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

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Abstract

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 disproportionate growth by the largest one percent of wholesalers (i.e., the intensive margin). To understand the origins and implications of these findings, I develop a model that incorporates downstream buyer demand with wholesaler market entry. Structural estimates based on detailed administrative data from the U.S. Census Bureau reveal that the rise of wholesalers was driven by an intuitive complementarity between their sourcing of goods from abroad and an expansion of their domestic distribution network to reach more buyers. Both elements require scale economies and lead to increased wholesaler market shares and markups. Counterfactual analysis shows that despite increases in wholesaler market power, intermediated international trade has two benefits for buyers: first, through buyers' valuation of globally sourced products, and second, through the passed-through benefits of wholesaler economies of scale. The combined benefits of intermediated international trade in 2007 account for a $314 billion net yearly increase in buyer surplus.

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

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1 Introduction

With advances in electronic communication technologies and falling trade costs, we imagine that the economy is moving to a frictionless state where buyers and sellers seamlessly connect, bypassing middlemen. However, in the distribution of manufactured goods, the opposite has occurred: using rich United States administrative data over the last two decades, I show that middlemen are more important than ever, doubling the value of distributed goods to three trillion dollars, expanding their distribution networks, and connecting domestic buyers to international markets. I find that these middlemen do not act as perfectly competitive firms that charge marginal cost. Rather, the largest intermediaries compete in an increasingly oligopolistic manner, by combining international trade with expanded domestic distribution networks to achieve greater scale economies.

This paper evaluates the implications of the expanding role played by wholesalers, a particular type of middleman that sells almost exclusively to other businesses, in the distribution of goods in a globalized economy. I make two principal contributions in this paper. First, I document the growing importance of wholesalers in distributing imported and domestically produced manufactured goods within the United States and show that this increase is driven by the intensive margin, with the largest wholesalers increasing in size. Second, I use a structural model to rationalize these trends, conduct counterfactuals to quantify their market consequences, and evaluate the role of wholesalers in globalization. In this model, wholesalers first enter, set up global sourcing and distribution networks, and determine prices. Downstream firms then decide to buy, choosing between using a wholesaler or directly sourcing from a manufacturer.

Structural parameter estimates reveal that the largest wholesalers pay significant fixed costs to set up nation-wide networks to distribute globally sourced products. The increasing combined fixed costs of international trade and expanded domestic distribution allow the largest wholesalers to exert more market power and raise prices. Downstream buyers receive two benefits from these wholesalers: the immediate benefit of being able to source from abroad, and a secondary benefit where the largest wholesalers exploit increasing returns to scale and improve their distribution networks for domestically sourced products. Both benefits are underpinned by two interacting mechanisms. Wholesalers make investments, that are increasingly complementary, to (a) increase the number of globally sourced varieties and (b) build better distribution networks within the United States. While I do not delve into the technology underpinning these investments in this paper, I provide preliminary evidence of the role of automation and software infrastructure.

This paper unfolds in four parts. First, it uses detailed micro data to characterize the nature and growth of the U.S. wholesale sector. In 2012, wholesale businesses in the United States sold \$3.2 trillion in aggregate to downstream buyers. This large figure is driven by wholesaler growth, as transactions intermediated by wholesalers have grown faster than the overall market. From 1997 to 2007, the share of transactions intermediated by wholesalers increased 34%, with internationally sourced varieties accounting for half of this gain. This growth is entirely driven by the intensive margin, through increased market share of the largest 1% of wholesalers. This expansion corresponds to these large wholesalers increasing the number of imported varieties by 56% and domestic distribution warehouses by 70%. In contrast, the median wholesaler rarely imported and saw no change in the number of distribution centers. On the other side of the market, downstream buyers are shown to systematically prefer nearby wholesalers for smaller purchases, being ten times more likely to to purchase through a wholesaler for shipments worth $1000 or less, compared to shipments worth over $1 million.

Second, this paper structurally estimates downstream buyer demand for wholesalers, allowing for the decomposition of the gains from wholesaling. Downstream buyers can either indirectly source intermediate goods from a wholesaler at a markup over manufacturers' prices an incurring a small fixed cost, or they can pay a large fixed cost and directly source from a manufacturer, skipping the wholesaler markup and allowing for scale economies. My two-stage demand system captures this tradeoff. Geographically dispersed downstream buyers first choose how much to buy and then choose their optimal sourcing strategy from a set of wholesalers. Differentiated wholesalers compete horizontally (types of distributed varieties), vertically (distribution quality), and spatially (geographic reach).[1] This discrete choice setup with heterogeneous buyers is estimated using both firm-level and aggregated data to (a) accurately gauge price elasticities, (b) correct for price endogeneity, and (c) allow for multi-product wholesalers. The estimates from the demand model help explain why wholesalers have increased their market shares. The average wholesaler has made it even easier to indirectly procure intermediate goods, while only slightly increasing costs and markups. I find that downstream buyers' value increases in wholesaler-distributed product varieties as well as expansions in wholesaler domestic distribution networks. These gains more than offset increases in wholesaler prices due to the cost of international sourcing, rising market power, and an adverse shift in buyer composition.[2] In particular, downstream benefits increase the most for buyers from the largest wholesalers, who now provide substantially more international varieties and a denser network of distribution centers, without substantially increasing their prices.

Third, the model endogenizes the prices, attributes, and entry decision of wholesalers. In the absence of detailed and accurate wholesaler cost data, I combine rich demand estimates with market-level assumptions to rationalize and estimate wholesaler costs. Using model-derived demand elasticities and first-order profit maximizing conditions, I recover wholesaler marginal costs and operating profits from a price-setting supply system with oligopolistic competitors. Subsequently, I consider the entry costs of wholesalers, who make increasingly large fixed investments in (a) more efficiently sourcing products from far-flung foreign factories and (b) setting up domestic facilities to redistribute these products across the nation. Estimation, based on equilibrium conditions, finds that these two wholesaler innovations positively interact, with investment in international sourcing and domestic distribution becoming increasingly complementary. This result, combined with demand estimates,

[1] Wholesalers exhibit a form of competition that is national in some respects, but local in others. For example, demand in the New York market is largely fulfilled by wholesalers in New York, but a large proportion comes from neighboring New Jersey and Connecticut. Changes in prices, demand, and competition are all spatially interlinked. Estimation of supply and demand in such a market explicitly considers such inter-related regions.

[2] Are buyers changing or are wholesalers getting better? I find that buyers are growing systematically larger and becoming more geographically clustered, which would indicate a decrease in wholesaling, as large buyers tend to source directly from upstream manufacturers.

implies that wholesalers in 2007 provide much better products to downstream buyers compared to wholesalers in 1997. However, to cover rising investment costs, these high-quality wholesalers require large market shares to produce sufficient operating profits, driving up their market concentration.

Fourth, I quantify the gains from wholesaling by running counterfactuals under the fully estimated model. In the principal scenario, indirect sourcing via wholesalers for international products is restricted to recover the downstream buyer gains from wholesaler-intermediated international trade.[3] To disentangle the various benefits of wholesaling, I initially consider the static buyer gains (without wholesaler entry/exit) of indirect global sourcing through wholesalers. Subsequently, I recover the secondary benefits that accrue though wholesaler scale economies by allowing wholesalers to make entry and exit decisions based on expected profits. Through complementarities in investment, increases in international trade positively interact with the size of a wholesaler's domestic distribution network, compounding and nearly doubling the gain in aggregate buyer surplus. I show how the market effects are mixed, with the largest wholesalers and smallest downstream purchasers coming out as winners. Specifically, the expansion of wholesalers into international trade in 2007 increased downstream purchase volumes by 5%, saving downstream buyers 8% in procurement costs as a percentage of purchase value ($314 billion). However, due to the costs of investing in international sourcing, the largest 1% of wholesalers are able to increase their overall market share by 30% and their operating profits by 15%.

De Loecker and Van Biesebroeck (2016)[4], 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 introduction or expansion of trade and simultaneously downplay the importance of intranational or localized competition between firms. This paper explicitly corrects for these gaps in the current trade literature in the context of a very large and important industry. I find that trade-induced scale economies, as well as the importance of localized markets, lead to significant operating profits and reduced competition for wholesaler distributors. However, this downside is more than completely offset with the provision of massive reductions in relative procurement costs and gains from variety for downstream purchasers.

These results illustrate an important linkage between international trade and market concentration. Public discourse (The Economist, 2016) has highlighted both increasing market power and market concentration across the economy as areas of general interest. Possible explanations for this linkage include technological innovation, firm consolidation, and the influence of large, diversified shareholders. This paper introduces another mechanism: the increasing returns to scale introduced by the fixed costs of international trade and their interaction with domestic investments. Simultaneously, these fixed costs can also explain the related phenomenon of the decreasing importance of

[3]Gains are all relative to sourcing directly from a manufacturer. Difficulty in sourcing from a manufacturer (both domestically and internationally) can offset gains from wholesaling. Future research will study this channel.

[4]They note that "...the interaction between efficiency and market power tends to be ignored. This is problematic as firms can use higher quality (imported) inputs or favorable locations to differentiate themselves and increase or gain market power" and "A final research avenue we believe to be promising is to study the distinction between local and global competition."

smaller firms, who tend to be less efficient and exert less monopoly power.[5]

Related Literature

This paper is related to a number of important questions in empirical international trade, is based on a set of theoretical microeconomic models, and is estimated using an industrial organization estimation framework. I discuss these literatures in relation to this paper below:

International Trade In international trade, a variety of papers study wholesalers by leveraging tractable general equilibrium frameworks in the style of Melitz (2003). Such frameworks typically allow for returns from scale due to international trade, but adopt a monopolistic competition structure that generalizes away from variations in market power. These papers find various cross sectional predictions that are verified in the data (Akerman, 2010; Ahn, Khandelwal and Wei, 2011; Felbermayr and Jung, 2011; Tang and Zhang, 2012; Crozet, Lalanne and Poncet, 2013). In general, these models find that as fixed or variable trade costs fall, the share of trade passing through intermediaries will fall. Similarly, Rauch and Watson (2004), Petropoulou (2008), Antràs and Costinot (2011), and Krishna and Sheveleva (2014) consider alternative theoretical models for the gains from trade. In contrast to this paper, these studies minimize market power and domestic trade considerations. This paper significantly contributes to the literature by allowing for wholesaler heterogeneity, downstream buyer heterogeneity, and market power. Disregarding wholesaling, studies such as Pavcnik (2002), Gopinath, Gourinchas, Hsieh and Li (2011), Goldberg and Hellerstein (2013), and De Loecker, Goldberg, Khandelwal and Pavcnik (Forthcoming) consider the effect of trade shocks and liberalization on markups, firm productivity, and price pass-through. This principally reduced form literature regresses firm outcomes on trade shocks; this paper directly considers a structural model to parse out the mechanism by which trade increases markups/productivity.[6]

Theoretical and Empirical Analysis of Intermediation There is an extensive theoretical literature on intermediation.[7] Early work by Rubinstein and Wolinsky (1987) endows intermediates with a special matching ability to connect buyers and sellers.[8] As summarized by Spulber (1999), these intermediaries can satisfy a variety of purposes: providing liquidity and facilitating transactions, guaranteeing quality and monitoring, market-making by setting prices, and matching buyers with sellers. This paper empirically addresses these purposes, combining the costs of facilitating

[5]An alternate explanation may be that wholesalers allow smaller downstream firms to survive as they do not have to run their own procurement networks.

[6]A burgeoning new literature exists in choosing the optimal source for intermediate inputs. Such work includes Antràs, Fort and Tintelnot (2014); Gopinath and Neiman (2014); Halpern, Koren and Szeidl (2015); Blaum, Lelarge and Peters (2015).

[7]A large operations management literature considers the best criteria for choosing an optimal source. These papers tend to build on the economics of contracts literature (Tirole (1988) and Katz (1989)), but focus on the explicit modeling of the operational details of production. See Tsay and Agrawal (2004) for an example.

[8]More detailed models as in Townsend (1983); Biglaiser (1993); Biglaiser and Friedman (1994) and Spulber (1996a,b, 1999) add various frictions to both buyers and sellers.

transactions and ensuring quality as fixed costs that must be paid by a wholesaler and which allow a wholesaler to charge markups.

The comprehensive structural empirical study of wholesaler markets is sparse. In international trade, their presence has been also documented by Feenstra and Hanson (2004), Bernard, Jensen, Redding and Schott (2010), Bernard, Grazzi and Tomasi (2011), and Abel-Koch (2013), who all find the rich and enduring presence of such intermediaries. Gopinath, Gourinchas, Hsieh and Li (2011) and Atkin and Donaldson (2012) study the role of prices and pass-through, but do not consider the exact mechanisms that lead to pass-through.[9] Bernard and Fort (2015) and Bernard, Smeets and Warzynski (2016) explore the emergence of factory-less good producers, which account for a portion of the wholesale industry. As part of a larger NBER project exploring industrialization in the United States, Barger (1955) summarizes the decline in the wholesale industry from 1869-1948. These papers all point to the importance of wholesalers, but consider their market structure as a black box.

In industrial organization, recent papers by Salz (2015) and Gavazza (2011) consider informational intermediaries and brokers, as opposed to physical good wholesalers.[10] These papers address Spulber's last criteria, with wholesalers reducing the cost of matching buyers and sellers, and structurally estimate search models where informational brokers simplify the process of acquiring prices or bids. Salz (2015) focuses on intermediaries both directly reducing search costs and providing an externality that reduces the prices paid by all buyers. In particular, such work abstracts away from competition and quality differentiation between brokers and considers intermediary entry and markups as exogenous and invariant to market conditions. This paper endogenizes the entry of middlemen and allows for endogenous middlemen markups. Papers such as Villas-Boas and Hellerstein (2006), Villas-Boas (2007), Nakamura and Zerom (2010), and Goldberg and Hellerstein (2013), consider retailers in a similar fashion to wholesalers. But these papers do not fully account for the incentives for such intermediaries outside of pricing.

Discrete Choice and Market Entry Methodologically this paper elaborates on the demand-side discrete choice framework of McFadden (1973).[11] First, it builds on the logic of Hausman, Leonard and McFadden (1995) to allow for an endogenous market size. Second, the model uses a well-defined spatial component of demand as in Davis (2006). A set of aggregate moments from survey data enables precise estimation of buyer heterogeneity as in Petrin (2002). Finally, while most demand estimates consider product attributes as exogenous, this paper endogenizes product attributes by combing a market entry model with reasonable timing assumptions along in vein of

[9] Gopinath et al. (2011) note that their findings suggest "that the correlation between the nominal and real exchange rate for the goods in our sample is not driven by local non-traded costs such as wages or by pricing to market at the retail level, but rather by pricing to market at the wholesale level." Atkin and Donaldson (2012) consider the markups that occur between the factory gate or port of entry and final retail sale for a variety of consumer goods. The market structure of these intermediaries does not allow for heterogeneity; the authors assume a number of identical middlemen under Cournot competition to derive welfare effects.

[10] In addition, these papers are closely related to papers that address real estate brokers. See Bar-Isaac and Gavazza (2015) for a recent example.

[11] A good overview of these techniques is found in Ackerberg et al. (2007).

Seim (2006), Eizenberg (2014), and Wollman (2014).

This paper extends Hausman, Leonard and McFadden (1995), which uses Gorman (1970) to adapt a two-stage demand system to a discrete-choice framework. Buyers decide how much to buy before choosing the optimal source.[12] While Hausman, Leonard and McFadden (1995) considers the number of vacations a consumer takes and fits a Poisson arrival function, this paper considers the number of downstream orders made and estimates a more general aggregate demand elasticity.[13]

In general, international trade papers consider an entire nation as a single market.[14] However, is a relevant market a city, a state, or an entire nation? This paper's model follows the spirit of Davis (2006), Houde (2012) and Murry (2014) and allows for buyers to place differing valuations on sources by distance. While these papers allow for buyers to optimally choose among geographically dispersed retailers, they still place exogenous restrictions on market size at the city or state levels; this paper extends such frameworks and allows for inter-regional shipments across the country.

The market entry setup takes into account sunk and fixed costs as in Sutton (1991) and Sutton (2001). Firms choose entry based on similar information structures to Seim (2006), where firms enter based the expected value of operating profits and thus may face ex-post regret. The market equilibrium solution concepts operate with firms satisfying plausible equilibrium assumptions as summarized in Berry and Reiss (2007).[15]

The remainder of the paper is as follows. Section 2 outlines the wholesaling industry, provides a case study, and presents a set of important descriptive facts. Section 3 describes the model. Section 4 explains identification and estimation. Sections 5, 6, and 7 summarize the estimation results, decompose results, and compute counterfactuals. Section 8 discusses alternative and complementary explanations and Section 9 concludes.

2 Data and Industry Facts

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

> ... an intermediate step in the distribution of merchandise. Wholesalers are organized to sell or arrange the purchase or sale of (a) goods for resale (i.e., goods sold to other wholesalers or retailers), (b) capital or durable non-consumer goods, and (c) raw and intermediate materials and supplies used in production.[16]

[12] This approach contrasts with Hendel (1999), who combines the choice of how much to buy and whom to buy from into a single stage and doesn't consider the extensive margin of new buyers.

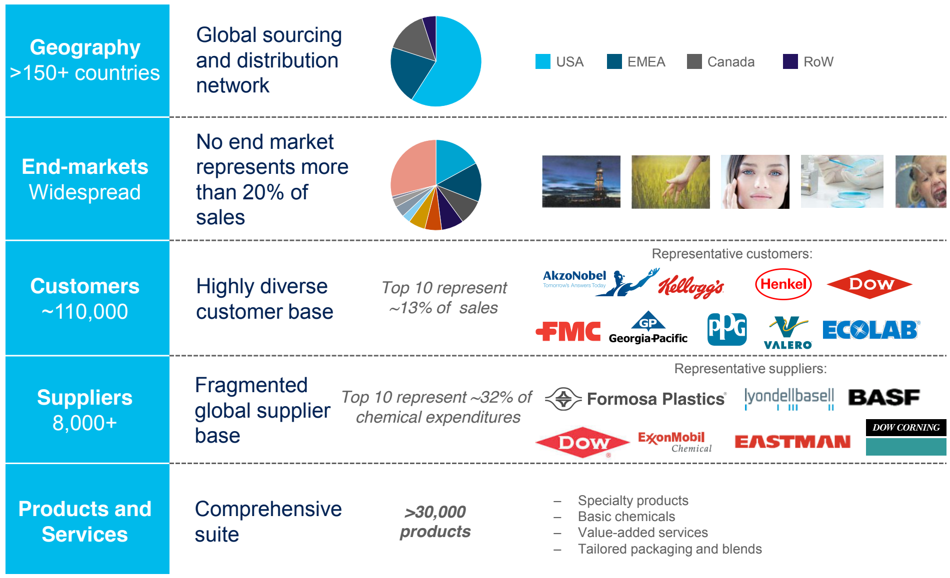
[13] A different type of two stage models are also frequently used in choice-set analysis. As reviewed by Manrai and Andrews (1998), buyers first choose a choice set and then choose the optimal choice from within this choice set.

[14] Arkolakis (2010) allows for a consumer-specific firm-level marketing cost, but still does not allow for firm-level market power beyond monopolistic competition.

[15] While related work using moment inequalities allows for idiosyncratic fixed cost shocks, this method relaxes the parametric and distributional assumptions in estimating these shocks and allows for tractable counterfactual analysis. This extensive literature was developed econometrically and theoretically by Chernozhukov et al. (2007); Andrews and Soares (2010); Andrews and Barwick (2012); Pakes et al. (2015). Select empirical examples include Ho and Pakes (2013); Eizenberg (2014); Wollman (2014).

[16] For full description see Appendix A.

Figure 1: **Univar Presentation at 2015 Barclays Industrial Distribution Forum**



Source: Univar Investor Relations

Within this category, I consider merchant wholesalers. These firms are independent of manufacturers and physically maintain possession of goods between manufacturer and downstream buyer.[17] In order to gain tractability, I present a simplified notion of the wholesale industry. End users can either buy directly from a manufacturer or from a wholesaler. Wholesalers source goods from a set of available manufacturers for a particular downstream user and then resell at an endogenously determined price.[18] This process is illustrated first by an industrial case-study and then summarized using comprehensive administrative data. Both the case-study and summary data provide salient details that will be incorporated into the model and estimation.

2.1 Wholesaler Case Study

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

Downstream buyers face heterogenous barriers to directly purchasing chemicals from a manu-

[17] I specifically exclude own-brand marketers to separate firms that design, market and sell, but that do not manufacture their products. In these cases, there is simply a division of the surplus problem that occurs between the designing firms and the manufacturing arm; they can rather be thought of as two divisions of the same firm.

[18] As is the case for the vast majority of economic studies, I simplify many aspects of the wholesale industry to balance realism with parsimony and tractability. In reality, there are many more business structures, ranging from exclusive contracts to brokers. For example, I implicitly incorporate exclusive contracts into my model through the unobservable term ξ in Section 3. As for brokers, I veer on the conservative side and consider sales aided by such agents as direct sales from manufacturers to downstream users and thus part of the outside option in equation (1) in Section 3.

facturers. According to a 2009 Boston Consulting Group survey, 80% of downstream buyers with purchases valued under €100,000 sourced goods indirectly through wholesalers, while larger purchasers nearly always sourced directly from a manufacturer. Downstream buyers value traditional distributor attributes such price, quality, and globally sourced varieties and are differentiated on two characteristics, their size and geographic location.[19]

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

Consider one of the large speciality chemical distributors, Univar. Univar is a large industrial chemical wholesaler with North American shipments of approximately $10.4 billion in 2014. The company was formed in 1928, increasing its distribution footprint through acquisitions and expansions. Today, it sources 30,000 varieties of chemicals and plastics from over 8,000 internationally distributed suppliers. Univar uses its 8,000 employees to run a distribution network spanning hundreds of locations to supply 111,000 buyers. Univar's business plan is summarized in a slide presented as Figure 1.

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

2.2 Data Description

I bring together a variety of censuses and surveys conducted by the United States Census Bureau, Department of Transportation, and Department of Homeland Security covering international trade, domestic shipments and both the manufacturing and wholesale sectors. In particular, I use the Census of Wholesale Trade, Census of Manufacturers, Longitudinal Firm Trade Transaction Database, Commodity Flow Survey, and the Longitudinal Business Database, from 1992 to 2012.[20]

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

[20]This draft only presents aggregated data for 2012. When available, micro-data will be used for 2012.

Table 1: **Merchant Wholesaler Statistics**

	Year		
	1997	2002	2007
Sales (2007 $'000)	6,544	7,854	9,995
Merchandise Purchases for Resale (2007 $'000)	4,722	5,626	7,104
International Sourcing (mean %)	17%	20%	23%
Number of International Country Sources (mean)	0.565	0.69	0.793
Number of International Country Source-Varieties (mean)	3.825	5.082	6.431
Physical Locations (mean)	1.206	1.263	1.300
Wholesaler Price (average Sales/Merchandise Purchases)	1.386	1.396	1.407
Product Markets	56	56	56
Wholesalers	222,000	218,000	214,000
Average Number of Imported Varieties			
Smallest 90% Wholesalers	1.2	1.6	2.2
Middle 90-99% Wholesalers	13.7	18.0	24.6
Largest 1% Wholesalers	137.4	183.6	213.8
Average Number of Domestic Locations			
Smallest 90% Wholesalers	1.0	1.0	1.0
Middle 90-99% Wholesalers	1.8	2.0	2.1
Largest 1% Wholesalers	14.2	20.7	23.9

Notes: Varieties measured at the HS-8 level. Differences between cells in a row of means are all significant with $p < .01$.

These databases are linked together every 5-years at the firm level and provide at the aggregate level the share of goods distributed by a wholesaler in 56 distinct product categories, corresponding to North American Industry Classification System (NAICS) 5-digit sectors. I will treat each of these product categories as an independent market. I focus on wholesalers independent of manufacturing establishments and collect details on each wholesaler's aggregate sales, physical locations, operating expenses, and the extent of international trade.[21] Additionally survey data provides statistics on the distribution of the origin, destination, and size of shipments across wholesalers and manufacturers. One limitation of the shipment data is the lack of information on the identity of downstream buyers; I only know the quantity purchased and their geographic location. This will have serious implications on my modeling choices. Certain industries related to petroleum, alcohol, and tobacco are removed due to data issues. Further details and the process of merging these databases is detailed in Appendix A.

This analysis is based on quantities in terms of producer prices. There are multiple reasons for doing this, and the first is due to the availability of data. While certain small industries produce quantity data, they form only a small portion of the overall goods economy. Secondly, when available,

[21] These operating expenses are not equivalent to marginal costs, as they are derived from balance sheet data and may or may not include rents on capital and other fixed investments.

Table 2: **Aggregate Statistics for All Manufactured Products**

	Year				
	1992	1997	2002	2007	2012
Domestic manufactured goods purchases	\$3,307	3,845	4,098	5,389	5,421
(\$ Billions in 2007 producer prices)					
Domestic Production	3,246	3,711	3,748	4,851	4,836
Exports	453	652	689	1,046	1,286
Imports	514	785	1,038	1,585	1,871
Wholesaler delivery share	31.7%	31.9%	37.1%	42.5%	45.0%
(Percent of all domestic deliveries)					
Wholesaler, from domestic sources	*n/a*	26.3%	29.9%	32.4%	*n/a*
Wholesaler, from international sources	*n/a*	5.7%	7.28%	10.1%	*n/a*
Top 1% of wholesalers	*n/a*	14.1%	18.2%	21.5%	*n/a*
Middle 2-10% of wholesalers	*n/a*	10.3%	11.5%	13.0%	*n/a*
Smallest 90% of wholesalers	*n/a*	7.5%	8.0%	8.0%	*n/a*

Notes: Quantities in producer prices. Exports and Imports assumed in producer prices unless conducted by a wholesaler, whereby prices are then adjusted using a wholesaler-specific margin. Data on 2012 derived from aggregate Census data.

physical quantity data rarely includes information on quality and cannot be easily compared across closely related sub-sectors. Third, in the United States, the Robinson-Patman Act of 1936 (also known as the Anti-Price Discrimination Act) prevents price discrimination to similar downstream buyers. Thus, an upstream manufacturer cannot charge a wholesale distributor different prices from a downstream buyer, conditional on purchase type.[22]

2.3 Descriptive Results

While the previous case study considers the distribution of goods within one sector, census micro-data shows similar trends and relationships across wholesale sectors. This data shows the rise of wholesalers both in aggregate and within intermediate goods sectors over time. It also highlights a series of facts that inform my modeling decisions. Within wholesaling, the largest wholesalers have been gaining market share while (a) expanding globalized sourcing and (b) increasing the number of domestic distribution outlets. Wholesalers serve geographically proximate buyers that request low-valued shipments, even though these customers have been requesting ever-larger shipments over time. I elaborate on these descriptive facts below.

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

Manufactured products can be shipped via one of two modes, (a) directly from the manufacturer to a downstream user or (b) indirectly through a wholesaler. Table 2 shows the aggregate share of

[22] As with most United State laws, this statute has a long and complex history and the enforcement is not consistent. A older, but still informative summary is provided by Ross (1984).

domestic absorption of manufactured goods distributed by all wholesalers from 1992 to 2007. In 1992, wholesalers accounted for the distribution of just 32% of all manufactured goods. In contrast, in 2007, wholesalers accounted for 42.5% of all shipments to downstream buyers.

Such aggregate trends may be caused by compositional shifts across product types. In particular, products such as chemicals with large wholesale shares have increased in importance over time. A regression with appropriate controls accounts for this possibility. I regress the wholesaler market share by product type[23] with yearly and product type fixed effects for 1997, 2002 and 2007 across approximately 400 product types.

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

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

Simultaneously, the proportion of goods distributed by wholesalers and acquired abroad has similarly increased. The trend is highlighted in Table 2. In 1997, such products accounted for 18% of wholesaler sales and 6% of all domestic purchases. By 2007, these products made up 32% of wholesalers sales and 10.1% of all domestic purchases.

Fact 2 *Wholesalers are becoming more heterogeneous, with the largest wholesalers increasing market shares and importing a larger share of their products.*

Most work on intermediates treat wholesalers in this sector as identical within a market. As shown in Tables 1 and 2, there is incredible heterogeneity in wholesalers, both inter-temporally and cross-sectionally.[24] Over just 10 years, the average wholesaler has nearly doubled real sales and become 35% more likely to source products internationally, from where they import 68% more varieties at the Harmonized System 8-digit category level. On average, these wholesalers increased the number of domestic distribution centers by 8%, all while decreasing average prices.

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

[23] I used the SCTG 5-digit code from the Commodity Flow Survey. Similar results hold at higher levels of aggregation.

[24] Detailed statistics are available in Appendix Tables A1 - A4

Table 3: **Geographic Spread**

	2002 Share of Domestic Shipments	
Source/Destination	Wholesalers	Manufacturers
Same State	54%	32%
Same Census Region	67%	47%
Same Census Division	75%	60%

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

times more likely to import goods from abroad and have nearly 20 times more domestic distribution centers.

Even starker are the inter-temporal trends across wholesalers The 99th percentile of wholesalers have increased their aggregate market shares 50%, while increasing the average number of imported product varieties from 140 to 210 and the number of distribution locations by 68%. In contrast, the median wholesaler's market share stayed constant, with no measurable change in the number of domestic distribution centers. Substantial heterogeneity may imply that larger wholesalers make strategic competitive decisions, while the smallest wholesalers are too small to exert market power.

Having focused primarily on the upstream aspect of the data, I shift to describing the nature and types of buyers in my model.

Fact 3 *Wholesalers, in contrast with manufacturers, predominantly ship products to nearby destinations.*

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

Fact 4 *Smaller buyers predominantly deal with wholesalers, instead of manufacturers.*

Downstream wholesaler shipments are of much smaller value than manufacturer shipments. Table 4 shows that shipments worth $1000 or less in producer prices account for 15% of total wholesaler shipments, but only 4% of manufacturer shipments. In contrast, shipments of over $1,000,000 account for only 3% of wholesaler shipments, but 15% of manufacturer shipments. Certain wholesalers may exert market power in small shipments, even if they exhibit smaller overall market shares.

Fact 5 *The distribution of buyer types has skewed towards larger shipments over time.*

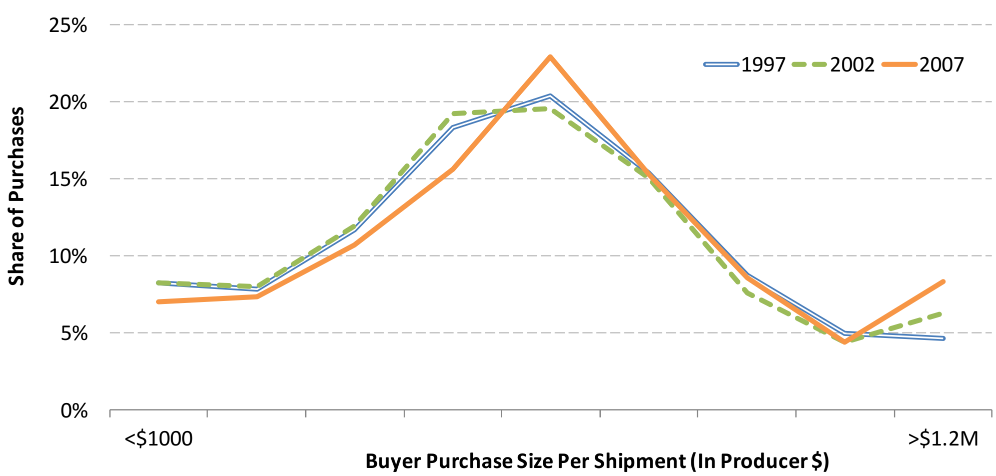
One hypothesis explaining the shift towards wholesaling is the spread of "just in time" manufacturing and supply practices. These business models forgo a small number of large deliveries for a larger number of smaller shipments. This provides downstream buyers with more flexibility

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

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

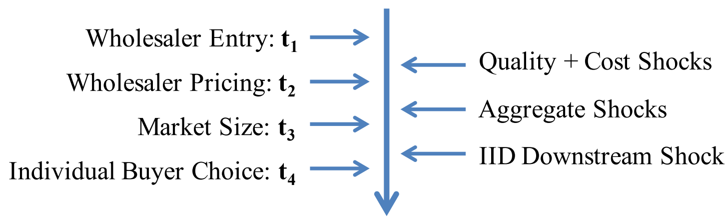
Notes: Figures in real 2007 dollars. Quantities equal revenues in producer prices. First two columns each sum to 1. Each row in the last two columns sum to 1.

Figure 2: **Distribution of Buyers**



Figures in real 2007 dollars.

Figure 3: **Model Timing**



and reduces inventory costs. In aggregate, such practices would imply that there is a shift towards smaller order sizes. If wholesalers are more adept at shipping smaller orders, then this may induce a shift of buyers switching to wholesalers. However, this has not occurred, as shown in Figure 2. Downstream buyers have slightly increased the average size of their orders over time.[25]

3 Model

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

3.1 Model Overview

There are four periods, $t_1 - t_4$. Periods $t_1 - t_2$ consider the decisions made by wholesalers. At t_1, wholesalers make market entry decisions and at t_2 wholesalers choose their prices. I will refer to stages t_1 and t_2 as **wholesaler entry** and **wholesaler pricing** respectively. Periods t_3 and t_4 involve the decisions made by downstream buyers searching for suppliers. At period t_3, aggregate downstream demand is determined, and downstream buyers choose how much to buy. Finally at t_4, downstream buyers choose between indirectly sourcing through wholesalers or directly sourcing from upstream sources. I will call stages t_3 and t_4 **market size** and **downstream choice** respectively.

In a pre-period t_0, the characteristics of upstream producers and manufacturers are made, they determine what to produce and how much to charge for it. This empirical strategy will take decisions made at t_0 as exogenous and open for future analysis; the focus will be on estimating and solving stages t_1 through t_4.

To aid in identification, wholesalers' entry and investment choices are consolidated in t_1. Wholesalers first decide to enter a market and choose their market position. In practice this means that

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

wholesalers choose both their geographic locations and how intensely to participate in global sourcing. Following this stage, wholesalers receive marginal cost and product quality shocks.

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

Downstream purchase choices occur in two stages. At time t_3, the total market size is determined. Downstream buyers decide whether to make purchases and if so, how much to purchase. In making this choice, the buyer considers their expected utility from a variety of factors, including local availability, price, and the the possibility of international sourcing. The stage determines the aggregate mass of downstream buyers in the market. This combines the choice of a downstream firm to buy and how much to buy, establishing the total market size. For example, this might be realized as 300 buyers demanding 1,000,000 units of industrial chemicals in New York.

At t_4, each of these downstream buyers make a choice to either source indirectly from a particular wholesaler or directly from a manufacturer. Each individual downstream buyer realizes a wholesaler-specific preference shock and makes their purchasing decision. Demand is fully realized.

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

3.2 Stage 4: Choice of Downstream Buyer

At t_4, heterogenous downstream buyers choose who to buy from. Do they buy goods indirectly through a wholesaler? If so, which wholesaler? These choices depend both on the buyers' own characteristics and the attributes of the available wholesalers.

There are two main methods of sourcing a good, either directly from a manufacturer or indirectly through a wholesaler. Within the second category, a downstream buyer i, indexed by type j chooses to buy from a particular wholesaler w. Types $j \in \mathcal{J}$ index buyers by their geographic location and quantity demanded. Each buyer can source from any given wholesaler w, who can supply one of a variety of products that is sourced from $o \in \mathcal{O}$, where o is the country origin of a product.

Within each downstream buyer type j, I model the sourcing choice as a bi-level nested multinomial logit decision. Each source o forms its own nest n. Within each nest, there are a variety of wholesalers selling products. This allows me to relax the independence of irrelevant alternatives (IIA) and allow purchases within nests to be correlated. Thus, if a wholesaler that sources internationally increases its prices, its downstream buyers will likely switch to another wholesaler that also sources internationally rather than a wholesaler that only sources domestically.

In this application, there are three main categories of wholesaler products: those sourced domestically, those sourced internationally from high income countries, and those sourced internationally from low income countries.[26] A wholesaler who procures products from multiple sources (say both domestic and foreign products) is considered a multi-product firm that sells products in multiple nests. I place products sold by multi-product wholesalers in their own respective nests. This implies that purchases from these multi-source wholesalers could be more substitutable with other multi-source wholesalers than with single-source wholesalers. For manufacturers, who are not the main focus of this paper, all possible sources are collected together and valued as the outside option (sometimes denoted as direct sourcing). I run this analysis for many product markets m, but suppress this subscript for clarity. See Figure 4 for a simplified example with just one foreign source.[27]

A customer i of type j buys from the from wholesaler w in nest n that provides the highest indirect utility:

$$U_{i,j,w,n} \quad = \quad \delta_{j,w,n} + \epsilon_{i,j,w,n}. \tag{1}$$

Wholesalers w provide mean benefit $\delta_{j,w,n}$ to all buyers of type j when selling products from a product nest n and customer-specific deviation $\epsilon_{i,j,w,n}$. This ϵ is unobserved by the econometrician and can represent unmeasured variables, optimization errors, and idiosyncratic preferences.

Following McFadden (1980) and Cardell (1997), I break up the unobserved deviation ϵ into three additive terms:

$$\epsilon_{i,j,w,n} = \nu^{o}_{i,j,n}\left(\sigma_o\right) + \nu^{n}_{i,j,n}\left(\sigma_o, \sigma_n\right) + \left(1-\sigma_o\right)\left(1-\sigma_n\right)\tilde{\epsilon}_{i,j,w,n}$$

The two $\nu\left(\cdot\right)$ terms incorporate the unobserved idiosyncratic taste of buyer i to wholesalers to products in nest n, and the residual disturbance $\tilde{\epsilon}_{i,j,w,n}$ is assumed to be drawn from a standard Gumbel distribution. The parameter $\sigma = \left(\sigma_o, \sigma_n\right)$ captures the relative weighting between ν and $\tilde{\epsilon}$.[28] The first ν^o denotes the correlation of ϵ between direct sourcing, indirectly sourcing from high-income foreign countries, and indirectly sourcing from low-income foreign countries. This allows for products sourced from abroad to be imperfect substitutes for domestically sourced products. The second ν^n denotes the correlation of ϵ of multi-source and single-source wholesalers conditional on sourcing from the same location. This allows for domestic products sourced by globalized wholesalers to be imperfect substitutes for products sourced by domestic-only wholesalers. The parameter σ captures the extent to which a buyer prefers a product in a particular nest. In this model, a large σ_n near 1 implies that products within a given nest are more highly substitutable within the nest than outside it. I consider alternative forms for ϵ in the Appendix.[29]

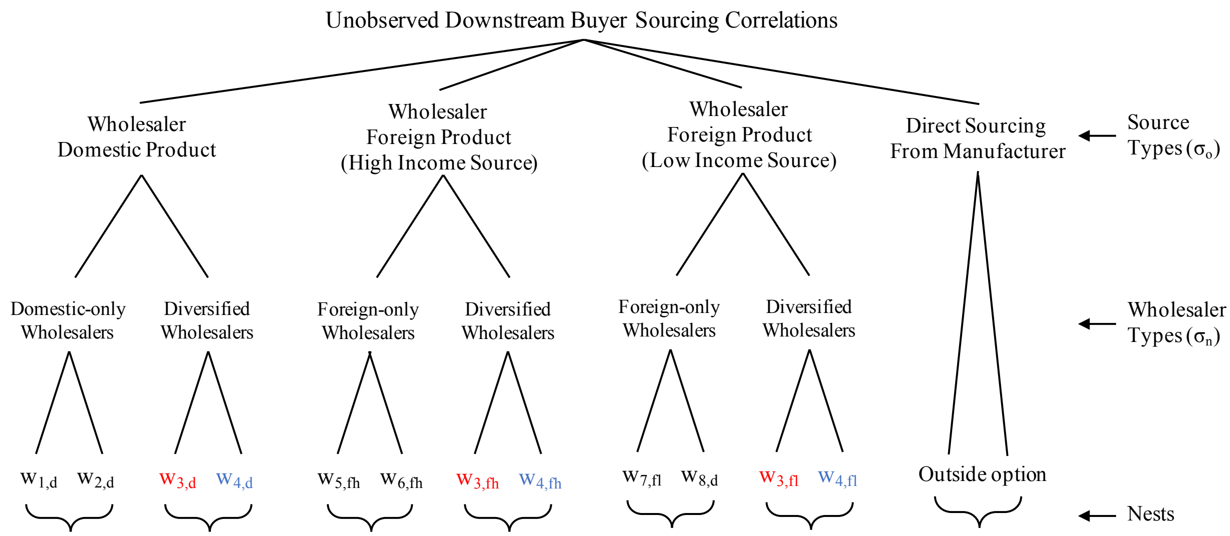
[26] This is a generalization of the Armington assumption that there is imperfect substitution between foreign and domestic varieties.

[27] In this main specification there are 7 disjoint nests; (1) directly sourced products from manufacturers, (2) products sourced domestically by single-source wholesalers, (3) products sourced from low-income countries by single-source wholesalers, (4) products sourced from high-income countries by single-source wholesalers, (5) products sourced domestically by multi-source wholesales, (6) products sourced from low-income countries by multi-source wholesalers, and (7) products sourced from high-income countries by multi-source wholesalers.

[28] The distribution ν is uniquely defined in Cardell (1997). Additionally $\sigma_{type} > \sigma_{source}$ and both $\sigma \in [0, 1)$.

[29] In the Appendix, I allow for one levels of nesting, with the product source (direct, indirect domestic, indirect high income foreign, and indirect low-income foreign) interacted by wholesaler type (grouping single-source wholesalers

Figure 4: **Stage 4 - Simplified Sourcing Error Variance Tree Diagram**



Notes: This tree diagram lists the correlation patterns for unobserved buyer valuations ϵ. The top level differentiates foreign and domestic sources. The second level differentiates wholesalers that sell both foreign and domestically sourced products from those that only sell either foreign or domestically sourced products. The bottom level nests differentiates between wholesalers, the first subscript denotes the identity of the wholesaler and the second subscript denotes the sourcing of a product. The model allows for two different types of foreign sources, those from high-income countries and from low-income countries. Wholesalers can belong to multiple bottom level nests, colors highlight wholesalers that participate in multiple nests. Additionally, all direct sourcing in lumped together in an outside option. Alternative nesting patterns are listed in the Appendix.

The mean valuation ($\delta_{j,w,n}$) of wholesaler w selling product in nest n for buyer of type j, can be decomposed into observed and unobserved components:

$$\delta_{j,w,n} \quad = \quad f_j\left(p_{w,n}, l_{w,n}, \mathbf{a}_{w,m}, q_j, l_j\right) + \xi_{w,n} \tag{2}$$

The function $f_j(\cdot)$ captures the preference of buyer type j for a particular wholesaler w selling products in nest n. These preferences are a function of both wholesaler and buyer attributes. In particular, the wholesaler price ($p_{w,n}$), wholesaler location ($l_{w,n}$) and observable characteristics ($\mathbf{a}_{w,n}$). The vector $\mathbf{a}_{w,n}$ includes characteristics of the wholesaler, such as the number and variety of international sources, as well as market-level observables, which include market-year fixed effects as well as indicators for the source of the good and the location of the wholesaler. There are two relevant buyer attributes: their location (l_j) and their purchase size (q_j). Purchase size q_j is binned into nine groups for tractability. The residual $\xi_{w,n}$ denotes the unobserved quality of wholesaler w selling products in nest n; it is realized between stages t_3 and t_4.

I use a linear functional form for δ:

$$\delta_{j,w,n} \quad = \quad \alpha^p \log p_{w,n} + \alpha^{l-state}\mathbb{I}^{l-state}_{w,n,j} + \alpha^{l-region}\mathbb{I}^{l-region}_{w,n,j} + \alpha^q \log q_j + \mathbf{a}_{w,n}\alpha^a + \xi_{w,n} \tag{3}$$

separately from multiple-source wholesalers). Results are largely unchanged. Robustness tests available on request test and reject alternative nesting structures. Non-nested models and generalized mixed logit models, in the vein of Bresnahan et al. (1997) find similar results.

The indicator function $\mathbb{I}^{l}_{w,n,j}$ captures the interaction of l_j and $l_{w,n}$; $\mathbb{I}^{l-state}_{w,n,j}$ equals one when the wholesaler and buyer are in the same state and $\mathbb{I}^{l-region}_{w,n,j}$ equals one when the wholesaler and buyer are in the same Census region. The vector $\alpha = \left(\alpha^p, \alpha^l, \alpha^q, \alpha^a\right)$ captures buyer's sensitivity to wholesaler prices, location choices, purchase quantities, and observable characteristics. In particular the parameters α^p and α^q allow me to capture the trade-off between the variable cost of buying q units at price p from a wholesaler with the fixed cost of directly sourcing q units of the good from the manufacturer. For a micro-foundation of this particular setup in relation to a downstream buyer's cost minimization problem, see Appendix B.

Conditional wholesaler market share Within buyer type j, the model follows a nested logit specification (McFadden, 1980) and aggregates across downstream buyers values for their buyer-specific shock ϵ. The probability of a purchase from wholesaler w, conditional on a downstream purchaser type j is a function of mean valuation $\delta_{j,w,n}$ and parameters σ:

$$s_{w,n|j} = s\left(\delta_{j,w,n}; \sigma\right). \tag{4}$$

This function $s(\cdot)$ has a closed form and is derived in Appendix (B.5).

Wholesaler market share The overall market shares of a wholesaler w in nest n aggregates across a wholesaler's market share across all j types of buyers:

$$s_{w,n} = \sum_{j \in \mathcal{J}} s_{w,n|j} \mu_j dj \tag{5}$$

Where $s_{w,n|j}$ represents the market share of wholesaler w with buyers of type j and μ_j denotes the relative mass of buyers of type j. Observed and recovered wholesaler and product attributes are collected as $\mathbf{x} = [\mathbf{p}\ \mathbf{a}\ \xi]$. While the mass of buyers μ_j is exogenous in this step, the next step endogenizes this choice.

3.3 Stage 3: Market Size

At t_3, downstream buyers make two decisions. First, buyers decide if they should make a purchase. Second, buyers decide how much to buy. Aggregated, these two steps establish the total downstream market size by considering both the mass of buyers and their purchase quantities.

Generally, discrete choice models assume that the total mass of possible buyers and their purchase quantities (conditional on buying) are fixed. However, this assumption is not plausible across all intermediate manufactured good markets. If a set of wholesalers enter, perhaps supplying goods from a new foreign market, there may be an increase in the overall downstream market size.

I combine both the number of buyers and how much they buy in a single step. In particular, I consider the elasticity of a market size for a buyer of type j with respect to the valuation of all wholesaler options. While adopting a slightly different functional form, this stage follows Hausman et al. (1995), where buyers first choose quantity before choosing among a set of discrete choices. This quantity choice incorporates information from the choice set in a parsimonious manner and models a situation where buyers must pick their purchase quantities before receiving their idiosyncratic cost draws ϵ.

In the absence of aggregate company size data for downstream buyers, I directly consider each downstream purchase as an independent purchaser.[30] The number of purchasers of type j varies with the vector $\mathbf{x}$ of wholesaler attributes. This allows for an increase in the number of purchases following increases in aggregate wholesale supplier quality. First, I denote the market share of purchases from buyer type j as:

$$\mu_j = \frac{q_j M_j(\mathbf{x})}{\sum_{\varsigma \in \mathcal{J}} q_\varsigma M_\varsigma(\mathbf{x})}.$$

The set $\mathcal{J}$ collects all possible types j. Let $M_j(\mathbf{x})$ denote the mass of downstream buyers of type j and q_j their purchase quantities. This function $M_j(\mathbf{x})$ captures two margins; downstream buyers can (a) choose to make a purchase or (b) change the quantity purchased due to changes in market characteristics $\mathbf{x}$. I assume the number of downstream buyers M_j is a function of their expected utility, which is denoted as:

$$M_j(\mathbf{x}) = m(EU_j)$$

where $m(\cdot)$ denotes some monotone increasing function, and $EU_j = E_j[\max_{w,n} U_{i,j,w,n}]$ denotes the expected utility for a buyer of type j integrating across ϵ. This expected utility is determined relative to the utility of directly sourcing from an upstream producer (outside option) and is determined up to a constant.

I parameterize this downstream buyer mass M_j as:

$$M_j(\mathbf{x}) = A_j \times (EU_j)^{\phi}. \tag{6}$$

The parameter ϕ denotes the elasticity of the number of purchasers relative to the aggregate valuation of purchases. The shifter A_j represents demand by downstream buyers of type j in the absence of wholesalers. In particular, as shown in Appendix B, this form of two stage decision making is consistent with simple forms of cost minimization, when costs are realized after production choices. This discrete choice setup allows me to directly measure relative expected utility EU_j using the overall wholesaler share, as $EU_j = \left(1 - S_j^W\right)^{-1}$. The variable S_j^W is the summed market share of all wholesalers selling to buyer type j:

$$S_j^W = \sum_{w \in \mathcal{W}} \sum_{n \in \mathcal{N}_w} s_{w,n|j}.$$

The set $\mathcal{W}$ refers to all wholesalers, and the set $\mathcal{N}_w$ refers to the nests wholesaler w sells in.

[30] An alternative formulation would consider the total purchase quantities, however this would require considering downstream buyers as ex-ante identical, before they make their purchase quantity decisions.

Taking logs, I obtain the relationship:

$$\log M_j = -\phi \log \left[1 - S_j^W\right] + \log A_j. \tag{7}$$

This relationship assumes that downstream buyers only realize shocks ϵ in equation (1) once they state their intent to buy a certain number of goods. For example, suppose a downstream manufacturer is considering the use of a new chemical in their production process. If the manufacturer perceives these chemicals to be cheap, they will choose to make a purchase; otherwise, they will not. This decision will rely only on the expectation of the shocks ϵ, along with the set of purchase options and their attributes, which are summarized by EU_j and A_j.

Parameters from both demand stages are collected as $\theta = [\alpha\ \sigma\ \phi\ \mathbf{A}]$. With the downstream buyer choice problem fully described, the model now describes the behavior of wholesalers.

3.4 Stage 2: Wholesaler Pricing and Marginal Costs

In stage t_2, I assume wholesalers compete on price, selling differentiated products.[31] This allows me to use a wholesaler's profit maximization conditions to recover and decompose their marginal costs, and to measure operating profits.

Wholesalers first post their prices and then sell any quantity demanded at that price. As wholesalers are not directly involved in production, they can find sources to meet any reasonable demanded quantity in the short run (see Spulber (1999) for examples).

Wholesaler w maximizes their total operating profits:

$$\pi_w = \sum_{n \in \mathcal{N}_w} \left(p_{w,n} - c_{w,n}\right) Q_{w,n}\left(\mathbf{p}, \bar{\mathbf{x}}; \theta\right), \tag{8}$$

where $p_{w,n}$ and $c_{w,n}$ represent the price and marginal cost of wholesaler w's products in nest $n \in \mathcal{N}_w$. $\mathcal{N}_w$ denotes the set of nests/sources for wholesaler w. For example, a multi-source wholesaler must choose a price for their domestically sourced and internationally sourced products. The function $Q_{w,n}(\cdot)$ denotes the expected number of purchases conditional of all other wholesalers' prices $\mathbf{p}$ as well as their non-price attributes $\bar{\mathbf{x}} = [\mathbf{x}/\mathbf{p}]$ and takes the form:

$$Q_{w,n}\left(\mathbf{p}, \bar{\mathbf{x}}; \theta\right) = \sum_{j \in \mathcal{J}} s_{w,n|j}\left(\mathbf{p}, \bar{\mathbf{x}}; \theta\right) q_j M_j\left(\mathbf{p}, \bar{\mathbf{x}}; \theta\right).$$

The conditional share function $s_{w,n|j}(\cdot)$ is defined in equation (4) and the market size function $M_j(\cdot)$ is defined in equation (6) for different purchasers buying quantity q_j.

Taking the derivative of operating profits with respect to prices and assuming profit maximiza-

[31] I assume pure-strategy prices, that are assumed to be uniquely determined. This is a typical assumption in the differentiated product demand literature, as in Nevo (2001); Eizenberg (2014). This assumption can by rationalized with the conditions imposed in Caplin and Nalebuff (1991).

tion, I can derive the marginal cost $c_{w,n}$ as a function of market observables and demand:

$$c^*_{w,n} = c\left(p_{w,n}, Q_{w,n}, \frac{dQ_{w,n'}}{dp_{w,n}}; n, n' \in \mathcal{N}_w\right). \tag{9}$$

This is a function of not only wholesaler price ($p_{w,n}$) and quantity sold ($Q_{w,n}$), but also the sales responsiveness of wholesaler w's product in nest n (say internationally sourced) with respect to the price ($dQ_{w,n}/dp_{w,n}$) and the sales responsiveness to the price for some other product in a different nest n' (say domestically sourced) sold by the same wholesaler $\left(dQ_{w,n'}/dp_{w,n}\right)$. See Appendix C for a full derivation.

These wholesalers face constant marginal costs $c^*_{w,t}$, which are a function of observable, recovered, and unobserved wholesaler-source attributes:[32]

$$c^*_{w,n} = c\left(\tilde{\mathbf{x}}_{w,n}, \nu_{w,n}\right) = \tilde{\mathbf{x}}_{w,n}\gamma + \nu_{w,n}. \tag{10}$$

The vector $\tilde{\mathbf{x}} = [\mathbf{x}/\mathbf{p}]$ includes wholesaler observables, such as the extent of international sourcing and number of domestic distribution locations, as well as the recovered wholesaler-source specific quality shock ξ from the demand choice stage. The model also allows for a univariate unobserved marginal cost shifter ν.

3.5 Stage 1: Wholesaler Market Entry

In stage t_1, wholesalers make entry decisions and pay fixed cost to realize their attributes $\tilde{\mathbf{x}}$, quality shocks ξ, and marginal cost shocks ν. When entering the market, wholesalers make two simultaneous choices: their importing profile and the configuration of their domestic distribution network.

In implementation, N wholesalers are observed entering as with configuration a, which is composed of the sourcing strategy $s \subset \mathcal{S}$ and location configuration $l \subset \mathcal{L}$. Sourcing strategies can take one of several main forms: wholesalers can choose to source domestically, from high-income foreign sources, and/or source low-income foreign sources. Furthermore, wholesalers can choose the number of foreign varieties to source. Combined, these possibilities form the set $\mathcal{S}$. In terms of distribution, wholesalers can choose to set up distribution in any of the fifty states along with the District of Columbia.

As in most entry models, this model does not necessarily have a unique equilibrium. It is possible that one equilibrium allows for only small wholesalers and another equilibrium allows for only large wholesalers. However, fixed entry costs may still be identified in these models, under the assumption that the current market configuration is some equilibrium.[33] In particular, two conditions must hold: (1) wholesalers will only enter if their expected operating profits are greater than entry costs, and (2) additional wholesalers of a type will not not earn expected operating profits greater than entry costs. Once wholesalers pay these fixed costs E_a and enter the market, each wholesaler receives a

[32]Constant marginal cost does not imply constant returns to scale, as wholesalers pay upfront fixed costs to realize attributes $\mathbf{x}$ in the first stage.

[33]For an example, see Berry et al. (2015).

draw ξ that shifts a buyer's valuation, and ν that shifts marginal costs for the products sold.

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

$$E_a \leq \mathcal{E}_{\xi,\nu}^{N}\left[\pi\left(a\right)|N\right] = \bar{E}_a \tag{11}$$

The notation $\mathcal{E}_{\xi,\nu}^{N}\left[\cdot|N\right]$ denotes the expectation over random variables (ξ,ν) conditional on N wholesalers of type $a=(s,l)$ participating.

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

$$\underline{E}_a = \mathcal{E}_{\xi,\nu}^{N+1}\left[\pi\left(a\right)|N+1\right] \leq E_a \tag{12}$$

These bounds do not require a market entry equilibrium to be computed. Rather, they only require that the current configuration of firms is in equilibrium, which does not need to be unique. Only the computation of counterfactuals require new equilibria calculation.[34]

4 Estimation and Identification

There are four types of parameters to be estimated: buyer demand parameters (α,σ), aggregate demand parameters $(\phi,\mathbf{A})$, marginal cost parameters γ, and fixed entry costs E_a. As with the model's description, estimation and identification details are described in reverse chronological order, starting with demand, then supply, and finally considering entry.

4.1 Stage 4: Choice of Downstream Buyer

The demand parameters α and σ are identified by the distribution of prices, observed wholesaler attributes, plausibly exogenous instruments, aggregate statistics across downstream buyer types, and the timing assumptions from the multi-stage model. The price coefficient α^p is identified directly from a set of geographic-based cost-shifters. The geographic and quantity based buyer valuations α^l and α^q are identified using a series of closely related aggregate moments. The parameters α^a and σ are identified from the set of observed wholesaler attributes combined with the two-stage entry game assumptions from Section 3. Parameter σ is also identified using geographic variation in the wholesaler choice set for downstream buyers. To simplify computation, I discretize the types of downstream buyers. I use 51 geographic bins (the fifty US states + DC) and nine purchase size bins (as shown in the data section).

Price Instruments An identification issue arises from the potential correlation between unobserved quality ξ and wholesaler price p. Prices in differentiated product supply system are directly

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

related to the unobserved quality ξ, as wholesalers will charge higher prices for higher quality products. Thus, a standard ordinary least squares regression of price on market shares may bias price coefficients upwards. The simplest instruments are signals of marginal costs, which are correlated with a wholesaler's cost but not the buyer's valuation ξ. These instruments shift cost and are related to prices in the vast majority of supply models. In my data, I have wholesaler-level accounting cost data $\tilde{c}$, which do not directly measure marginal costs, but are an informative signal. However, I explicitly assume that marginal costs c_w are functions of quality ξ_w; thus, instrumenting a wholesaler's own cost on the wholesaler's price is inherently problematic.

Instead, I combine the geographic nature of the Hausman et al. (1994) and Nevo (2001) instruments with standard cost-based instruments. Assume that marginal costs c_w for wholesaler w has two components, $c_{w,\xi}$ and $c_{w,l}$, where $c_{w,\xi}$ is correlated with ξ. Component $c_{w,l}$ is due to the unobserved cost of doing business in a particular location l. This includes warehouse rents and fork-lift operator labor costs. While these costs are unobserved, I use the observed average operating costs of other wholesalers in different product categories within nearby geographic regions. These costs c_{-w} only share their component $c_{-w,l}$ with c_w and are thus correlated. As cost $c_{-w,l}$ is uncorrelated with ξ_w, the independence assumption is satisfied. As marginal costs are not directly observable, I use accounting cost data and form instruments by aggregating across wholesalers in different wholesale sectors at the ZIP code, County, and State levels. I denote this accounting cost $\tilde{c}_{-w,l}$. For robustness, if ξ is correlated geographically with $\tilde{c}_{-w,l}$, I consider the change in the accounting costs of other wholesalers, $\Delta\tilde{c}_{-w,l}$. For example, changes in the accounting costs of medical equipment wholesalers in New Haven county will be used as a price instrument for industrial chemical wholesalers. This strategy assumes that the unobserved product quality for an industrial chemical wholesaler will be uncorrelated with accounting costs for medical equipment wholesalers. I collect these shifters as instruments Z_1[35]

Aggregate Moments Aggregate data on shipment patterns identifies downstream preferences for wholesale suppliers conditional on quantities demanded and local distribution. Inbound downstream shipments from wholesalers can originate from a local distribution facility or from a distant distribution facility. The probability of shipments from local facilities pins down a downstream buyer's preferences for local wholesalers. Inbound downstream shipments can originate from either a wholesaler or manufacturer. The probability of these shipments originating from a wholesaler, conditional on shipment size, identifies the preference of a downstream buyer for a wholesaler instead of direct shipments from a manufacturer.

The relative desirability of direct sourcing versus indirect sourcing is identified by using the estimated aggregate wholesaler market share for a given quantity q:

$$s_{W|q} = \sum_{w\in\mathcal{W}} \sum_{n\in\mathcal{N}_w} \sum_{j\in\mathcal{J}_q} s_{w,n|j}\mu_j,$$

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

where $s_{W|q}$ denotes the total market share of all wholesalers conditional on buyer size q. This is a function of conditional market share $s_{w,n|j}$ and buyer weights μ_j. Additionally, $\mathcal{W}$ represents the set of all wholesalers, $\mathcal{N}_w$ represents the sets of nests wholesaler w is present in, and $\mathcal{J}_q$ represents the set of buyer types j that purchase q units. This relationship helps identify α_j^q, as $s_{W|q}$ differs from $s_{W|q'}$ due to $\log(q)$ in equation (3).

The appeal of a local wholesaler versus a distant wholesaler is captured by the probability that a particular downstream buyer purchases locally versus nationally. In a similar vein, the desirability of a local wholesaler versus a distant wholesaler is identified by matching the estimated share of local, regional, and national shipments to their observed shares:

$$s_{W|d} = \sum_{w\in\mathcal{W}}\sum_{n\in\mathcal{N}_w}\sum_{j\in\mathcal{J}} s_{w,n|j}\mu_j \mathbb{I}\{l_j = l_w\}$$

The indicator function identifies shipments that do not cross state or regional lines, where the location of the buyer and the location of the wholesaler correspond. The set $\mathcal{J}$ sums across all buyer types j. This identifies α_j^q as $s_{W|d}$ differs from the unconditional share due to differences in $\alpha_j^q \mathbb{I}_{w,n,j}^q$ across wholesalers w.

In addition, the share of consumers sourcing from wholesaler that (1) source products domestically, (2) that source products globally, and (3) that source both products, in each geography is matched to observed data. This also helps partially identify the nested logit parameter σ, along with α_j^l. Collectively, I denote these aggregate moments as set $\mathbf{m}$.

Nest Correlation Coefficient Estimation uses two additional types of instruments to identify the nested logit correlation parameter σ. The first leverages the fact that wholesalers make location decisions and the discrete choice to source internationally, before realizing product quality and marginal cost draws ξ and ν. Downstream buyers have similar preferences, but some have different choice sets, due to regional variations in wholesaler networks. The second uses the fact that even without wholesalers, there would be a downstream market, and uses estimates of this counterfactual downstream market size as an instrument.

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

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

The sales share of a wholesaler w selling a product sourced from n, conditional on selling products in nest n is denoted $s_{w,n|n}$. This variable is naturally correlated with $\xi_{w,n}$ as wholesalers with higher quality draws will not only have higher unconditional market shares, but higher within-type market shares. Thus, a valid instrument needs to satisfy the exogeneity criterion, but at the same time relate to the regressor of interest. As the number and type of wholesalers is chosen before the realization of ξ, exogeneity is satisfied. The estimation strategy generalizes this to include the number of competitors within a type (single-source or multiple-source) and sourcing from particular locations (domestically, high income foreign sources, and low income foreign sources) at the regional and state level.[36] I collect these instruments as Z_2.

Aggregate Market Size Shifters The second instrument uses size of the downstream market as a shifter for the number of wholesalers present. This assumption is similar to that in Berry et al. (2015), where the total population of a consumer market is plausibly exogenous. The larger the market, the greater the possible profits and thus more wholesaler entry. However, unlike Berry et al. (2015), the total size of the downstream market is endogenous so this strategy requires a modification to split the total downstream market size into two components: one part endogenous to the presence of wholesalers and the other part exogenous to the presence of wholesalers.

While the total market downstream market size is endogenous, there also exists an exogenous "choke" market size, the size of the market without the presence of **any** wholesalers. This is consistent with location choices of upstream manufacturing suppliers occurring in a pre-period. The number of downstream buyers in this world is related to a baseline demand; in markets with a high downstream baseline demand, many wholesalers are likely to enter, driving down realized market shares. There is likely more business to be "stolen" from competitors and more downstream buyers to serve. In a world with low baseline downstream demand, fewer wholesalers will enter, but they will individually have larger market shares. Formally consider the value A_j from Equation 6. Even if the total value of wholesaling is zero, downstream market demand is realized as $M_j^{CF} = A_j$. By summing across discrete buyer types j, total counterfactual downstream demand without wholesalers is:

$$M^{CF} = \sum_{j \in \mathcal{J}} M_j^{CF}.$$

Thus, the aggregate instrument M^{CF} and the disaggregated instruments M_j^{CF} are exogenous to ξ_w. The estimation routine uses the logarithm of a local demand version for location l:

$$\log M_l^{CF} = \log \sum_{j \in \mathcal{J}_l} M_j^{CF}.$$

The sum aggregates across the set $\mathcal{J}_l$, which denotes the set of buyer types j that are based in location l. I collect these instruments as Z_3.

[36] Estimation considers the logarithm of these variables.

Empirical Implementation

Estimation follows Petrin (2002), adapted to a multiple-stage nested-logit model with observably heterogenous agents. Conditional on parameters and observable data, equations (2) - (5) produce estimates for unobserved quality ξ and aggregate moments $\mathbf{m}$. A generalized method of moments objective function is constructed using the following two sets of moments:

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

The matrix Z consists of cost-shifters (Z_1, Z_2, Z_3) and the other exogenous observable attributes of a wholesaler (the data X, excluding prices p), which are assumed to be chosen before the shock ξ is known. The vector $\mathbf{m}_{data}$ consists of the empirical analogs of estimated aggregate moments $\mathbf{m}$. See Appendix B.5 for a full description of the empirical estimation routine.[37]

4.2 Stage 3: Market Size

The first stage of demand is identified simultaneously with the second stage. I seek to (a) estimate the elasticity ϕ of the number of downstream purchasers with respect to the aggregate mean utility provided by wholesalers and (b) recover the the size of the market without wholesalers $\mathbf{A}$.

Estimation uses equation (7), reproduced below:

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

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

$$\log M_{c,q,l} = -\phi \log \left[1 - S^W_{c,q,l}\right] + \lambda_{c,l} + \lambda_{c,q} + \lambda_{l,q} + \lambda_{c,q,l}. \tag{13}$$

The covariate $\lambda_{c,l}$ represents a fixed effect for a particular product c sold in region l, $\lambda_{c,q}$ represents a fixed effect for a particular product c sold at quantity q, and $\lambda_{l,q}$ represents a fixed effect for shipments of quantity q in a given region l. These covariates represent the local demand for certain products, the general nature of that demand, and the market size of that downstream location. The

[37] Geographic controls are included at the census-division-market level as a robustness check. Results are largely unchanged.

last term $\lambda_{c,q,l}$ represents the **deviation** of a particular (c,q,l) from the three previous fixed effects. The residual term A_j equals $\exp(\lambda_{c,l}+\lambda_{c,q}+\lambda_{l,q}+\lambda_{c,q,l})$, where the first three linear terms are controlled for, but the last term is unobserved. I then collect the set of residual demand shifters in vector $\mathbf{A}=\{A_j\}$.

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

Estimation assumes that $E[X_D\lambda_{c,q,l}]=0$, where X_D includes share of goods sourced from wholesalers and the three fixed effects. Econometrically, the last lambda, $\lambda_{c,q,l}$ is not controlled for and may be correlated with wholesaler market shares. A related econometric risk is reverse causation: higher demand M may induce more wholesaler entry. Due to the timing assumptions made, structure of demand and explicit product-location fixed effects controlling for wholesaler presence, I explicitly rule this out.

As a robustness check, I can use geographic instruments (as first used by Hausman (1996)) to discipline $\lambda_{c,q,l}$ and $M_{c,q,l}$. I assume that $\lambda_{c,q,l}$ is uncorrelated with $\lambda_{c,q,l'}$ for location $l\neq l'$ after correcting for the previously mentioned fixed effects. As wholesalers can ship across state-lines, my model assumes that $S^W_{c,q,l}$ is correlated with $S^W_{c,q,l'}$. Thus, I instrument $S^W_{c,q,l}$ using the average of $S^W_{c,q,l'}$ across all l' in set of states $\mathcal{L}^n_l$ that neighbor location l. This assumes that $M_{c,q,l}$ is correlated to $M_{c,q,l'}$ only through $S^W_{c,q,l'}$ and the fixed effects.[38]

4.3 Stage 2: Wholesaler Pricing and Marginal Costs

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

Marginal costs are directly derived from equation (9). They are a function of the demand parameters $\theta=(\alpha,\sigma,\phi)$, the recovered product qualities ξ, and aggregate demand shifters $\mathbf{A}$, all conditional on observed and recovered data $\mathbf{X}=[\mathbf{p}\ \mathbf{a}\ \xi]$.[39]

Once recovered, wholesaler attributes can be projected onto these marginal costs. Marginal costs $\hat{c}_{w,n}(\theta,\mathbf{A};\mathbf{X})$ are a function of wholesaler attributes:

$$\log\hat{c}_{w,n}(\theta,\xi,\mathbf{A};\mathbf{X}) \quad = \quad \tilde{\mathbf{x}}_{w,n}\gamma+\nu_{w,n}, \tag{14}$$

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

[39] In implementation, this step needs function M_j, requiring the demand parameter A_j. In the estimation of demand, A_j is assumed to have an idiosyncratic component $\lambda_{c,q,l}$. (See equation (13)). The estimation routine therefore uses the distribution of $\lambda_{c,q,l}$ to produce an estimate of the expected value of A_j: $\tilde{A}_j=\mathbb{E}(A_j)$. The econometric specification in 13 assumes that $E[\lambda_{c,q,l}]=A$. This step uses the resulting distribution of λ and takes an exponential transformation to derive the expectation of A.

where $\tilde{\mathbf{x}} = [\mathbf{x}/p]$ are all characteristics after omitting price. As a slight departure from the standard methodology, marginal costs are a function of unobserved quality ξ. Products with higher ξ, especially concerning better customer service or availability, are likely to incur higher marginal costs. The structural error $\nu_{w,n}$ is assumed to be known only after all wholesaler attributes are chosen, but before markups are chosen. I assume that there exists Z_ν, such that $E\left[\nu Z_\nu\right] = 0$. As quality ξ and wholesaler attributes x are chosen or realized in a earlier period, these characteristics form a plausible vector Z_ν.

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

4.3.1 Dealing with wholesalers participating in both domestic and international trade

The underlying data only provides prices for wholesalers that source from a single source. Prices for multi-product wholesalers are only reported in aggregate. To get prices and costs by source, multi-product wholesaler details are recovered separately using data from single-product wholesalers. The primary estimation of stages 2-4 are done only for single product wholesalers. This stage recovers the parameters for multi-product wholesalers that source both domestically and from abroad.

For exposition, assume a wholesaler sells both a domestically sourced product D and a internationally sourced product F. Instead of observing prices $p_{w,F}$ and $p_{w,D}$ separately for goods sourced internationally and domestically, I only observe the sales weighted average $\bar{p}_w$, where the weights are the known sales shares, $M_{w,F}$ and $M_{w,D}$. The pricing estimation stage recovers multiplicative markups $\mu_{w,F}$ and $\mu_{w,D}$, as well as data on single-product wholesalers on $c_w\left(\cdot\right)$. For details on markup calculations see Appendix C.

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

$$\bar{p}_w = M_{w,D} p_{w,D} + M_{w,F} p_{w,F} \tag{15}$$

$$p_{w,D} = \mu_{w,D} c_{w,D} \tag{16}$$

$$p_{w,F} = \mu_{w,F} c_{w,F}. \tag{17}$$

To close the system, I assume that the unobserved component of cost $\nu_{w,t}$ is identical across domestically and internationally sourced goods, rewriting equation (14) as:

$$\log c_{w,F} - \log c_{w,D} = \bar{\mathbf{x}}_{w,F} \gamma_F - \bar{\mathbf{x}}_{w,D} \gamma_D \tag{18}$$

This is justified as wholesalers appear to provide the same levels of customer service to their downstream buyers, even if product acquisitions costs observably differ, once attributes x are accounted for. A product that originates from China likely is handled and shipped by the same warehouse worker as a product produced in Alabama.[40]

Equations (15) - (18) can be combined to solve for $p_{w,D}$, $p_{w,F}$, $c_{w,D}$ and $c_{w,F}$.[41] This technique is easily generalizable to more than two products.

4.4 Stage 1: Wholesaler Market Entry

Market entry cost estimation utilizes a set of equilibrium assumptions. As direct evidence on fixed costs is sparse, they are recovered indirectly. Bounds for wholesaler entry costs (E_a) for a wholesaler with configuration a directly uses two equilibrium conditions: (1) wholesalers will only enter if their expected operating profits are greater than entry costs, and (2) additional wholesalers of the same configuration will not earn expected operating profits greater than entry costs. As shown in equations (11) and (12), these equilibrium conditions imply upper bounds $\bar{E}_a$ and lower bounds $\underline{E}_a$ on entry costs. The following empirical analogs are computed:

$$\mathbb{E}_{\xi,\nu}\left[\pi\left(a\right)|N\right] = \bar{E}_a$$

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

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

These bounds are empirically implemented by simulating counterfactual net profits π_a for each type of wholesaler a. This estimation technique can hypothetically provide extremely wide bounds. In practice, due to the number of wholesalers typically available in a market, bounds are relatively narrow, with the exception of the very largest wholesalers.[42]

[40] Single-source wholesalers may be systematically different from multi-source wholesalers; this is controlled for by (a) using $\bar{\mathbf{x}}$ to govern differences in marginal costs and (b) only considering differences in marginal costs, not levels.

[41] In practice, I use two more equations with two more unknowns. I use $\delta_{w,D}$ and $\delta_{w,F}$ from the demand estimation to recover $\xi_{w,D}$ and $\xi_{w,F}$. In this simplified example:

$$\begin{aligned}\delta_{w,D} &= \alpha^p \log p_{w,D} + \mathbf{x}_{w,D}\gamma_D + \xi_{w,D},\\ \delta_{w,F} &= \alpha^p \log p_{w,F} + \mathbf{x}_{w,F}\gamma_F + \xi_{w,F}.\end{aligned}$$

[42] Such bounds are computed for every every possible observed configuration of a wholesaler. As there technically are 2^{51} possibilities for wholesaler location choices, not all possible configurations are seen in the data and the counterfactual will only consider the number of locations, not the specific configuration. This revealed preference approach can extended to consider the costs for a particular wholesaler to change their configurations. This is left for future research.

5 Results

5.1 Stage 4: Choice of Downstream Buyer

Table 5: **Downstream Firm Choice Estimates**

	est/se		est/se		est/se
log (price)	-2.496	$\mathbb{I}_{\{\text{Same State}\}}$	3.329	log {Shipment Size}	-0.318
	0.0665		*0.0464*		*0.0024*
log (Locations)	0.179	$\mathbb{I}_{\{\text{Same Census Region}\}}$	1.358		
	0.0038		*0.0817*		
σ_o	0.621	$\mathbb{I}_{\{\text{South Imports}\}}$	-2.929	$\mathbb{I}_{\{\text{North Imports}\}}$	-2.772
	0.0130		*0.0131*		*0.0102*
σ_n	0.671	$\times$log (south varieties)	0.654	$\times$log (north varieties)	0.656
	0.0235		*0.0088*		*0.0071*
Fixed Effects	Market $\times$ Source, Year $\times$ Source, Census Region $\times$ Year				

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

Table 5 reports results from the estimation of downstream buyer choices. All coefficients, except for σ, are relative to direct purchases from manufacturers. As noted in Section 4.3.1, estimates are derived from single-source wholesalers.

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

Three coefficients consider the importance of observed downstream buyer heterogeneity and are precisely identified by the aggregate moments. A wholesaler in the same state, and to a lesser extent in the same census region, is extremely valuable for downstream buyers. Similarly, the benefit to indirect sourcing versus direct sourcing is declining in shipment size. Quantifying the buyer tradeoff between scale and indirect sourcing, wholesalers provide almost no benefit to downstream buyers receiving the largest shipments.

The nest coefficients σ relate to the substitutability between internationally sourced and domestically sourced goods, as well as between wholesaler types (single-source versus multi-source). A value of 1 implies zero substitutability between these categories, and a value of 0 implies no differentiation in the substitutability between categories. I find there to be imperfect substitutability between domestically and internationally produced varieties (σ_o), as well as between wholesalers with different sourcing strategies (σ_n). This is important since it implies that (a) internationally sourced varieties are imperfect substitutes for domestically sourced varieties and (b) multi-source

Table 6: **Market Size Estimation (1st Demand Stage)**

Specification	(1)	(2)	(3)	(4)
ϕ	0.241	0.214	0.245	0.281
	(0.0197)	*(0.0410)*	*(0.0185)*	*(0.0319)*
Fixed Effects				
Product-Year×Location	x	x	x	x
Product-Year×Shipment Size	x	x	x	x
Location×Shipment Size	x	x	x	x
Product-Year Aggregation	SCTG-4	SCTG-4	SCTG-5	SCTG-5
Industry Weights		X		X

Notes: Regression results use the logarithm of total market size as the dependent variable. Robust standard errors clustered by product-year presented. See text for full regression specification.

wholesalers are imperfect substitutes for single-source wholesalers. An analogy from retail for (a) would be that Parmesan Cheese (from Italy) and Vermont Cheddar (sourced domestically) are imperfect substitutes. For (b), this implies that buying Parmesan Cheese from an Italian-only grocery store is different than buying the same cheese from Whole Foods.[43]

5.2 Stage 3: Market Size

Estimates for the elasticity of the downstream market size with respected to expected utility from wholesaling are reported in Table 6. Columns (1) - (4) report results across various specifications. Shipments are binned in the same nine size categories as in the demand choice estimates. Locations consider the fifty disjoint US states as well as the District of Columbia. Product-year categories consider Standard Classification of Transported Goods (SCTG) good classifications, which are more disaggregated than the wholesaler NAICS categories used in the demand choice estimation. Columns (1) and (2) consider 4-digit SCTG categories and specifications (3) and (4) consider 5-digit SCTG classifications. In general, more disaggregated classifications lead to more fixed effects and higher R^2 values, even though the parameter estimates do not significantly change. Columns (2) and (4) weight results based on market size.

In general, all four specifications find precise parameter estimates for the elasticity ϕ between .25 and .30. I will use estimates from specification (4) in the counterfactual analysis as well as subsequent estimation as it is robust to the greatest number of fixed effects and includes the finest level of disaggregation.

5.3 Stage 2: Wholesaler Pricing and Marginal Costs

Wholesaler-level marginal costs are broken down in Table 7 following equation (14) and regress the logarithm of marginal cost on a set of covariates. The specification includes source-product-markets

[43] As $\sigma_{source} \approx \sigma_{wholesaler}$, the nesting order of these nests are of second order importance, and can be collapsed to one level.

Table 7: **Log Marginal Cost Regressions**

	est/se		est/se		est/se
log (Locations)	-0.104	$\mathbb{I}_{\{\text{South Imports}\}}$	0.118	$\mathbb{I}_{\{\text{North Imports}\}}$	0.095
	0.001		*0.002*		*0.002*
ξ	0.289	$\mathbb{I}_{\{\text{South Imports}\}} \times \xi$	-0.119	$\mathbb{I}_{\{\text{North Imports}\}} \times \xi$	-0.058
	0.001		*0.001*		*0.001*
		$\mathbb{I}_{\{\text{South Imports}\}} \times$	-0.054	$\mathbb{I}_{\{\text{North Imports}\}}$	0.001
		log (south varieties)	*0.001*	$\times$log (north varieties)	*0.001*
Fixed Effects	Market $\times$ Source $\times$ Year, Census Region				

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

fixed effects (at the 5-digit NAICS wholesale level) and geographic fixed effects at the state-level. The marginal cost of distributing globally sourced products is 10% higher than distribution for domestically sourced products. Similarly, higher quality shocks ξ imply higher marginal costs, though this relationship is stronger for domestically sourced products than internationally sourced ones. Finally, wholesalers with many domestic distribution locations have substantially lower marginal costs, perhaps reflecting better optimization technology.

Implied Markups To gauge the importance of considering localized, geographically linked markets, Table 8 compares implied markups and marginal costs across three scenarios. Panel A considers the mean wholesaler's marginal cost of delivering \$1 of upstream producer output to a downstream buyer. Panel B displays the mean wholesaler markup for delivering the same \$1 of upstream producer output to a downstream buyer. Panel C presents the implied aggregate profits from equation 8. In each panel there are three rows. The first presents results from the full localized demand model, the second from a model with a single national market, and the last from a model with monopolistic competition. These comparisons are relevant as the vast majority of international trade models consider monopolistic competition.

In terms of marginal costs, the full model produces marginal costs about 7-8% lower than monopolistic competition, markups 4-5% higher than monopolistic competition, and implied operating profits 4-7% larger. This difference is even starker when looking at the change across time to marginal costs and markups. From 1997 to 2007, the marginal costs increase is 22% smaller under the full model when compared to a simple monopolistic competition model. Similarly, the mean markup increase is 50% greater under the full model in comparison to monopolistic competition. Even if the differences between models are considered small within a cross-section, the inter-temporal trends are relevant. Essentially, a wholesaler may have a small localized monopoly (say within New England) and may exert market power with only small buyers in that region alone. The full "localized mar-

Table 8: **Supply Estimation Statistics**

Year	1997	2002	2007
Panel A: Marginal Costs ($ per $1 of producer output)			
Localized Markets	0.192	0.199	0.207
National Markets	0.197	0.204	0.213
Monopolistic Competition	0.204	0.212	0.222
Panel B: Markups ($ per $1 of producer output)			
Localized Markets	0.194	0.197	0.200
National Markets	0.190	0.192	0.195
Monopolistic Competition	0.183	0.184	0.186
Panel C: Wholesaler Operating Profits (Real 2007 $B)			
Localized Markets	264.7	310.4	443.2
National Markets	259.2	302.9	431.0
Monopolistic Competition	250.7	288.1	404.6

Notes: Marginal costs and markups derived from equation (9). Wholesaler operating profits derived from equation (8). Localized markets imply downstream customer heterogeneity and wholesaler market power. National markets allow for wholesaler market power, but no downstream customer heterogeneity. Monopolistic competition shuts down both downstream customer heterogeneity and wholesaler market power. Results are the sums across all considered wholesale markets.

kets" model accounts for this market power, while models with a single national market average out wholesaler market shares across markets and thus attenuate any market power findings. The standard monopolistic competition model performs the worst, as it fails to account for any differences in market power due to wholesaler size.

5.4 Stage 1: Wholesaler Market Entry

Table 9 considers the lower and upper bounds of fixed entry costs E_a for each type of wholesaler a. While the underlying calculations are done by wholesaler type and industry, displayed results are the product of regression of wholesaler and market characteristics regressed on fixed entry cost estimates. These results are further binned by broad type groupings a'. Additionally, due to small sample sizes, 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, fixed entry costs are between $495,000 and $500,000. Similarly, wholesalers that participate in international trade and operate in at least four states have fixed costs between $22 and $25 million dollars. This discrepancy is even greater for wholesalers in 2007. Moreover, this table also shows that the biggest gains in operating profits go to wholesalers that both participate in international trade and have extensive domestic distribution networks.

Table 9: **Average Entry Costs Across Product Markets** ('000 2007 Dollars)

Year	1997		2007	
Wholesaler type / # of Locations	Domestic Distributor	International Importer	Domestic Distributor	International Importer
One State	[$495 500]	[1,046 1,076]	[629 638]	[1,398 1,462]
Two States	[3,098 3,142]	[3,903 4,137]	[4,042 4,113]	[5,040 5,386]
Three States	[4,485 4,546]	[6,285 6,808]	[8,473 8,772]	[11,870 13,700]
Four-Six States	[8,963 9,189]	[9,285 9,895]	[15,080 15,660]	[23,740 28,140]
Seven+ States	[36,910 38,880]	[36,630 40,820]	[39,820 42,470]	[51,180 57,050]

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

Table 10: **Increasing in Returns to Scale + Global Sourcing: Change in Operating Profits from 1997 to 2007**

Number of Distribution Warehouses	Wholesaler Type	
	Domestic Distributor	International Importer
One State	28%	36%
Two States	31%	30%
Three States	93%	101%
Four-Six States	70%	184%

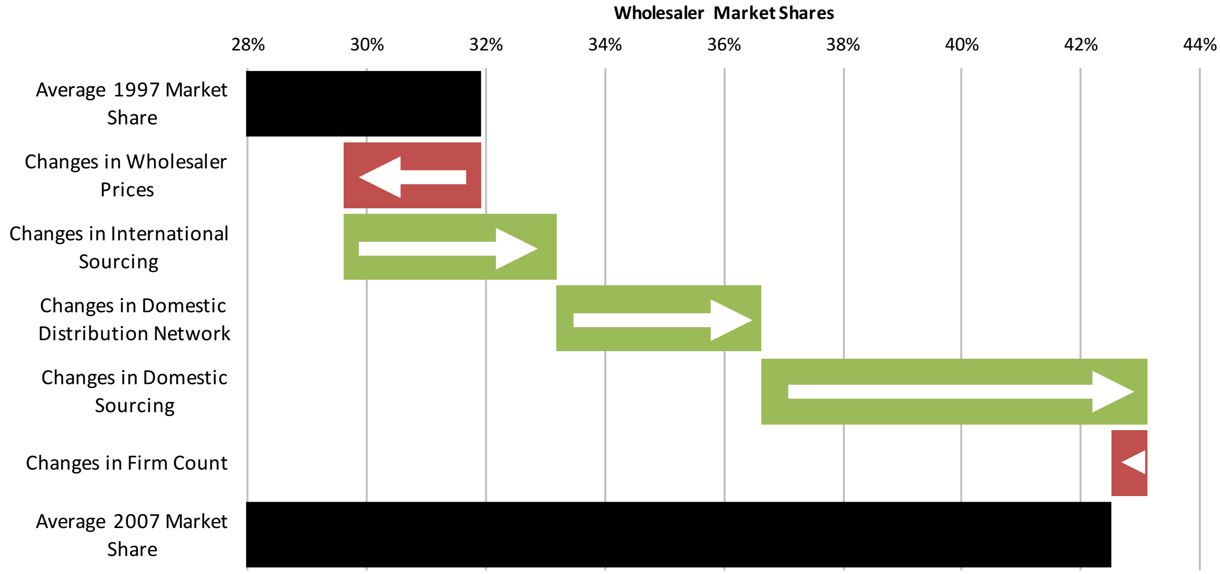
Notes: Each cell displays the percentage change in real operating profits for the average firm between 1997 and 2007.

Complementarity Between International Trade and Distribution Network Expansion

Table 10 quantifies both the increasing returns to scale over time and the complementarity between the number of wholesaler distribution warehouses and global sourcing. This table displays wholesaler operating profits, averaged across industries and binned by wholesaler types. From 1997 to 2007, a wholesaler with only one distribution center that sources only domestic products saw operating profits increase only 28%. An otherwise similar wholesaler, but that also sourced products from abroad saw profits increase 36%. A wholesaler that sources only domestic products, but operates a domestic distribution network with a presence in four or more states saw profits increase 70%. However, a wholesaler that (a) imports products and (b) operates a domestic distribution network present in four or more states, saw real operating profits more than double, increasing 184%. It is this complementarity that both motivates and underpins the results in the counterfactuals.[44]

[44]Statistics are not computed for wholesalers that distribute in seven or more states, as there are compositional changes, along with small sample sizes; this renders direct comparison with other groups problematic.

Figure 5: Wholesaler Growth Decomposition



Notes: This chart decomposes changes to the market shares of wholesalers versus direct distribution from 1997 to 2007. In terms of interpretation, the topmost bar represents the market share of wholesalers in 1997. The red second line indicates if wholesaler prices in 1997 reflect wholesaler prices in 2007, wholesale market share would be approximately 2 percentage points lower. The third green line indicates that if wholesaler distribution networks in 1997 resembled wholesaler distribution networks in 2007, wholesaler market share would be 3 percentage points higher. Similar calculations take place for changes in domestic sourcing quality, international sourcing quality and wholesaler numbers. Data is aggregated across markets and normalized to account for changes in market sizes.

6 Growth Decomposition

The probability of a buyer sourcing from a wholesaler has increased about 35% from 1997 to 2007, even though the number of wholesalers has fallen. There are multiple channels to decompose out buyer gains from wholesaling. These include changes in buyer types, wholesaler varieties, prices, economies of scale and quality (which can be further decomposed into gains from domestic and international sourcing strategies), and local product availability. What are the relative importance of each of these channels? Table 11 and Figure 5 decompose these gains through the lens of the demand and pricing models.

Table 11 nets out difference in the distribution of downstream buyers[45] and considers changes in four categories; price effects, domestic distribution networks, domestic and international sourcing, and the variety of wholesalers. Column (1) displays these results considering the average of these effects across all sample markets. These changes are further broken down according to the size of the wholesalers. The column sums to 100%, accounting for the total change in wholesaler market share from 1997 to 2007. Columns (2), (3), and (4) consider the smallest 90% of wholesalers, the

[45] Formally, counterfactuals are run considering only the composition of buyers in 2007; the changes in wholesaler market shares due to changes the composition of buyers in 1997 is netted out. In addition, as the underlying counterfactual decompositions do not linearly sum up to 100% as effects can interact both positively and negatively, the data presented data is normalized as to sum to 100%. Non-normalized figures are available on request.

Table 11: **Decomposition of Shift to Wholesaling from 1997 to 2007**

	All Firms	Wholesale Firm Percentile		
		Bottom 90%	90-99%	Top 1%
	(1)	(2)	(3)	(4)
Aggregate	100.0%	12.1%	29.0%	63.5%
Gains Due To Price Effects	-14.9%	1.0%	-2.2%	-13.7%
Due To Changes in Marginal Costs	-12.7%	0.8%	-1.7%	-11.9%
Due To Changes in Markups	-2.2%	0.2%	-0.5%	-1.8%
Gains Due to Domestic Distribution	21.2%	0.5%	2.6%	18.2%
Gains Due to Sourcing Quality	98.4%	10.7%	28.6%	59.1%
Due to Domestic Sourcing	64.4%	7.6%	19.0%	37.8%
Due to International Sourcing	33.9%	3.0%	9.6%	21.3%
Gains Due To Variety (Logit/CES Taste)	-4.6%			

Notes: This table decomposes changes to the market shares of wholesaler distribution versus direct distribution from 1997 to 2007. In terms of interpretation, the topmost line represents the percentage of change in market shares of wholesaler in 1997 to 2007. Changes in the quality and number of the smallest 90% of wholesalers account for 12% of the change. Similarly changes in the quality and number of the top 1% of wholesalers account for 64% of the change in wholesaler market shares. The next eight lines decomposes this by various changes to wholesaling from 1997 to 2007. For example the first column of the second line states that wholesaler market share in 1997 would be 15% smaller than the observed wholesale market share if wholesalers charged prices similar to 2007. . Data is averaged across markets and normalized to account for changes in market sizes.

middle 90-99% of wholesalers, and the largest 1% of wholesalers respectively. Figure 5 presents the aggregate results graphically. Positive numbers indicate changes that are surplus enhancing for buyers and negative numbers indicate changes that are surplus reducing.

The first channel considers changes in prices, which are decomposed into changes in markups and marginal costs. 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 15 percent larger. This change is driven by both increases in marginal costs and changes in markups. As shown in Section 5 and Table 7, both internationally sourced products and high quality domestic distribution incur higher marginal costs. While smaller in comparison, markups also increase, reflecting increased market power, primarily for the largest 1% of wholesalers.[46]

The second channel reflects changes in domestic distribution networks due to more comprehensive regional and national warehouse location choices. This accounts for a quarter 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.

The third channel considers the changes to the quality of domestic sourcing and international

[46]Note, the demand estimates find that market power and marginal costs actually decrease for the smallest wholesalers, reflecting a selection effect with the smallest inefficient wholesalers exiting the market. Markups do not increase much for the largest wholesalers as these wholesalers expand into new states, where they may not be large enough to exert enough market power.

sourcing through wholesalers. Changes in domestic sourcing account for 2/3 of this change, and changes to international sourcing account for the remaining 1/3. This reflects either better customer service for downstream buyers or more comprehensive procurement strategies from wholesalers. Wholesalers may offer more varieties within each category. While the changes to the quality of domestically procured products are distributed among wholesalers in proportion to wholesaler market size, changes to the quality of internationally procured products accrue mostly to the largest wholesalers.

The last channel is due to the presence of idiosyncratic downstream buyer-wholesaler preference shocks. Downstream buyers choose the source with the highest value (or lowest cost) inclusive of these shocks. As the number of wholesalers decrease, wholesale market share mechanically falls, as downstream buyers receive fewer shocks to choose from. If the number of wholesalers in 2007 was at 1997 levels, the change in wholesaler market share would be 5% smaller.

7 Gains from Intermediated International Trade

To quantify the welfare effects of intermediated international trade and innovations in wholesaling, I focus on the role of international trade and 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. In the Appendix, I consider a second scenario that measures aggregate gains in the wholesaling industry from 1997 to 2007, i.e. the inter-temporal gains.

I conduct two forms of counterfactuals; one fixes the set of wholesalers and the other allows for wholesaler entry/exit. The first counterfactual design considers the current set of wholesalers to be fixed and restricts them to only distributing domestically sourced products. Even without new entry and market repositioning by existing wholesalers, this simulates the short-run changes in outcomes due to wholesaling. The second counterfactual design takes seriously 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, and their market implications. If particularly valuable wholesalers (from a buyer perspective) exit, this could lead to negative consequences. However, if entering wholesalers exert less market power then exiting wholesalers, this could lead to positive outcomes.

Counterfactual Statistics

Wholesalers alter the market in three significant ways: through a market size effect, a market surplus effect, and a scale effect. First, wholesalers increase the total downstream market by allowing more buyers to purchase goods. Second, wholesalers provide value to downstream buyers that would otherwise directly purchase goods from manufacturers. Third, large wholesalers achieve larger economies of scale and provide better benefits to downstream customers, while exerting market

Table 12: **Surplus Changes from Intermediated International Trade**

	Baseline			Counterfactual 1 Static Gains			Counterfactual 2 Static + Entry/Exit		
	1997	2002	2007	1997	2002	2007	1997	2002	2007
Panel A: Levels									
Number of Wholesalers	221,500	217,900	213,800	221,500	217,900	213,800	298,700	296,300	290,900
Number of Wholesalers/Market	3,955	3,891	3,818	3,955	3,891	3,818	5,334	5,291	5,195
Total Purchased Value	\$3,327	\$3,385	\$4,263	\$3,276	\$3,319	\$4,144	\$3,247	\$3,269	\$4,071
Average HHI	219.3	291.9	327.7	213.0	274.9	283.5	66.1	92.8	107.9
Wholesaler Mean Market Share	43%	49%	55%	40%	45%	50%	38%	43%	48%
Implied Markups	0.194	0.197	0.200	0.193	0.195	0.196	0.183	0.184	0.186
Panel B: Changes									
Δ Downstream Surplus (bil)				\$131	\$152	\$222	\$172	\$220	\$314
Δ Wholesaler Profits (bil)				\$3	\$6	\$7	\$0	\$0	\$0
Δ Surplus + Δ Profits (bil)				\$134	\$158	\$228	\$172	\$220	\$314
Δ Surplus/Purchased Value				4.1%	4.8%	5.5%	5.3%	6.7%	7.7%
Δ Market Size (bil)				\$51	\$66	\$119	\$80	\$116	\$192
Δ Market Size/Purchased Value				1.5%	1.9%	2.8%	2.4%	3.4%	4.5%

Notes: Static gains are computed as the compensating variation needed to maintain the same expected utility for downstream customers, assuming no changes in the number, type or prices of wholesalers. Static gains allow wholesalers to change their prices in response to changes in their ability to source international varieties. Entry/Exit gains allow wholesale firms to enter or exit the market due to changes in fixed costs and operating profits due to change in international sourcing. All figures in Billions of 2007 dollars.

power.

Market Size Gains The mechanism by which wholesalers increase the total market size is encompassed by the aggregate downstream demand stage. As the expected utility of purchasing from a wholesaler increases, existing downstream buyers will not only decide to purchase from a wholesaler, but new downstream purchasers will enter the market.

Surplus Gains I compute changes in the value of indirect sourcing to downstream buyers as well as changes in wholesaler profits. Wholesalers can improve the downstream surplus of buyers that already purchase from wholesalers, or those that switch from purchasing directly from manufacturers. Through estimates of the indirect utility function in equation (1), I back out the monetary valuation of these changes. In addition, counterfactual wholesaler profits can be computed using the estimated wholesaler fixed entry and market positioning costs.

Changes Due to Entry/Exit Wholesaler entry and exit can cause further shifts in both downstream buyer surplus and wholesaler profits. Changes in the fixed cost of wholesaler entry, from changes in returns to scale, can lead to changes in the composition of wholesalers and their benefits to downstream firms. Previewing my findings, international trade allows for a large number of high quality nation-wide wholesalers and nearly doubles the direct surplus gains from intermediated international trade.

Counterfactual estimation is hard due to the difficulty (a) in finding all equilibria and (b) in choosing the correct alternative equilibrium.[47] As the entry and exit of wholesalers allows for many possible counterfactual equilibria, computation simplifies the choice set of entrants and their decisions. Instead of allowing for the full set of wholesaler choices a used in estimation, a simplified set a' will be used. In terms of the pricing game, wholesalers will have iterated best responses calculated starting from their marginal costs.[48] Wholesalers continue to (a) enter while expected operating profits are higher than fixed costs and (b) exit if operating profits do not cover fixed costs.

7.1 Counterfactual 1: Fixed Set of Wholesalers

Table 12 summarizes the market effects of indirect international sourcing under the two counterfactuals. The first set of columns presents baseline results for 1997, 2002, and 2007. The second set of columns, labeled "Counterfactual 1," summarizes changes due to indirect international sourcing,

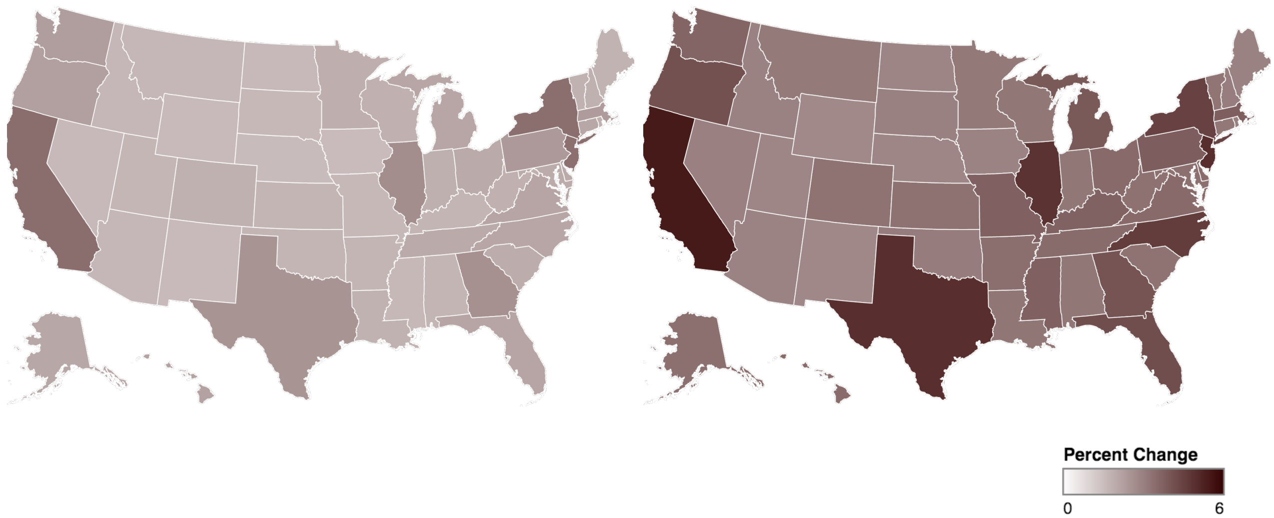
[47] Wholesalers must choose which of the 51 geographic locations to participate in, along with the choice to participate in both domestic and different forms of international sourcing. This produces $2^{51} \times 7 \approx 2 \times 10^{16}$ possibilities per wholesaler. The typical market has over 3000 wholesalers, so competitive effects across all these wholesalers must also be computed.

Solving for a single equilibrium, let alone establishing uniqueness is a Sisyphian task without further simplifying assumptions. In terms of the single firm problem, Jia (2008) and Seim and Waldfogel (2013) make progress. However, these frameworks do not solve for the best solution in light of competitive behavior or more then two heterogenous firms. Jia (2008) finds a solution that relies only on having one competitor, and Seim and Waldfogel (2013) heavily restrict the behavior of competitive firms by limiting heterogenity.

[48] This avoids the issue of multiple equilibria in pricing.

Figure 6: **Increase in Buyer Surplus due to Intermediated International Trade**

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



considering wholesaler price responses, but not wholesaler entry/exit decisions. The third set of columns labeled "Counterfactual 2" allows for wholesaler entry/exit and is discussed in the next section. Panel A displays the results of each counterfactuals in levels. Panel B considers changes in wholesaler profits and changes in downstream buyer surplus.

In this scenario, as shown in Panel A, market size and wholesaler market shares slightly decrease in all three years. This reflects the value downstream buyers place on sourcing products from abroad through wholesalers. Wholesaler market share falls, as international sourcing is heavily concentrated in the largest wholesalers. This also causes a similar decrease in markups.

Panel B considers the changes in market outcomes. In 1997, the loss of indirect international sourcing by wholesalers would reflect a \$131 billion loss in surplus (in 2007 dollars), or 4.1% of downstream expenditures. Analogously in 2007, the loss would reflect a \$222 billion decrease in surplus, or 5.5% of downstream expenditures.[49] The last row in Panel B computes changes in downstream market size due to indirect international sourcing. In 1997, total manufactured good purchases would be \$50 billion smaller, a 1.5% decrease, without indirect international sources. In 2007, there would be \$119 billion fewer downstream purchases of manufactured goods, a 2.8% decrease. These figures can be further decomposed across types of downstream buyers, both geographically and by purchase size.

Figure 6 displays the geographic distribution downstream of international-trade related changes to buyer surplus in 1997 and 2007. Details from 1997 are shown in Panel A and details from 2007 are shown in Panel B. Figure 6 displays the change in downstream surplus as a percentage of downstream expenditures. In 2007, California, New Jersey, and Texas all show an approximately

[49]This figure assumes that the outside option - sourcing from manufacturers is unchanged. This discrete choice framework is unable to distinguish what are the gains due to changes in the outside option, rather just changes relative to the outside option.

Table 13: **Downstream Surplus from Intermediated International Trade** (Bil $)

Buyer Shipment Size		ΔDownstream Surplus		Market Size	
log ($)	$'000	1997	2007	1997	2007
<6	<1	13.59	28.75	308.6	384.0
7-8	1- 3	12.05	24.99	303.8	388.6
8-9	3- 8	15.02	30.95	441.0	563.5
9-10	8 - 22	19.12	38.35	665.6	796.2
10-11	22 - 60	17.75	51.85	753.5	1154
11-12	60 - 160	13.77	30.72	607.7	753.7
12-13	160 - 440	7.17	17.1	370.7	420.5
13-14	440 - 1,200	2.66	8.03	188.1	212.7
>14	>1,200	1.79	7.55	130.6	242.9

Notes: Quantities are all in producer prices.

Table 14: **Change in Operating Profits from Intermediated International Trade**

	Wholesaler Type		
Year	Smallest 90%	$90-99\%$	largest 1%
1997	-0.2%	4.3%	10.3%
2002	-0.1%	4.1%	11.2%
2007	-3.5%	0.6%	16.3%

Notes: Profits re-computed after resolving iteratively for best-response prices.

5% gain in downstream surplus. In contrast, the inland states of Wyoming, Montana, and Nebraska show approximately half the gain in surplus, with all three under 3%.

Downstream buyers are also heterogenous in the size of their shipments. Table 13 computes the relative surplus gains accruing to downstream buyers by the size of their received shipments. The first line considers orders valued under $1000. In 1997, these buyers accounted for $309 billion in expenditures and accrued $14 billion in benefits from indirect international sourcing. At the other end, downstream buyers receiving shipments valued over $1.2 million, received $130 billion in product and only accrued $1.8 billion in benefits from indirect international sourcing. Similar trends hold in 2007, with the largest benefits in indirect international sourcing going to the downstream purchasers receiving the smallest shipments.

Different forms of wholesalers also differentially profit from international sourcing. Specifically, the largest wholesalers derive much more of their sales and operating profits from facilitating indirect international sourcing. Table 14 computes the aggregate changes in operating profits for three types of wholesalers, the largest 99th percentile of wholesalers by sales, the middle 90th to 99th percentile, and the bottom 90th percentile. In 1997, by limiting indirect international trade, the smallest wholesalers benefit with operating profits rising 0.2%, as some downstream buyers switch from using internationally sourced products to domestically sourced products. The largest wholesalers see a 10.6% decrease in operating 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

Table 15: **Wholesalers in Intermediated International Trade**

	Mean Wholesalers by Market		Mean Wholesaler Market Share		Mean Wholesaler HHI	
	Baseline	After Entry/Exit	Baseline	After Entry/Exit	Baseline	After Entry/Exit
1997	3,955	5,334	0.011%	0.008%	219.3	66.1
2002	3,891	5,291	0.013%	0.008%	291.9	92.8
2007	3,818	5,291	0.014%	0.009%	327.7	107.9

Notes: The first set of columns counts the number of wholesalers present in the median market before and after wholesaler entry/exit. The second set of columns presents the average aggregate national market share for a wholesaler within their respective market. The last column presents the HHI of the wholesale industry, allowing for direct sourcing.

results from 2007 follow the same pattern, but are larger in magnitude. The smallest wholesalers see a 3.5% gain in operating profits, while the largest wholesalers face a 16.3% decline.

7.2 Counterfactual 2: Allowing Wholesaler Entry/Exit

This counterfactual offers an extremely simplified view of competition, with all wholesalers taking one of three configurations, either 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 materials. The hybrid wholesaler no longer has to pay the market positioning costs of international distribution, but loses sales from their earlier internationally sourced products.

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

As there are two types of remaining wholesalers, there may still be more than one equilibrium in the number of each wholesaler type. For example, there may be one domestic wholesaler and two hybrid wholesalers, or three domestic wholesalers and one hybrid. This analysis chooses the equilibrium with the greatest number of hybrid wholesalers. As the hybrid wholesalers have higher expected qualities and lower marginal costs, such wholesalers can be considered large first-movers.[50] In computation, I simulate market entry 50 times and use the lower bounds of fixed cost estimates. This allows for the most free entry and provides for the most conservative statistics.

Table 12 and Table 15 summarize market outcome changes from indirect international sourcing.

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

In the third set of columns in Table 12 that are labeled "Counterfactual 2," I show aggregate changes in downstream surplus, wholesaler profits, and market size after allowing for simplified wholesaler entry. International trade leads to increases of \$172 billion in buyer surplus in 1997 and over \$314 billion in 2007. This is nearly 70% higher than the first counterfactual that limits wholesaler entry/exit. Market forces drive out the best wholesalers (i.e. those that had both domestic and internationally sourced products). However, the free entry condition allows more domestic-only wholesalers to enter the market, partially compensating for the loss of wholesalers that source globally.

In Table 15, the counterfactual number of wholesalers and their mean market shares are presented and compared to observed data. Broadly speaking, there are many more wholesalers, each with lower market share. In 1997, the typical wholesale market had 3,955 wholesalers; in the counterfactual, this increases about 34%. Simultaneously the average counterfactual wholesaler has 27% percent lower market share. These figures are larger for 2007, with 36% more wholesalers with, on average, 28% less market share. Market concentration also changes, as shown in the third set of columns, intermediated international trade allows for much higher concentrations, summarized by the Herfindahl–Hirschman Index.

7.3 Alternative Scenario: Wholesaler Technology

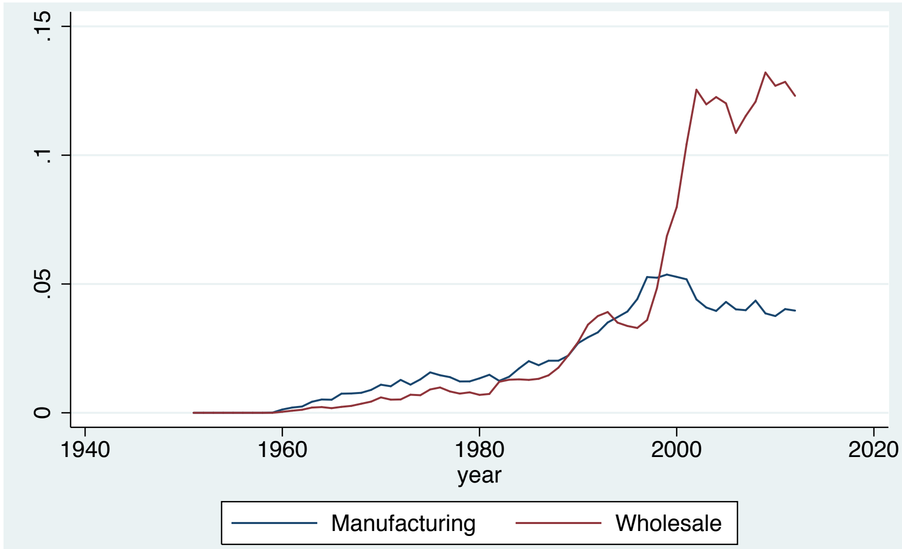
In Appendix D, I consider a second scenario that measures aggregate gains in the wholesaling industry from 1997 to 2007, i.e. the inter-temporal gains from wholesaler technology. Downstream buyers in 2007 will no longer buy from the set of wholesalers from 2007, rather they will buy from the set of wholesalers using wholesaling technology from 1997. Summarizing my findings, changes in wholesaler technology and sourcing provide a yearly gain of \$300 billion in total surplus, offsetting a \$40 billion loss from increases in wholesaler market power.

8 Underlying Mechanisms Interpretations

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

All measurements to wholesaler quality are relative to the outside option, as are wholesaler prices. If domestic manufacturing is declining in quality or availability, downstream buyers will naturally substitute towards foreign suppliers, which may only be accessible through indirect sourcing. Similarly, changes in relative manufacturer's prices across sources may change the relative valuation of wholesaling versus direct sourcing. Further work, using both international trade data and domestic production data could provide new insights. Recent research (Bernard and Fort (2015) and Bernard, Smeets and Warzynski (2016)) and anecdotal evidence suggest that the rise in wholesalers may be due to a economy-wide trend in former manufacturing firms closing domestic production operations

Figure 7: **Share of Investment in Software**



Source: BEA Investment Data

and only retaining design and distribution facilities. However, I find that these firms are not driving my results in Appendix E.

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 7 provides preliminary and suggestive evidence that innovations and expenditures on information technology (IT) may be driving these trends. This figure shows the share of investment on software (an important component of IT) in both the manufacturing and wholesale sectors. While the share has increased at a similar rates from 1960 to 1995, the path diverged between 1995 and 2005. Today, software accounts for 13% of all investment by wholesale firms, but less than 5% of investment by manufacturers. This finding corresponds favorably to my data; however, showing causality requires further analysis and is part of a larger research agenda.

9 Conclusion

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

Globalization is a wedge that may allow for both (a) more market power and (b) widespread benefits. In the context of wholesaling, I find that benefits dominate changes in market power over the last 20 years. However, this result is hard to generalize over other industries, time periods, or contexts. This result stemmed from both the observed data and the model's estimated parameters; different contexts will provide different results.

This paper provides one of the first comprehensive empirical studies of wholesaling and the role it plays in both the global and domestic economies. However, there is wide scope for both extending this framework and examining various assumptions. In terms of expansion, future work could use a model of intermediation with heterogenous demand and place wholesalers in a tractable general equilibrium framework to consider aggregate welfare changes. Alternatively, additional work should consider changes in upstream manufacturing. Gains are all relative to sourcing directly from a manufacturer. Difficulty in sourcing from a manufacturer (both domestically and internationally) can offset gains from wholesaling. This paper also leads to questions that examine the boundary of the firm: should a manufacturing firm expand domestic distribution networks, or outsource to a wholesaler? Finally, this paper highlights the fruitful and productive work possible at the intersection of industrial organization and international trade.

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Appendices

A Data Sources and Construction

A.1 Data Used

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

The Census of Wholesale Trade (CWH) collects data every five years on the entire universe of wholesale establishments, subdividing wholesalers by both type and ownership structure. In particular the CWH divides wholesale establishments into merchant wholesalers (MW) and manufacturers sales and brach offices (MSBO). As this paper considers wholesalers that are independent from manufacturers, I exclude MSBO and other similar establishments from analysis. However aggregate census statistics may not distinguish between these two establishment forms and overestimate the wholesaler market presence. Notably, distribution centers owned by downstream buyers, such as those by large retail chains are systematically excluded from this census.[51] This dataset is central to our analysis and provides administrative data on operating costs, merchandise purchases, total sales, goods sold, and buyer types.[52] Wholesale industries distributing products with sales consisting of more than 50% non-manufactured goods are excluded. This includes certain petrochemical segments distributing crude oil and all agricultural and mining sectors.

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

The Commodity Flow Survey (CFS) is conducted every five years and collects data on a random selection of shipments for a set of establishments. This data is collected for both wholesale and manufacturing establishments and is used to construct crosswalks between manufacturing and wholesale sectoral designations. Additionally the micro-data includes statistics on the origin, destination, and value of individual shipments as well as export status.

The Longitudinal Firm Trade Transaction Database (LFTTD) tracks and links imports and

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

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

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

A.2 Census of Wholesale Trade (CWH)

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

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

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

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

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

Wholesalers are classified according to their five-digit NAICS code. A market is defined as all downstream buyers that buy and sell from these five-digit NAICS codes. For example, Code 42161 refers to wholesalers participating in the resale of "Electrical Apparatus and Equipment, Wiring Supplies and Construction Material". While firms may appear to belong to multiple codes, this project only considers the Census-designated code. Future research projects may further explore multiple-industry wholesalers.

Sales are aggregated considering the wholesaler's purchase cost from their upstream source, net of export sales, and correcting for inventory adjustments. Prices are in manufacturers dollars and computed using the ratio between the sales to downstream buyers divided by upstream purchases by the wholesalers. Wholesale industries that derive more than 50% of revenues from products that are not manufactured are removed from analysis. These industries pertain primarily to mining and agricultural products. Additionally, NAICS sector 42471 and 42472 dealing with petroleum and petroleum products are removed, as are NAICS sectors 42481, 42482, and 42494 that deal with beer, wine and tobacco products. Petroleum products are removed due to the the industry taking a unique form due to the ownership and distribution of pipeline networks. Alcohol and tobacco products are often regulated at the wholesaler level by individual states. Some states do not allow for direct sourcing by downstream retailers and force the usage of wholesalers, rending my model of wholesaling spurious.

A.2.1 Wholesaler Prices

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

Wholesalers prices p_w are constructed as follows:

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

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

$$C_m = p_m q_m,$$

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

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

where R_w represents the revenue of a wholesaler.

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

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

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

A.2.2 Wholesaler Sales Data

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

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

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

Wholesaler purchases of domestic manufactured good are computed by subtracting imports from total merchandise purchases for resale. Finally, sales are adjusted to only consider domestic buyers. I subtract the percentage of sales and purchases that are used for export shipments.

A.3 Outside Share (Direct Sourcing) Data Construction

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

Total domestic absorption is computed as:

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

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

Similarly domestic absorption accounted by wholesalers is computed as:

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

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

Table 2 aggregates these statistics across our entire sample. See the main text for further analysis and a summary.

A.4 Detailed Wholesaler Statistics

Tables A1-A4 highlight additional wholesaler statistics by wholesaler size.

A.5 Geographic Differentiation

In lieu of a continuous distance measure, this project discretizes downstream buyer location by US states[53], which are each located in 4 regions and 9 divisions. This project considers three distinct levels of distance with regards to the downstream buyer, wholesaler that are located in the same state, wholesaler located in the same census division and wholesalers located in the same census division. Figure 8 displays these divisions.

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

Table A1: **Wholesaler Margins and Accounting Costs by Market Share Quantile**

Mean Wholesaler Prices			
Share	Year		
Quantile	1997	2002	2007
0-10	2.33	2.12	2.01
10-20	1.95	1.84	1.83
20-30	1.82	1.74	1.74
30-40	1.74	1.69	1.69
40-50	1.68	1.65	1.63
50-60	1.63	1.60	1.59
60-70	1.58	1.57	1.55
70-80	1.54	1.53	1.51
80-90	1.48	1.49	1.48
90-99	1.41	1.43	1.43
99-99.5	1.35	1.38	1.38
99.5+	1.34	1.36	1.37

Mean Accounting Costs			
Share	Year		
Quantile	1997	2002	2007
0-10	1.32	1.08	0.97
10-20	0.92	0.72	0.71
20-30	0.77	0.61	0.60
30-40	0.68	0.55	0.54
40-50	0.61	0.51	0.49
50-60	0.55	0.46	0.45
60-70	0.49	0.43	0.42
70-80	0.44	0.39	0.38
80-90	0.38	0.35	0.34
90-99	0.31	0.30	0.29
99-99.5	0.23	0.23	0.23
99.5+	0.19	0.20	0.19

Notes: Wholesaler margins calculated as Sales/Merchandise Purchases. Operating Costs calculated as Operating Expenditures/Merchandise Purchases.

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

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

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

Table A3: **Prices and Average Costs by Market Share Quantile**

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

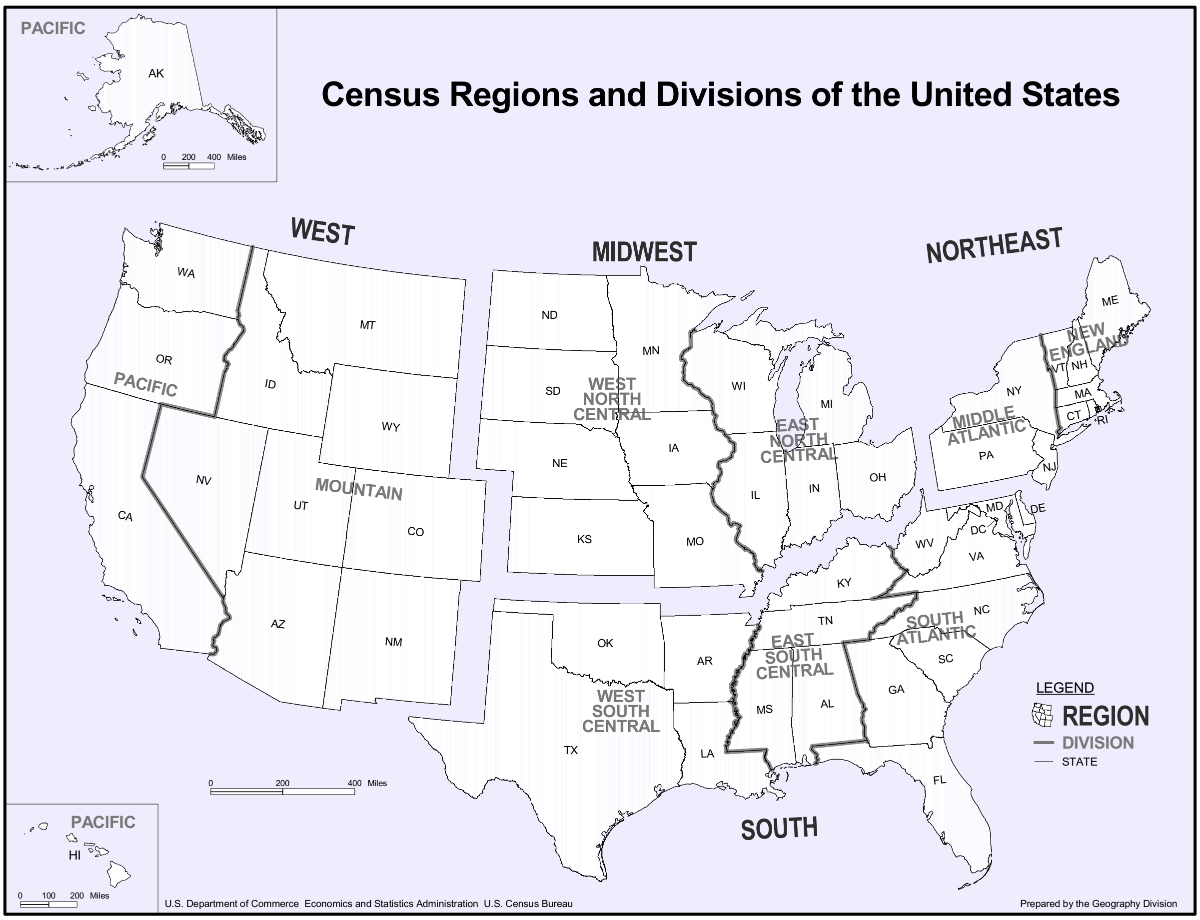
Import Country-Products			
Share Quantile	Year 1997	2002	2007
0-10	0.2	0.3	0.4
10-20	0.4	0.4	0.5
20-30	0.5	0.8	0.9
30-40	0.7	1.1	1.4
40-50	1.0	1.4	1.7
50-60	1.4	1.8	2.6
60-70	1.9	2.5	3.5
70-80	5.0	4.1	5.0
80-90	5.0	8.8	11.6
90-99	13.7	18.0	24.6
99-99.5	54.1	77.0	73.4
99.5+	137.4	183.6	213.8

Table A4: **Number of Locations by Market Share Quantile**

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

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

Figure 8: **US Census Regions and Divisions**



An alternative approach that would allow for tractable computation would be to map distance directly to distance indicator variables. This would prevent issues from considering the distance from New York to Connecticut differently than the distance from New York to New Jersey, due to Census division classifications. Instead of considering buyers that are within the same census division or region, the alternative would be to consider other states within pre-specified distance bands. For example, distance band 1 for New York would include all wholesalers in states that are reachable within 4 hours (250 miles) and distance band 2 would include all wholesalers in states that are within 8 hours (500 miles). Preliminary results show that estimates in Sections 5 and 6 are largely consistent and the aggregate estimates in Section 7 are similar. However, the geographic breakdown is slightly changed, with the welfare gains due to intermediation slightly rising in small New England and South Atlantic States (in particular Rhode Island and Delaware) and slightly falling in rural Mountain States (Wyoming and Montana).

B Demand Systems

This section provides micro-foundations for the indirect downstream profit functions used in Section 3. This provides support for both the two-stage demand system and allows for simple extensions. While this specific toy demand model provides micro-foundations for the exact demand structure presented in the main paper's model, it is slightly generalizable, while still providing the needed structure. There are two critical elements, first requiring a single-input invertible production function and second requiring that the expectation of the marginal cost is sufficient for the wholesaler's decision in the last demand stage (in period t_4) .[54]

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

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

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

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

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

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

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

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

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

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

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

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

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

Then in the first stage, a wholesaler solves:

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

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

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

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

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

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

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

Revisiting fixed cost f, expected profits are:

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

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

Aggregate downstream profits are decreasing function of marginal cost, thus a reduction in marginal costs increases downstream profits.[55] The second stages demand decision involves choosing the optimal wholesaler to reduce this marginal cost. Additionally, these profits are a function of the fixed cost f; lowered marginal costs imply that more firms will be able to enter the market. Aggregating across the draws for downstream demand η and the fixed costs f, this produces a mass of buyers M_q that demand q units. If $\mathbb{E}(mc)$ falls, then the mass of M_q will shift upwards. In my model $\mathbb{E}(mc)$ is directly related to $\mathbb{E}\left(\bar{U}\right)$, the expected utility of indirectly sourcing from a wholesaler.

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

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

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

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

$$C_{indirect} = qp_1$$

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

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

As long as downstream profits or utility are a function of the difference in per-unit costs, then the estimating equation (2) is appropriate.

B.3 Quantity discounts

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

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

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

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

Simplifying the mean utility δ_q from equation (3) for any wholesaler selling to a buyer purchasing q units produces:

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

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

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

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

B.4 Constant Elasticity of Substitution

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

Assume that downstream product demand takes the form:

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

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

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

Wholesaler profit maximization takes the following form:

$$\pi = \max_p (p - c) D(p),$$

which p denoting the price and c denoting wholesaler marginal cost. Assuming monopolistic competition, the optimization is as follows:

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

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

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

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

$$\log R = (1-\rho)\log p + \log\xi + \log\frac{Y}{P^{1-\rho}} \tag{19}$$

Now since revenues are related to market share s and total market size Y as $R = sY$, equation (19) can be rewritten as:

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

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

B.5 Demand Estimation

B.5.1 Discrete Choice Estimation Routine

Estimation follows a Generalized Method of Moments technique in the vein of Petrin (2002) and matches both aggregate national market shares and moments derived from the micro-level data.[56]

Assuming away buyer heterogeneity and allowing for one level of nests, I can derive the standard Berry (1994) estimation equation:

$$\log s_{w,n}/\log s_0 = \delta_{w,n} + \sigma_n \log s_{w,n|n}, \tag{20}$$

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

where s_0 represents the share of the outside option, sourcing directly from a manufacturer.[57]

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

$$\log s_{w,n} = \log \sum_{j \in \mathcal{J}} \left[s_{0|j} \cdot s^{\sigma}_{w,n|j,n} \cdot \exp\left(\delta_{w,n,j} / \left(1 - \sigma_n\right)\right) \right] \mu_j \tag{21}$$

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

In practice the estimation uses a finite number of buyer types j, each with overall mass μ_j. Mean utility $\delta_{w,n,j}$ can be decomposed $\delta_{w,n,j} = \delta_{w,n} + \tilde{\delta}_{w,n,j}$. The first component is common across all downstream buyers and the second is specific to downstream buyers of type j. Solving for $\xi_{w,n}$, equation (21) is operationalized with one level of nests as:

$$\xi_{w,n} = \log s_{w,n} - \log \sum_{j \in \mathcal{J}} \left[s_{0,j}\left(\vec{\delta}\right) \cdot s^{\sigma}_{w,n|j,n}\left(\vec{\delta}\right) \cdot \exp\left(\frac{\tilde{\delta}_{w,n,j}}{1-\sigma}\right)\right] \mu_j - \alpha^p_j \log p_{w,n} + \alpha^l_j \mathbb{I}^l_{w,j} + \alpha^q_j \mathbb{I}^q_{w,j} + \mathbf{a}_{w,n}\alpha^a_j \tag{22}$$

Where $\delta_{w,n} = \xi_{w,n} + \alpha^p_j \log p_{w,n} + \mathbf{a}_{w,n}\alpha^a_j$. This defines a contraction mapping from $\mathbb{R}^N \to \mathbb{R}^N$. By recursively solving for $\xi_{w,n}$, I can solve this system of equations. Multiple levels of nests simply generalize this setup. Unlike the most general form in equation (21), the vector of parameters for unobservable coefficients is set such that $\alpha_j = \alpha$ for all $j \in J$.

In practice, this contraction mapping is the lengthiest step, as it is difficult to parallelize and requires 3 days of processing time the confidential census computing cluster. Alternative computation methods such as Mathematical Programming with Equilibrium Constraints (MPEC) are similarly slow as they require equality constraints for all 600,000 firms to be individually computed and checked.

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

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

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

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

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

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

$$\hat{\theta} = \arg_{\theta} \min G(\theta)' WG(\theta), \tag{23}$$

where

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

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

By using the relation, $\delta_w(\sigma) = x_w\alpha + \xi_w$, estimation can be simplified. Thus conditional on σ, the GMM routine can use the estimation:

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

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

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

B.5.2 Least-Squares Estimating Equation with Multi-Stage Nested Logit

In such a system, the market share of a wholesaler w, in nest n that sources from origin o (indirect foreign, indirect domestic, or direct sourcing) is

$$s_{w,n} = s_o s_{n|o} s_{w,n|n}.$$

Where $s_{w,n}$ is the overall market share, s_o is the market share of indirect foreign or indirect domestic sourcing, $s_{n|o}$ is the market share of a particular nest n conditional on source o. Assuming a correlation structure parameterized by σ_s and σ_n, I can obtain the following market share equations (that generalize Berry (1994)):

$$\ln\left(\frac{s_{w,n}}{s_0}\right) = \delta_{w,n} + (\sigma_n)\ln\left(s_{w,n|n}\right) + (\sigma_o)\ln\left(s_{n|o}\right).$$

Where $\delta_{w,n}$ is the mean valuation of wholesalers w's product in nest n and s_0 is the market share of direct sourcing from a manufacturer.

Similarly closed form demand elasticities can be obtained:

$$\frac{ds_{w,n}}{dp_{w,n}} = \frac{\alpha^p}{p_{w,n}} s_{w,n} \left\{ s_{w,n|n} \left\{ [1 - s_o]\, s_{n|o} + \left[\frac{1}{1-\sigma_s} \left(1 - s_{n|o}\right) \right] \right\} + \left[\frac{1}{1-\sigma_n} \left(1 - s_{w,n|n}\right) \right] \right\}$$

B.5.3 Demand Estimation

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

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

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

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

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

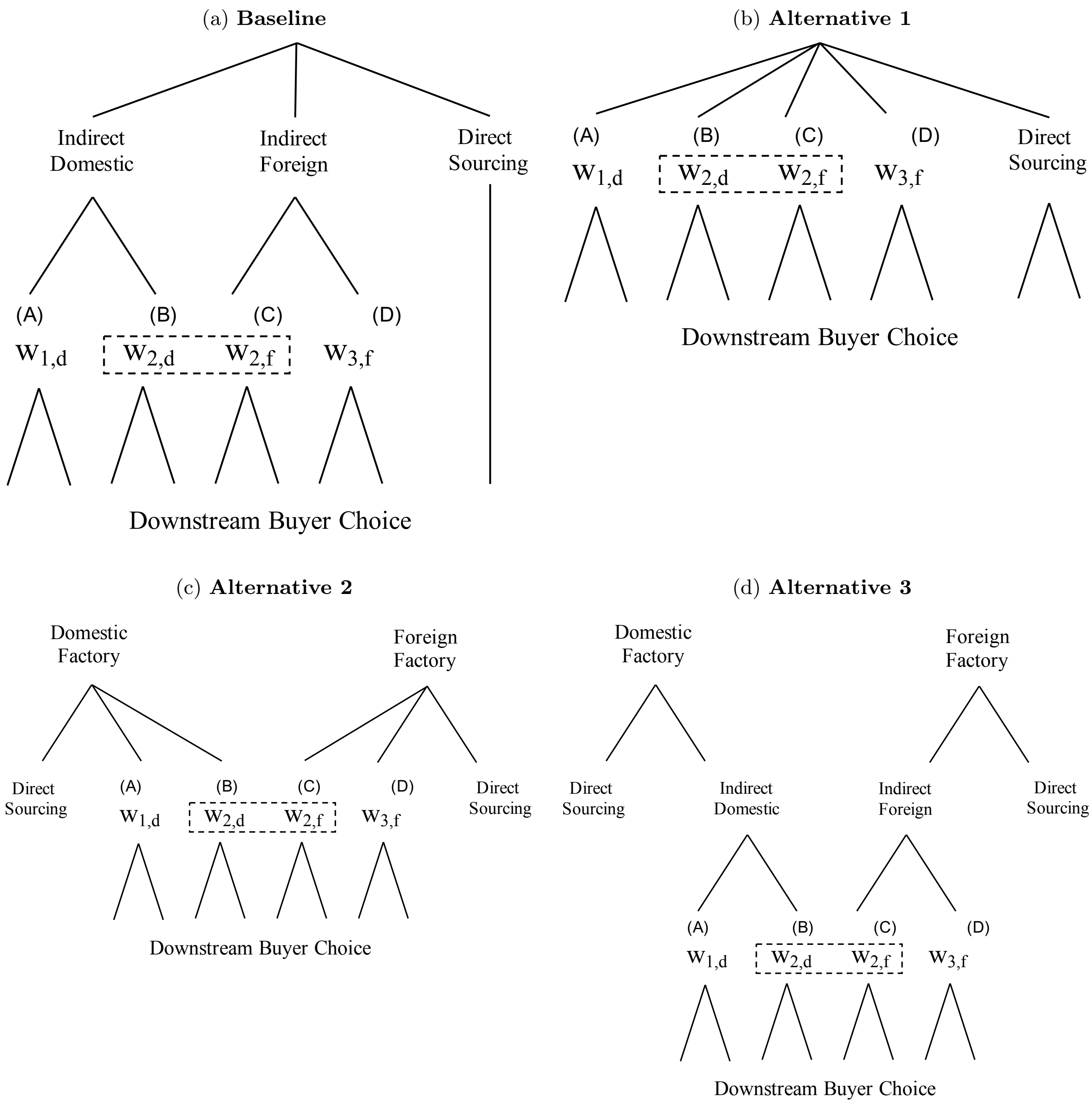
Assumption 1, 2 and 3, along with the the structure imposed from the model and set of regularity conditions identify $\xi_{w,n}$ with probability 1 and the function $s_{w,n}(\chi)$ is identified on χ. Formally, even without assuming a functional form for $s_{w,n}(\cdot)$, demand identification stems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

B.6 Demand Robustness

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

Multi-level Logit Demand In Figure 9, I show my baseline demand specification in panel (a) and an alternative demand specification in panel (b). Panel (b) compresses the top nesting structure into the second nest. This implies that foreign-sourced products sold by multi-source wholesalers are similarly substitutable between foreign-sourced products sold by single-source wholesalers and

Figure 9: **Downstream Buyer Sourcing Choice Trees**



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

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

	est/se		est/se		est/se
log (price)	-2.564	$\mathbb{I}_{\{\text{Same State}\}}$	3.367	log {Shipment Size}	-0.333
	0.023		*0.045*		*0.003*
$\mathbb{I}_{\{\#\text{ Locations}>1\}}$	0.199	$\mathbb{I}_{\{\text{Same Census Region}\}}$	1.340		
	0.005		*0.082*		
σ_n	0.632	$\mathbb{I}_{\{\text{South Imports}\}}$	-3.021	$\mathbb{I}_{\{\text{North Imports}\}}$	-2.915
	0.002		*0.016*		*0.013*
		×log (south varieties)	0.704	×log (north varieties)	0.739
			0.010		*0.009*
Fixed Effects	Market × Source, Year × Source				

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

domestically-sourced products sold by multi-source wholesalers. Estimates from such a model are shown in Table A5. In general, this simplified model produces estimates slightly different from the baseline model, as the coefficient estimates α change to rationalize the data to difference in σ.

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

Parameter Heterogeneity In Table A6 I repeat the estimation of my model, however within each of my 56 product-markets. This produces 56 estimates for the parameter vector (α, σ). I report the average of three critical values for my model and markup calculations, the price coefficient (α^p) , and the two parameters governing substitution between nests (σ_o and σ_n). Results are similar to my main pooled specifications.

C Markup Calculations

For simplicity in this Appendix, I assume one level of nests and derive markups when wholesalers exert market power. In terms of notation $Q_{w,n}$ denotes total sales by wholesaler w selling in nest

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

Single-Level Logit		Bi-Level Logit	
	mean est/sem		mean est/sem
log (price)	-1.651	log (price)	-1.444
	0.494		*0.502*
σ_o	0.844	σ_n	0.879
	0.054		*0.058*
		σ_o	0.801
			0.092
Regressions/ Markets	56		
Fixed Effects, Controls	Year × Source; Geography; Shipment Size; Source ×Varieties		

Notes: Results from optimizing generalized method of moments (GMM) routine using a gradient search. Robust GMM standard errors presented. See text for full regression specification. These estimates are highly preliminary.

n, $s_{w,n|j}$ is the market share conditional on downstream buyer type j, $s_{w,n|j,n}$ is the same share also conditional on sourcing from nest n, M_j is the mass of downstream buyer type j, and $p_{w,n}$ is the wholesaler's price. Parameters α^p, ϕ, and σ are recovered from demand estimation, and respectively reflect the price sensitivity, aggregate demand elasticity, and substitution elasticities.

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

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

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

Marginal cost c_w are as follows for a single product wholesaler:

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

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

For a wholesaler, the price set for products originating from o can also have implications for the sales of products originating from n' where $n \neq n'$:

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

For a multi-product wholesalers sourcing from multiple origins/selling in multiple nests $n_1, n_2, \ldots$, consider the matrix of partial derivatives of sales of each sold with respect to to the prices of both the same product and other products sold:

$$\boldsymbol{\Delta} = \begin{bmatrix} \frac{\partial Q_{w,n_1}}{\partial p_{w,n_1}} & \frac{\partial Q_{w,n_2}}{\partial p_{w,n1}} & \cdots \\ \frac{\partial Q_{w,n_1}}{\partial p_{w,n_2}} & \frac{\partial Q_{w,n2}}{\partial p_{w,n2}} & \cdots \\ \vdots & \vdots & \ddots \end{bmatrix} = \alpha \begin{bmatrix} \mathfrak{s}_{n_1,n_1} & \mathfrak{s}_{n_2,n_1} & \cdots \\ \mathfrak{s}_{n_1,n_2} & \mathfrak{s}_{n_2,n_2} & \cdots \\ \vdots & \vdots & \ddots \end{bmatrix} \begin{bmatrix} 1/p_{w,n_1} & 0 & \cdots \\ 0 & 1/p_{w,n_2} & \cdots \\ \vdots & \vdots & \ddots \end{bmatrix}$$

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

$$\begin{pmatrix} c_{w,n_1} \\ c_{w,n_2} \\ \vdots \end{pmatrix} = \begin{pmatrix} p_{w,n_1} \\ p_{w,n_2} \\ \vdots \end{pmatrix} + \Delta^{-1} \begin{pmatrix} Q_{w,n_1} \\ Q_{w,n_2} \\ \vdots \end{pmatrix}$$

D Alternative Counterfactual: Intertemporal Comparison

This second scenario considers the aggregate gains in the wholesaling industry from 1997 to 2007, i.e. the inter-temporal gains. Downstream buyers in 2007 will no longer buy from the set of wholesalers from 2007, rather they will buy from the set of wholesalers using wholesaling technology from 1997.

D.1 Counterfactual 1: Fixed Set of Wholesalers

What is the net benefit to downstream buyers and wholesalers due to aggregate market changes from 1997 to 2007? As shown in Section 2, total indirect sourcing has increased 35% in market share and 98% in real shipments. Section 5 parses out these gains through the demand model and attributes these gains to various changes in the types of wholesalers. This section assesses the net valuations of these changes by including both downstream buyer surplus and wholesaler profits.

Table A7 computes a variety of market outcomes by placing the universe of 1997 wholesalers in 2007. The first column lists a variety of relevant market outcomes, the number of wholesalers present, the number of wholesalers per market, the total market size for intermediate manufactured goods in producer prices, the change in downstream buyer surplus, the change in wholesaler profits, the sum of the changes in surplus and profits, and finally mean wholesaler market share (across

Table A7: **Scenario 2: Intertemporal Comparison Statistics**

Market Outcome	Market Configuration		
	Baseline	Counterfactual 1	Counterfactual 2
Number of Wholesalers	213,800	221,500	288,000
Number of Wholesalers/Market	3,818	3,956	5,142
Total Market Size (bil)	$4,263	$4,024	$4,116
Δ Downstream Surplus (bil)		-$348	-$263
Δ Wholesaler Profits (bil)		$55	$0
Δ Surplus + Δ Profits (bil)		-$293	-$263
Wholesaler Mean Market Share	55%	47%	49%
Wholesaler Mean HHI	327.7	219.3	151.8

Notes: Market shares computed using the value of distributed goods in producer prices. Counterfactual 1 considers the wholesale market without wholesaler entry and exit. Counterfactual 2 allows wholesalers to enter the market. Mean results averaged over 60 markets. Figures in the last row differ from prior tables as they consider the unweighted mean across markets.
Source: Author's calculations bases on US Census Data.

sectors). The second column presents baseline data with the set of wholesalers from 2007, facing the demand from 2007.[58]

The third column of Table A7 considers the first counterfactual. The set of wholesalers from 1997, along with their attributes, are placed in their corresponding markets in 2007. In this counterfactual, wholesalers aren't allowed to change their market position, but rather only their markups. As the number of wholesalers is larger in 1997, the number of wholesalers increases 4% in the counterfactual. However, these wholesalers are of lower quality, higher price, and lack the domestic distribution reach and internationally sourcing ability of wholesalers in 2007. The total downstream market size decreases 5.6% or by $239 billion and the wholesaler share of this market decreases by 15%. Analogously, the surplus of downstream buyers decreases by $348 billion.

In 2007, the total size of the market is much larger, accounting for 10 year of economic growth. As the both the entry of wholesalers and the investment in wholesaler attributes are restricted, remaining wholesalers are able to increase their profits by $55 billion. By offsetting the decrease in downstream surplus with wholesaler profits, total surplus decreases by $293 billion. As a frame of reference, this total figure is equivalent to 2% of the 2007 gross domestic product. To further refine this figure, I allow for a simplified form of wholesaler entry in the next section.

D.2 Counterfactual 2: Allowing Wholesaler Entry/Exit

The counterfactual for this second scenario places wholesalers from 1997 in the 2007 marketplace. In this counterfactual there is only one type of wholesaler, wholesalers that are present in 1997, and thus does not require an equilibrium selection procedure. Potential wholesalers draw types, qualities, and marginal costs from the observed distribution of wholesalers in 1997. Wholesaler choose to enter

[58]These figures are taken directly from the data.

if the expected profits from entry are greater then fixed costs and choose not to enter if expected profits are less than entry costs. Letting N denote the number of wholesalers in the market, this implies the following two conditions must hold:

$$\begin{aligned} E_G\left[\pi^{2007}(N+1)\right] &< 0 \\ E_G\left[\pi^{2007}(N)\right] &> 0 \end{aligned}$$

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

The third column of Table A7 computes changes in market outcomes relative to the observed set of wholesalers in 2007. If wholesaling technology from 1997 were placed in 2007, downstream surplus would decrease by \$263 billion. Wholesaler profits would remain unchanged as the free entry condition would force them to zero. The total downstream market for purchases would also decrease by \$170 billion, or 4%. In terms of wholesalers, aggregate wholesale market share would decrease 6 percentage points, but the number of wholesalers would increase by one third, from 3,818 wholesalers per market to nearly 4,595 wholesalers. The individual market share of each wholesaler would also decrease by nearly 1/3, with a corresponding market concentration decrease.

E Factory-less good manufacturers

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

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

The Census of Wholesalers includes categorizations such as "own-brand marketer" and "single-brand marketer". If these wholesalers market only their own brand, then they are excluded from the sample of wholesalers and treated as manufacturers. A possible example could be the electronic firm Apple, that markets its own products but outsources manufacturing.[59] In addition, the analysis

[59] The exact categorizations of firms cannot be disclosed outside of the US Census Bureau, it is unclear where firms

also excludes manufacturer owned sales and branch offices. These locations exist to distribute products manufactured by a parent or sister firm. The elimination of these establishments does reduce the observed growth in the wholesale sector, providing a conservative approach to measuring the wholesaler market shares gains.

The behavior of the growth of these wholesalers takes a very particular form. As shown in tables A2 and A4, the largest wholesalers are importing many more varieties from new foreign sources and simultaneously increasing their distribution network within the United States. A common formulation of the factory-less good manufacturer theory is that these manufacturers close down production in the United States and move manufacturing abroad, with little to say about designing **new** varieties for production or expanding **local distribution** networks. As the benefit from wholesaling primarily derives from both sourcing new international destination, not just moving producing overseas, and expanding domestic distribution, it is unclear that the shift to factory-less production is driving the entirety of the trend towards wholesaling.

Finally, while this trend may be new for some firms, with Apple closing manufacturing lines in the United States and outsourcing manufacturing to Foxconn in China, such 'factory-less' producers have existed for a long time. Historically when IBM produced personal computers, they did not produce all components sold with the IBM brand; the printer was simply a rebadged Epson device imported from Asia.[60]

F Endogenous Quality

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

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

F.1 Model Changes

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

such as Apple stand and the textual discussion is purely hypothetical.

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

Conditioning on a firm's type and location choices, the model assumes wholesaler w optimally chooses $\xi_{w,n}$ for each product $n \in N_w$. In particular they must invest $f_w(\xi)$ to receive product attributes $\xi_{w,n}$, which realize in operating profits $\pi_w(\xi_{w,n})$ from equation (8). If a firm only participates in only domestic sourcing, they maximize the following problem by choosing their optimal firm quality $\xi_{w,n}$:

$$\max_{\xi=[\xi_{w,D},0,0]} \pi_w(\xi) - f_w(\xi) \tag{24}$$

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

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

For simplicity, I now present results involving a single firm only involved in domestic sourcing and suppress firm subscript w and product type subscript t. Conditional on location choices (market entry), a firm's first order maximization results in a first order conditions as ξ are both are optimally chosen:

$$\frac{d\pi(\xi)}{d\xi} = \frac{df(\xi)}{d\xi} \tag{26}$$

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

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

F.2 Estimation

In this model, unobserved downstream consumer valuations ξ are not exogenous shocks as in standard discrete choice models. They are the product of wholesale firm investments. This ξ is better written as $\xi(a)$. This means that demand identification cannot identify $a^a a_{w,n}$. In this case, all fixed effect, $a^a a_{w,n}$, and ξ are all subsumed by the new measure $\xi(a)$. $\xi(a)$ is no longer residual quality, it is a complete measure of quality. Regardless, the coefficient α^p can be identified as a cost shock hits a particular firm following their choice of a and $\xi(a)$. In terms of α^q, α^l, and σ; they are partially identified off of aggregate moments. As α^p is the only coefficient required to derive demand elasticities, estimation can proceed in a more restricted fashion.

Having made these assumptions, identification of this investment function proceeds directly from the first order conditions in equation (26). For any given company configuration a (that is conditional on a company type s and location choices l), assume that the fixed costs of market positioning are:

$$f_w^a(\xi,\eta) = \left(\frac{\psi_1^a}{\psi_2^a}\eta_{w,\xi}\right)\exp\left(\psi_2^a\xi\right) + E_a$$

The function $f_w^a(\xi)$ measures the the cost of investing in quality ξ for wholesaler of configuration a. There are scalar fixed costs E_a and two parameters, ψ_1^a and ψ_2^a. Finally there is a wholesaler specific shock $\eta_{w,\xi}$. This structural investment cost shock is known to the firm, but not the econometrician.

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

$$\frac{df_w^a(\xi,\eta)}{d\xi} = \left(\psi_1^a\eta_{w,\xi}\right)\exp\left(\psi_2^a\xi\right)$$

and marginal profits stem from the first derivative of equation (8) with respect to ξ, $d\pi_w(\xi)/d\xi$. As all the parameters in $\pi(\cdot)$ are known, the optimal marketing costs in equilibrium solve:

$$\frac{d\pi_w(\xi)}{d\xi} = \frac{df_w^a(\xi,\eta)}{d\xi} = \left(\psi_1^a\eta_{w,\xi}\right)\exp\left(\psi_2^a\xi\right). \tag{27}$$

Taking the logarithm of this equation produces the following relationship:

$$\log\frac{d\pi_w(\xi)}{d\xi} = \log\psi_1 + \psi_2\xi + \log\eta_{w,\xi}. \tag{28}$$

The relationship should be theoretically estimated by ordinary least squares, however the shock $\eta_{w,\xi}$ likely is correlated with the choice of ξ. This echoes the endogeneity problem with ξ and h_w in estimating equation (2). Estimation of ψ requires a shifter of ξ that is uncorrelated with η. This leads to an assumption required for identification.

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

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

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

In computation, $\pi_w(\xi)$ is not fully known by a firm before the investment decision ξ is made. In particular there is an unobserved cost shock ν from equation (14) that shifts profits. I assume the distribution of ν is known and firms maximize their expected profit. To aid in computation, instead of numerically integrating over ν, simulated draws of ν are used to compute $E[\pi_w(\xi)]$. For simplicity, I omit the expectation in what follows.

Investment function $f_w^a(\cdot)$ is identified up to some fixed entry constant E_c. Following estimation of ψ_1^a and ψ_2^a , this step also generate the distributions $G_\eta^a(\cdot)$ for investment shocks of $\eta_{w,\xi}$. For notational simplicity denote ξ_w^* as the optimal choice for firm w with investment cost shocks η.[61]

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

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

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

Note that $f(\cdot)$ is only identified up to some constant E_a, $\bar{f}(\cdot)$ subtracts this constant. The function $n_a(\eta)$ is used in the next stage to identify this entry cost E_a. For tractability, I assume that fixed cost E_a is not paid in this stage, as firms in this stage have already entered into the market and that an infinitesimally small investment in ξ (that is $\xi \to -\infty$) will realize a investment cost of 0.[62]

F.3 Market Positioning Estimation

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

The first three rows of Table A8 illustrate year-specific coefficients for ψ_2 from equation (28). These estimates measure the cost in investing in quality $\xi_{domestic}$ and $\xi_{international}$. The first column shows that it becomes more costly to invest in domestic sourcing quality over time. One interpretation would be that there are fewer domestic manufacturers, and thus it is more difficult to find new and better domestic sources. Coefficient $\psi_2^{domestic}$ increases 7% from 1997 to 2007. The second column shows that it has become less costly to invest in the quality of international sourcing, with $\psi_2^{international}$ decreasing 20% from 1997 to 2007. This may reflect both lowered trade barriers and increases in the quality of foreign manufactured good sources, both of which make it easier to

[61] The chosen functional form for $f_w^a(\cdot)$ and the estimation equation (28) imply that $\psi_1\eta$ is greater than zero, thus as long at ψ_2 is greater than zero, $f_w^a(\xi^*)$ will be always greater than zero.

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

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

Product Type	Domestically Sourced	Internationally Sourced
$\xi \times 1997$	1.143	2.656
	(0.004)	*(0.167)*
$\xi \times 2002$	1.187	2.822
	(0.003)	*(0.201)*
$\xi \times 2007$	1.223	2.189
	(0.003)	*(0.136)*
Complementary with other sourcing	-0.336	1.476
	(0.005)	*(0.195)*
Fixed Effects		
Year	x	x
Product	x	x
Location	x	x

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

increase the quality of imported products.

These regression estimates also reveal the degree of complementarity between investment in domestic and international sourcing. The fourth row is reflects estimates for $\log \psi_1$ for instances where wholesale firms participate in both domestic and international sourcing. The negative estimate in the first column shows that participating in international sourcing makes it slightly cheaper to increase the quality of the domestically sourced product. The opposite is true for participating in domestic sourcing, which makes it much more expensive to invest in the quality of the internationally sourced product.