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

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Half of all transactions in the $6 trillion market for manufactured goods in the United States were intermediated by wholesalers in 2012, up from 32 percent in 1992. Seventy percent of this increase is due to the growth of "superstar" firms—the largest 1 percent. 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. (*JEL* D22, D24, F14, L15, L60, L81)

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 information technology (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

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[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.

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 roles of globalization and 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 percent per year in procurement costs as a percentage of purchase value ($442–449 billion). However, due to large fixed costs, the largest 1 percent of wholesalers were able to increase their overall market shares and their variable profits.

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 (*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

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

[3] For example, see Azar, Schmalz, and Tecu (2018); De Loecker, Eeckhout, and Unger (2020); Gutiérrez and Philippon (2017); and Barkai (2020).

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, Levinsohn, and Pakes (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 that 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 (1999) 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, Grazzi, and Tomasi (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, Khandelwal, and Wei 2011; Felbermayr and Jung 2011; Crozet, Lalanne, and Poncet 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.

I. 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 are defined by the US Census Bureau 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" (see https://www.bls.gov/iag/tgs/iag42.htm).

[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.

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 buy directly either 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.

A. *Wholesaler Case Study*

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

In the industrial chemical market, wholesalers source varieties from various chemical manufacturer and ship to a convenient loading bay for a markup over the manufacturers' price. This trade-off 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 percent of the North American market

[6] I exclude own-brand marketers to separate firms that design, market, and sell but 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 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 percent of downstream buyers with small purchases (under €100,000) sourced goods indirectly through wholesalers, while larger purchasers sourced directly from a manufacturer (Elser, Jung, and Willers 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 is 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.

B. *Data Description*

I use administrative data from the United States 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 Longitudinal Business Database. I focus on 1997–2007, as firm-level data from 1992 and 2012 are not comparable due to industry reclassifications.[9] All data are in 2007 dollars using the Bureau of Economic Analysis (BEA) price deflator 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) six-digit industries. I look at wholesalers independent of manufacturing, and collect details on aggregate

[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 do not only value flexibility and speed of delivery, which are highly correlated with geographic proximity (Jung et al. 2013).

[9] 1992 data use microdata; 2012 data are estimated using publicly available reports on aggregate values.

sales, physical locations, operating expenses, and imports. Survey data provide statistics on the distribution of the origins, destinations, and sizes of shipments across wholesalers and manufacturers. See Supplemental 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 lack these features. I preview the empirical fixes here, with full implementation details in Section III.

Market Definition.—Aggregate studies of market power typically treat administrative data categories as distinct markets. For example, De Loecker, Eeckhout, and Unger (2020) primarily use NAICS two-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 six-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 are often limited on the identities of customers and detailed products, I turn to accounting data, which are 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.

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.

This data on buyer heterogeneity links directly to the market definition issue above. As noted in Ganapati (2021) and Rossi-Hansberg, Sarte, and Trachter (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.

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

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) and Hausman, Leonard, and McFadden (1995), I assume that these preferences take an extreme value distribution and identify the distribution using variation in market participant characteristics.

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

In wholesaling, data are 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 it 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 mismeasure price. The empirical strategy will rely on an instrumental variable strategy to account for accurately estimating demand elasticities. In counterfactuals, this mismeasurement 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 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).

[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 Supplemental Appendix B.3.

C. *The Evolution of Wholesaling*

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

First, the data show 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.

Aggregate Wholesale Trends.—Manufactured products are shipped via one of two modes, (i) directly from a manufacturer to a downstream user or (ii) 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 United States, as well as the share distributed by the wholesale industry from 1992 to 2012. In 1992, wholesalers accounted for the distribution of 31.7 percent of all manufactured goods to downstream users. In 2012, they accounted for 47.4 percent of all such goods.

Consistent market level data are available for 56 wholesale markets defined at the NAICS six-digit level. While there is heterogeneity across NAICS six-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 percent to 54.9 percent from 1997 to 2007. Averaging across markets, the market share similarly increased from 45.1 percent to 52.3 percent.

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.

$$\begin{aligned} \textit{wholesale share}_{i,t} = & \underset{(0.01)}{0.33} + \underset{(0.01)}{0.05} \times \mathbf{1}\{2002\} + \underset{(0.02)}{0.09} \times \mathbf{1}\{2007\} \\ & + \lambda_i + \epsilon_{it}. \end{aligned}$$

Regressors $\mathbf{1}\{t\}$ are dummy indicators by years, and λ_i is a fixed effect for commodity type i. 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.

Table 1—Aggregate and Market-Level Statistics

	Year				
	1992	1997	2002	2007	2012
All domestic manufactured goods purchases (in billions of dollars 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 (*in billions of dollars*)					
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%	
Wholesaler, from low-income sources		2.5%	3.5%	5.4%	
Wholesaler, 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%	
Wholesaler, from low-income sources		3.0%	4.4%	6.7%	
Wholesaler, 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 percent of distribution from agricultural or natural resource industries are excluded. As some markets include partial use of nonmanufactured 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.

In most demand systems with normal demand curves or elasticities, an increase in output or share can imply either 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 II 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) show 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 the distribution of goods sourced in the United States as well as those sourced abroad. In 1997, 38.2 percent of domestic deliveries in the average sampled market were conducted by wholesale firms with product varieties sourced in the United States. In 2007, that share increased to 41.4. percent. Similarly, in 1997, 6.9 percent of domestic deliveries where conducted by wholesale firms with varieties sourced from abroad. By 2007, that share increased to 11.0 percent. 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 an implied aggregate markup increase from 9.3 percent to 13.5 percent (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 percent to 12.7 percent (1.092 to 1.127).

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

$$\log(\textit{accounting profit rate}_{i,t}) = \underset{(0.03)}{1.83} + \underset{(0.05)}{0.31} \times \mathbf{1}\{2002\} + \underset{(0.05)}{0.48} \times \mathbf{1}\{2007\} + \lambda_i + \epsilon_{it}.$$

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

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 nonprice attributes have significantly improved, with domestic distribution and international varieties increasing.

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

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%
HHI	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 subvarieties measured at the HS-10 level. Prices and average costs computed averaging over each of the 56 markets.

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 percent to 22.9 percent, and increased the number of distributed foreign product lines at the Harmonized System (HS-10) ten-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 percent to 23.2 percent, and distributed varieties increased from 3.83 to 6.43. While the increase in international varieties speaks only to wholesalers improving direct sourcing from abroad, the increase in domestic distribution facilities speaks to improvements for all types of sourcing. 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 nonprice attributes. A change in wholesaling technologies allows 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.

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 percent 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 ninety-ninth percentile of a sector by sales controls nearly 1 percent of the national market, a share hundreds of times larger than the smallest wholesaler. In aggregate, such large firms had a 20.2 percent market share in 1997, rising to 26.7 percent in 2007. The wholesalers in the bottom ninetieth percentiles saw their aggregate market shares fall from 10.6 percent to 9.8 percent.

Equally important are intertemporal trends across wholesaler characteristics. The ninety-ninth percentile of wholesalers increased their aggregate market shares while increasing the average number of imported product subvarieties from 98.3 to 142.9 and the number of distribution locations from 9.5 to 17.8. In contrast, wholesalers in the bottom ninetieth percentiles only increased the number 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 Supplemental 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 indicate that the smallest 90 percent 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 (HHI), are low, such measures may obscure downstream buyer market segmentation and mismeasure market power.

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 of 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 to retailers and downstream producers. This fact is illustrated in Table 3. Wholesalers conduct 54.2 percent of sales within the same state, while manufacturers only do so for 32.3 percent 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

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%

Note: 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($)	$'000s	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 sums to 1.

worth $1,000 or less in producer prices account for 14.9 percent of total wholesaler shipments, but only 3.9 percent of manufacturer shipments. In contrast, shipments of over $1.2 million account for only 1.3 percent of wholesaler shipments, but 9.5 percent 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 Supplemental 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]

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 that the types of purchases that wholesalers specialize in increased, but there is little evidence of that. If anything, the types of purchases that 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

[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.

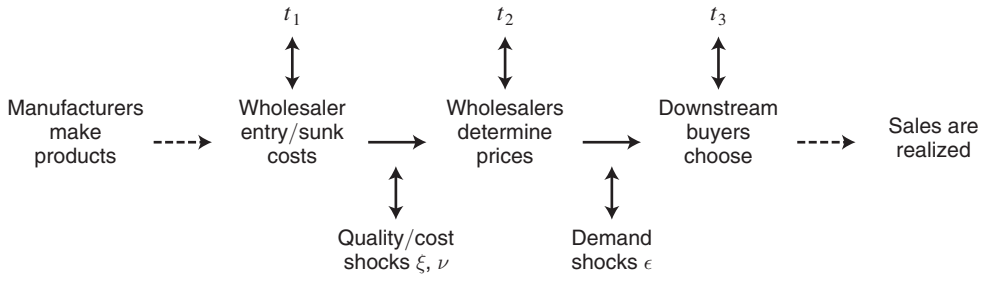

FIGURE 1. MODEL TIMING

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.

II. 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 five-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 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.

A. *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 IB 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 either sources with 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

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

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 scale purchasing economies (separate from scale

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

economies in wholesaling itself). This directly links to the last fact in Section I 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:

$$\underset{(w,s)\in\mathcal{W}\times\mathcal{S}}{\operatorname{argmax}} \left\{0, \delta_{j,w,i} + \epsilon_{j,w,i}, \ldots, \delta_{j,W,I} + \epsilon_{j,W,I}\right\}. \tag{2}$$

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 both wholesaler and buyer attributes:

$$\delta_{j,w,i} = \alpha \log p_{w,i} + \mathbf{x}'_{w,i}\beta_j + \xi_{w,i}.$$

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 $\mathbf{x}_{w,i}$ and vary on buyer preferences β_j. The last term $\xi_{w,i}$ captures residual wholesaler attributes.

Idiosyncratic Valuation: Following McFadden (1980) and Bresnahan, Stern, and Trajtenberg (1997), the distribution of the vector of ϵ for a buyer is drawn from a "principals of differentiation" 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 to a wholesaler that only sources domestically. The parameter $\sigma = (\sigma_i, \sigma_n)$ measures these two effects within $\epsilon_{j,w,i}$. See Supplemental 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 do 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. Mismeasured or inaccurate market definitions will skew attempts to gauge market power. The use of administrative data further complicates this; wholesaler data appears at the six-digit NAICS level. Such market definitions may be overly broad and should be adjusted to account for hypothetical submarkets.

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 Supplemental 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.

B. *Stage 2: Wholesaler Prices*

I model the supply side of a wholesale firm with a fixed cost and 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 that 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, and 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:

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

The vector $\tilde{\mathbf{x}} = \big[\mathbf{x}, \xi\big]$ 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.

C. *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 a 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 $G\big(\xi, \nu|\mathbf{x}\big)$.

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, Eizenberg, and Waldfogel 2016). Two conditions must hold: (i) wholesalers will only enter if their

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

expected variable profits are greater than entry costs, and (ii) additional wholesalers will not earn expected variable profits greater than entry costs.

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

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

The notation $E^{N}_{\xi,\nu}[\cdot]$ 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 additional wholesaler to enter with attributes $\mathbf{x}$. The second condition means the lower bound of the entry cost $\underline{E}_{\mathbf{x}}$ is

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

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.

III. 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.

A. *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 multistage model.

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

$$\delta_{j,w,i} = \alpha \log p_{w,i} + \beta_q \log q_j + \sum_{l \in \{state,region\}} \beta_l \mathbf{1}\{l_w = l_j\} + \mathbf{x}'_{w,i}\beta_{\mathbf{x}} + \xi_{w,i}. \tag{9}$$

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

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, whether the wholesaler has a warehouse near a downstream buyer $\left(\mathbf{1}\{l_w = l_j\}\right)$, 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 subproducts), the total number of warehouses, and indicators for multivariety 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 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 $\beta_{\mathbf{x}}$ captures all other observable valuations. Data on the mass of buyers (b_j) in equation (3) come from the Commodity Flow Survey, which surveys purchases by location and quantity.

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, respectively, are identified using aggregate moments. The parameters $\beta_{\mathbf{x}}$ 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 multivariety 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, and direct use can cause endogeneity issues, I adapt the geographic nature of Hausman, Leonard, and Zona (1994) and Nevo (2001) instruments. 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 $\mathbf{Z}_1$.

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 (i) only domestic varieties, (ii) only international varieties, and (iii) 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 II, 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, Levinsohn, and Pakes (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 levels. I collect these instruments as $\mathbf{Z}_2$.

TABLE 5—DOWNSTREAM FIRM CHOICE ESTIMATES

Parameter	Estimate	Parameter	Estimate
log(price)	−2.744	Within-state shipment	3.228
	(0.0707)		(0.2372)
log(shipment size)	−0.422	Within-region shipment	1.226
	(0.0006)		(0.1358)
log(# warehouses)	0.349	σ_i (varieties)	0.517
	(0.0037)		(0.0579)
South imports × log(HS lines)	0.726	σ_n (wholesaler breadth)	0.666
	(0.0077)		(0.0942)
North imports × log(HS lines)	0.733	ψ (submarket size)	0.220
	(0.0071)		(0.0024)
Multivariety wholesaler × 1997	0.127	Multivariety wholesaler × 2002	0.183
	(0.008)		(0.0075)
Multivariety wholesaler × 2007	0.329		
	(0.0069)		
Fixed effects	6-digit industry × variety		
	Multiproduct wholesalers × year × variety		

Notes: Results from an optimizing 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.

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 (GMM) objective function is constructed using the following sets of moments:

$$\mathbf{Z}'\xi = 0$$

$$\mathbf{m}_{data} - \mathbf{m} = \mathbf{0}.$$

The matrix $\mathbf{Z}$ consists of instruments $(\mathbf{Z}_1, \mathbf{Z}_2, \mathbf{X})$, where $\mathbf{X}$ are wholesaler attributes determined at entry. The vector $\mathbf{m}_{data}$ consists of the empirical analogs of estimated moments. See Supplemental Appendix B.5 for details on the instruments and robustness.

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 ($\approx$ 0.220) than that implied by naïve use of administrative data (Ganapati 2021). Administrative data

TABLE 6—MARGINAL COST REGRESSIONS

Parameter	Estimate	SE	Parameter	Estimate	SE
log(plants)	−0.016	(0.0009)	$\xi \times 1997$	0.219	(0.0008)
			$\xi \times 2002$	0.185	(0.0008)
South imports × log(HS lines)	−0.035	(0.0018)	$\xi \times 2007$	0.164	(0.0009)
North imports × log(HS lines)	−0.027	(0.0016)	$\xi \times$ south imports $\times$ 1997	−0.066	(0.0026)
			$\xi \times$ south imports $\times$ 2002	−0.044	(0.0024)
Multivariety wholesaler × 1997	−0.081	(0.0019)	$\xi \times$ south imports $\times$ 2007	−0.026	(0.0022)
Multivariety wholesaler × 2002	−0.064	(0.0018)	$\xi \times$ north imports $\times$ 1997	−0.059	(0.0022)
			$\xi \times$ north imports $\times$ 2002	−0.038	(0.0024)
Multivariety wholesaler × 2007	−0.061	(0.0013)	$\xi \times$ north imports $\times$ 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.

would effectively imply minimal market concentration; however, $\psi = 0.220$ 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 multisource). I find imperfect substitutability between varieties produced domestically in the global "South," and in the global "North" ($\sigma_i = 0.517$), as well as between wholesalers with different sourcing strategies ($\sigma_n = 0.666$). Internationally sourced varieties are imperfect substitutes for domestically sourced varieties, and multisource wholesalers are imperfect substitutes for single-source wholesalers.

B. *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 $\tilde{\mathbf{x}} = \left[\mathbf{x} \;\; \xi\right]$ are then projected onto marginal costs $\hat{c}$:

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

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 estima-

[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 $\hat{c}_{BS,w,o}\left(\theta_{BS}; \mathbf{X}\right)$. These new estimates are then used to produce standard errors for estimates for marginal cost parameters γ.

tion, due to prices for multiple-variety wholesalers being only known in aggregate. Supplemental 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.

The top line in the first column implies that as the number of distribution facilities doubles, marginal costs decrease by 1.6 percent, echoing Houde, Newberry, and Seim (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 percent from 1997 to 2007. Referring back to Table 2, the largest 1 percent of wholesalers 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 subvarieties (HS-10 subproducts) further decrease marginal costs. A doubling of subvarieties decreases marginal costs by 3.5 percent and 2.7 percent 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 multivariety firms). The second dispenses with the assumption that firms know that 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 $\psi = 0.22$. The fourth assumes a single national market and that the administrative data accurately measure 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 reestimate the model; rather, I simply reestimate 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 that marginal cost fell from \$0.104 to \$0.81, or a decrease of 28 percent. In contrast, all other scenarios

Table 7—Supply Estimation Statistics

	1997	2002	2007
Panel A. Average wholesaler marginal costs (dollars per $1 of producer output)			
Full model with local market power	1.104	1.088	1.081
No multivariety differentiation	1.135	1.137	1.141
National-level submarkets ($\psi = 0.22$)	1.153	1.159	1.167
National-level market power only ($\psi = 1$)	1.151	1.157	1.166
Monopolistic competition	1.163	1.170	1.181
Panel B. Average markups (price/marginal cost across markets)			
Full model with local market power	1.256	1.283	1.303
No multivariety differentiation	1.222	1.228	1.234
National-level submarkets ($\psi = 0.22$)	1.203	1.205	1.207
National-level market power only ($\psi = 1$)	1.205	1.207	1.208
Monopolistic competition	1.193	1.193	1.192
Panel C. Aggregate wholesaler operating profits (real billion 2007 US dollars)			
Full model with local market power	401	579	749
No multivariety differentiation	356	484	606
National-level submarkets ($\psi = 0.22$)	327	439	553
National-level market power only ($\psi = 1$)	335	433	530
Monopolistic competition	317	408	498
Implied average HHI	1,691	2,492	3,059

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 multivariety 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 $\psi = 0.22$. The fourth assumes a single national market and that the administrative data accurately measure market size with $\psi = 1$. The last line assumes a model with monopolistic competition, where markups are invariant to wholesaler size.

find an increase in marginal costs. For example, if I only allow national market power with $\psi = 0.22$, the marginal cost rose from \$0.151 to \$0.167. 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 \$0.163 to \$0.181.

Panel B takes the aggregate prices from Table 1 and puts the model-derived marginal costs into context. A markup of one denotes sales at marginal cost. With the fully estimated model, markups rise from 25.6 percent to 30.3 percent (1.256 to 1.303 in the price/marginal cost ratio). With national markets, there is a much more modest rise from 20.5 percent to 20.8 percent, reflecting the low increase in the HHI index in Table 2. Finally, markups are relatively consistent at 19.3 percent 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.

Table 8—Average Entry Costs Bounds across Markets ('000s of 2007 Dollars)

Wholesaler category/ # of locations	1997		2007	
	Domestic only	Domestic + international importer	Domestic only	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-to-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.

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 87 percent (from \$401 billion to \$749 billion). In contrast, under monopolistic competition, variable profits only increase 57 percent (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.

C. *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: (i) wholesalers will only enter if their expected variable profits are greater than entry costs, and (ii) 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:

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

where $E_{\xi,\nu}$ 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 $N_{\mathbf{x}}$ 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 Supplemental 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 million 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 million 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 seven-plus states and sell domestic and international varieties, this gap grows from 16.7 percent in 2007 to 20.9 percent 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 estimates for not just 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).

IV. Model Implications

The probability of a buyer sourcing from a wholesaler in a typical market increased from 45 percent to 52 percent 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 percent 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

Table 9—Decomposition of Shift to Wholesaling from 1997 to 2007

		Wholesale firm size percentile		
	All firms	0–90%	90–99%	Top 1%
Gains due to price effects	−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 percent smaller than the observed wholesale market share if wholesalers charged prices similar to 2007. Data are averaged across markets. See text for full details.

standard deviation in 1997 across all wholesalers. I then do this for wholesalers of different size ranks.

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 percent of wholesalers, the middle 90–99 percent of wholesalers, and the largest 1 percent of wholesalers, respectively. 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 percent 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, Sarte, and Trachter (2020). This gain is only attributed to the very largest wholesalers, as all wholesalers outside of the largest 1 percent 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 percent of the aggregate change, and changes to international sourcing account for 14 percent. This may reflect better customer service for downstream buyers or

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

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 percent of wholesalers. This channel partially reflects on changes to quality, through the ξ term. It is important to note that ξ is modeled as a quality draw, and it is conditional 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 percent 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.

V. Counterfactuals Market Power Analysis

I run two sets of counterfactual scenarios to understand the trade-offs between fixed costs, market power, and downstream costs. The first 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.

A. *Counterfactual: Wholesaler Technology Changes*

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

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 and higher price, and lack the domestic distribution reach and internationally sourcing ability of wholesalers

Table 10—Scenario 2: Intertemporal 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 HHI	3,060	1,688	[1,217, 1,305]
Welfare relative to 1997 (billions of $)			
Δ downstream welfare (billions)		−$319	[−$247, −$223]
Δ wholesaler profits (billions)		$152	[$0, $0]
Δ profits + Δ welfare (billions)		−$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. HHIs 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.

in 2007 (reflecting Section IV). The average wholesaler market share decreases from 52 percent to 45 percent. Analogously, the welfare of downstream buyers (reflecting changes in their total procurement costs) 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 ten 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 percent of 2007 gross domestic product. To further refine this calculation, I allow for a simplified form of wholesaler entry in the next section.

Scenario 2: Allowing Wholesaler Entry/Exit.—In this scenario, there is only one type of wholesaler, those that are present in 1997, and it 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 toward 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:

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

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 III. In each market, I resample 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 percent and 47 percent, but each wholesaler would have smaller market shares. Downstream welfare would also fall by $223 billion to $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 ten 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 percent 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 percent from 1992 to 2005. Relative to that, I find that gains in wholesaling technology and attributes imply welfare gains that together represent 2 percent 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 the 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.

B. *Counterfactual: Role of International Trade*

Two large changes to the underlying nature of manufactured good distribution in the United States were the implementation of the North American Free Trade Agreement and the ascension of many economies to the World Trade Organization, including

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	220,000	220,000	210,000	220,000	220,000	210,000	[340,000, 340,000]	[350,000, 360,000]	[390,000, 380,000]
Number of wholesalers/market	3,929	3,929	3,750	3,929	3,929	3,750	[6,071, 6,071]	[6,250, 6,429]	[6,964, 6,786]
Mean local HHI	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. HHIs 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.

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 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

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

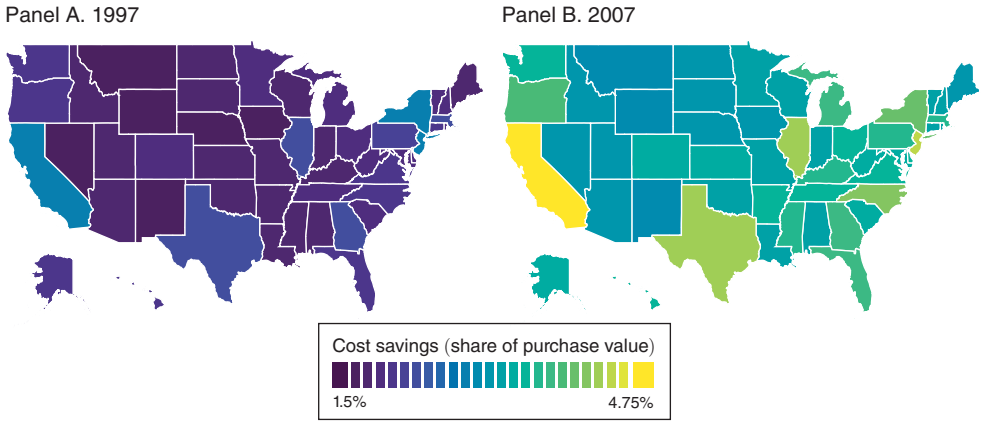

FIGURE 2. DOWNSTREAM BUYER COST SAVINGS DUE TO INTERMEDIATED INTERNATIONAL TRADE

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.

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 that 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 an 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 percent 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 to buyer costs (as a share of total expenditures) in 1997 and 2007. In 2007, California, New Jersey, and Texas face a 5 percent 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.

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 recomputed after resolving iteratively for best-response prices, holding fixed the number of wholesalers. See text for details.

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 percent, as some downstream buyers switch from using international to domestic varieties. The largest wholesalers see a 34 percent 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 percent gain in variable profits, while the largest wholesalers face a 50 percent decline.

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 wholesalers N_h.

Empirically, I take the estimates for $E_{\mathbf{x}}$ from Section III 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 resample 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_h 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 billion and 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 unconcentrated 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, 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.

VI. 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 toward 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; Bernard, Smeets, and Warzynski 2017) points out a trend in former manufacturing firms closing domestic production operations and only retaining design and distribution facilities (see Supplemental Appendix F). Aggregate data from Feenstra and Weinstein (2017) show that the direct sourcing option combining domestic and international trade has itself improved welfare (by about 1 percent of GDP), meaning that these estimates are a lower bound on welfare improvements during this period of globalization. I

[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 the ability to sell products from abroad while retaining very large fixed costs, and are unprofitable.

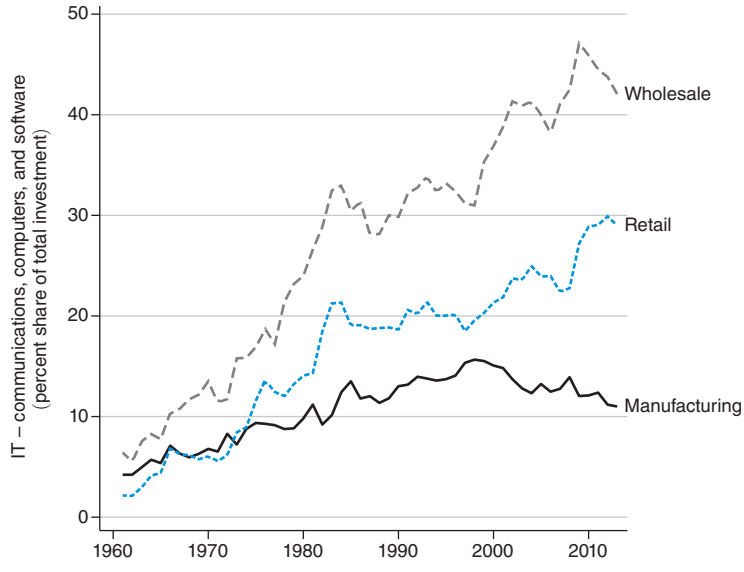

Figure 3. Information Technology Share of Total Investment

Source: BEA Investment Data

consider measures of welfare in this paper as additive to such estimates. Naïvely, this represents a 2 percent 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 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 percent of all investment by wholesale firms but only 10 percent 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 (i) more market power and (ii) widespread benefits. In the context of wholesaling, the benefits dominate changes in market power. Other industries, time periods, or contexts may provide different results.

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