results are further binned by broad groupings $\mathbf{x}'$. For clarity, wholesalers that only participate in international trade are combined with wholesalers that participate in both domestic and international trade.[36]

F Factory-less good manufacturers

Recent research (Bernard and Fort, 2015; Bernard et al., 2017) 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. (2017). 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

[35] 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. Selection of firms into 'positive' cells is a very real and possible problem. Thus I bin cells and average across the observed number of firms. Counterfactuals will only consider aggregate bins with positive firm counts.

[36] This binning does introduce potential compositional issues within each bin. Over time, the types of firms do change; firms in the biggest bin are on average 'larger' over time and firms in the domestic and international bins carry more product lines. This is reflected in the higher estimated variable profits and thus estimated entry costs.

sample of wholesalers and treated as manufacturers. A possible example could be the electronic firm Apple, that markets its own products but outsources manufacturing.[37] In addition, the analysis also excludes manufacturer owned sales and branch offices. These locations exist to distribute 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 A2 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.[38]

G Endogenous Market Size

In the main model, the number of buyers of type j: $B_j \equiv B \times b_j$ is exogenous. This section endogenizes this aspect, to better line up with the macroeconomic and trade literatures.

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, one could expect an increase in the overall downstream market size. I 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.[39]

The number of purchases of type j varies with the set of available wholesalers $\mathbf{x}$. This allows for

[37] 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.

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

[39] 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.

an increase in the number of purchases following increases in aggregate wholesale supplier quality.

$$b_j \quad = \quad B\left(\mathbf{x}\right)$$

This relationship is parameterized by:

$$B_j = A_j \left(\underbrace{\sum_{g \in T} \left(D_g\right)^{1-\sigma}}_{D_W} \right)^{\phi} \tag{22}$$

Where B_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 I only vary the quality and quantity of wholesalers, I normalize the valuation of buying from a manufacturer to 1. Denoting the term within brackets as D_w and taking logs:[40]

$$\log B_j \quad = \quad \phi \log\left[D_W\right] + A_j. \tag{23}$$

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

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

Thus I obtain the relationship:

$$\log B_j = -\phi \log\left[s_{0|j}\right] + A_j. \tag{24}$$

G.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 (24), reproduced below:

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

This equation shows that the relative value of wholesalers compared to direct sourcing is entirely captured by aggregate wholesaler market shares.[41] 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

[40] 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 $\exp\left(\delta_{w,j}\right)$, $\left(D_W\right)^{\phi}$ is defined up to a multiplicative constant.

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

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 $B_{c,q,l}$ as the total observed downstream purchases and $S^W_{c,q,l}$ as the aggregate wholesaler purchase share for product c, in region l, where the shipment size is q units, I estimate the following relationship:

$$\log B_{c,q,l} = -\phi \log \left[1 - S^W_{c,q,l}\right] + \lambda_{c,l} + \lambda_{c,q} + \lambda_{l,q} + \lambda_{c,q,l}. \qquad (25)$$

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 $\exp(\lambda_{c,l} + \lambda_{c,q} + \lambda_{l,q} + \lambda_{c,q,l})$, 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 $E[X_D \lambda_{c,q,l}] = 0$, 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 B 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.[42]

G.2 Market Size Results

Estimates for the elasticity of the downstream market size with respect to expected utility from wholesaling are reported in Table A8. 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

[42] 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 A8: **Market Size Estimation (1st Demand Stage)**

	1	2	3	4
Elasticity $-\ \phi$	0.234	0.174	0.248	0.262
	(0.020)	(0.045)	(0.017)	(0.029)
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).

(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. If implemented in the main estimation, these estimates imply about 20% higher welfare gains - within the same order of magnitude.

H 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 $x_{w,i}$, all attributes are subsumed in a single vertical quality dimension ξ. Therefore now:

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

H.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 $\xi_{w,i}$:

$$\max_{\xi=[\xi_{w,D},0,0]} \pi_w(\xi) - f_w(\xi) \tag{26}$$

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:

$$\max_{\xi=[\xi_{w,D},\xi_{w,F_H}]} \pi_w(\xi) - f_w(\xi) \tag{27}$$

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:

$$\frac{d\pi(\xi)}{d\xi} = \frac{df(\xi)}{d\xi} \tag{28}$$

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 $f(\cdot)$, 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?

H.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 $\xi(\mathbf{x})$. In this case, all fixed effects and ξ are all subsumed by the new measure $\xi(\mathbf{x})$. $\xi(\mathbf{x})$ is no longer a residual, it is a complete measure of quality. Regardless, the coefficient α can be identified as a cost shock hits a particular firm following their choice of $\mathbf{x}$ and $\xi(\mathbf{x})$. In terms of β_q, β_l, and σ, they are identified from aggregate moments. As α 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 (28). For any given company configuration $\mathbf{x}$, assume that the fixed costs of market positioning are:

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

The function $f_w^x(\xi)$ measures the cost of investing in quality ξ for wholesaler of configuration x. There are scalar fixed costs E_x and two parameters, χ_1^x and χ_2^x. 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 x seeks to maximize profits $\pi_w(\xi)$ net of investment $f_w^x(\cdot)$. As both $\pi_w(\cdot)$ and $f_w^x(\cdot)$ are smooth linear functions, computation of the optimal profits requires solving the firm's first order conditions. Marginal investment costs are:

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

and marginal profits stem from the first derivative of equation (5) 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:

$$\frac{d\pi_w(\xi)}{d\xi}=\frac{df_w^x(\xi,\eta)}{d\xi}=\left(\chi_1^x\eta_{w,\xi}\right)\exp\left(\chi_2^x\xi\right). \tag{29}$$

Taking the logarithm of this equation produces the following relationship:

$$\log\frac{d\pi_w(\xi)}{d\xi} \quad = \quad \log\chi_1+\chi_2\xi+\log\eta_{w,\xi}. \tag{30}$$

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 (9). 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 $\mathbf{x}$ before investing in ξ, thus the number of firms of type $\mathbf{x}'$ 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 (10) 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 $E\left[\pi_w\left(\xi\right)\right]$. For simplicity, I omit the expectation in what follows.

Investment function $f_w^x\left(\cdot\right)$ is identified up to some fixed entry constant E_x. Following estimation of χ_1^x and χ_2^x , this step generates the distributions $G_\eta^x\left(\cdot\right)$ for investment shocks of $\eta_{w,\xi}$. I denote ξ_w^* as the optimal choice for firm w with investment cost shocks η.[43]

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

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

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

Note that $f\left(\cdot\right)$ is only identified up to some constant E_x, $\bar{f}\left(\cdot\right)$ subtracts this constant. The function $n_x\left(\eta\right)$ is used in the next stage to identify this entry cost E_x. For tractability, I assume that fixed cost E_x 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.[44]

[43]The chosen functional form for $f_w^a\left(\cdot\right)$ and the estimation equation (30) imply that $\chi_1\eta$ is greater than zero, thus as long at χ_2 is greater than zero, $f_w^a\left(\xi^*\right)$ will be always greater than zero.

[44]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 $\pi'\left(\xi\right) = F'\left(\xi\right)$. 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.