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Understanding evolutionary processes in non-manufacturing industries: Empirical insights from the shakeout in pharmaceutical wholesaling

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Abstract. Although the empirical pattern of industry shakeout has been documented for many manufacturing industries, we know little about the processes by which market structure evolves in non-manufacturing service industries. This paper establishes detailed empirical observations about the consolidation of a single non-manufacturing industry, the wholesale distribution of pharmaceuticals. These observations are used to explore differences between manufacturing and wholesaling in both the patterns and explanations for consolidation and analyze the explanatory power of theories that link consolidation to technological change. The analysis demonstrates that theories developed to explain consolidation in new manufacturing industries have varying degrees of applicability to the consolidation of drug wholesaling. The observed patterns of exit, innovation, and growth suggest important modifications to evolutionary theories of market structure.

Key words: Production and market structure – Size distribution of firms – Technological change: choices and consequences – Retail and wholesale trade – Marketing

JEL-classification: L11; O33; L81; M31

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1 Introduction

The empirical pattern of industry shakeout has been documented for an impressively broad range of technologically progressive manufacturing industries (Klepper and Graddy, 1990; Gort and Klepper, 1982; Utterback and Suarez, 1993). These studies, which use fairly precise product class definitions and non-government data sources, also counter broad econometric studies showing very gradual movements in concentration and industry structure (Curry and George, 1983; Geroski, Masson, and Shaanan, 1987).

While this research has advanced the empirical agenda of evolutionary economics, we know little about the processes by which market structure evolves in non-manufacturing service industries. The ongoing restructuring of wholesale distribution channels provides a excellent research setting for examining consolidation[1] in a service industry. A wholesaler (also called a distributor or wholesaler-distributor) is a non-manufacturing company that sells products to retailers, merchants, contractors, and/or industrial, institutional, and commercial users, but does not sell in significant amounts to ultimate consumers (end-users). As an intermediary in a distribution channel, wholesalers simplify product, payment, and information flows by bridging the gap between the assortments of goods and services available from individual producers and the assortments demanded by industrial, retail, and commercial customers (Stern and El-Ansary, 1992). The functions of a distributor can be (and sometimes are) performed by other members in the marketing channel, either via forward integration by suppliers or backward integration by wholesale distribution customers.

The number of wholesalers has declined across a broad range of industries (Table 1), although a few industry channels have experienced little or no change in market structure to date. These shakeouts appear to be consistent with many of the empirical regularities identified in previous research (Klepper, 1996a). In particular, there has been a sharp drop in the number of firms, a virtual cessation of entry once the shakeout begun, and a transition from a fragmented to an oligopolistic industry structure. Many of these shakeouts occurred during periods of industry growth, consistent with prior research (Klepper and Graddy, 1990; Gort and Klepper, 1982; Willard and Cooper, 1985) but in counterpoint to studies of exit from declining industries (e.g., Harrigan, 1982).

Despite these changes in wholesale distribution market structure, there has been very little research on evolutionary processes in distribution channels. With the exception of non-empirical speculations about channel evolution (Guiltinan, 1974) and studies of manufacturer vertical integration through time (Stigler, 1951; Livesay and Porter, 1969), there has been no research on the evolution of wholesale distribution market structure since Bucklin's

[1] Throughout this paper, I use the term *consolidation* to refer to the time period when a small number of companies grow to control a majority of the market share in an industry, transforming a fragmented market structure into a concentrated one. A common rule of thumb is that an industry is fragmented when the four firm concentration ratio is 40 percent or less (Porter, 1980). This concentration of market share can occur with little change in the number of competitors if fringe competitors remain or entry balances out exit, suggesting that shakeout can simply be considered to be a form of consolidation during which the number of firms declines.

Table 1. Estimated change in number of wholesaler-distributors

Wholesale distribution line of trade	Estimated number of wholesaler-distributors		% change
	1985	1995	
Cleaning equipment	800	800	0%
Electrical products	5,500	5,500	0%
Copper and Brass	67	65	−3%
Flowers and florists supplies	1,300	1,200	−8%
Woodworking machinery	240	220	−8%
Locksmith	120	100	−17%
Specialty tools & fasteners	3,000	2,500	−17%
Sporting goods	105	75	−29%
Wholesale grocers	366	242[a]	−34%
Air conditioning & refrigeration	275	180	−35%
Electronic components	2,100	1,300	−38%
Water and sewer	250	150	−40%
Wine & spirits	350	210	−40%
Waste equipment	240	120	−50%
Periodicals	205	100[b]	−51%
Average change			−25%
Weighted average change			−15%

Source: Fein (1997).
[a] 1990 data.
[b] 1996 data.

(1972) historical account. This an important gap in our knowledge because there are important differences between manufacturing and wholesaling industries.

The first objective of this paper is to explore the characteristics of wholesale distribution and wholesaler-distributors that imply differences in both the patterns and explanations for consolidation. The most important differences are the prevalence of exit by acquisition (rather than bankruptcy), weak or non-existent advantages to early entry, a minimal role for innovation in physical products, and the role of geography in defining competitive markets. To some extent, these differences are a function of the lengthy period of fragmentation in the industry. Any theory developed to explain consolidation in a new (manufacturing) industry will have varying degrees of applicability to an older industry such as wholesale distribution. Even so, I demonstrate that the basic rationales behind some of these explanations are not applicable to a service industry such as wholesale distribution. There are inherent differences in the nature of work performed and the potential sources of competitive advantage.

My second objective is to establish detailed empirical observations about the consolidation process in wholesaling. To do this, I focus on the consolidation of a single industry, pharmaceutical wholesaling. Between 1978 and 1995, the number of pharmaceutical wholesalers dropped from 147 firms to 53 survivors while the national market share of the largest six firms increased from an estimated 35% in 1977 to 77% in 1995. Despite some loss of generality, the overall findings should shed light on the consolidation processes

in other wholesale distribution industries. Since channel consolidation is a recent (and ongoing) phenomenon, the historical record is substantially more complete than the typical industry studied in previous research, enabling the use of resources such as computer databases and interviews with industry participants.

My third objective is to provide a theoretical explanation for the consolidation of drug wholesaling. As in theories that link market structure to firm R&D efforts, I found evidence for increasing returns to firm size conferred by innovation (Klepper, 1996a; Shaked and Sutton, 1987). However, an explanation based on increasing returns does not explain why the consolidation began when it did, nor can it account for the presence of late entrants who grew to dominate the industry along with the two largest incumbents. Theories which postulate a triggering innovation also do not appear to fit the data. Despite numerous important innovations in drug wholesaling, there was no single process or service innovation that could meets the requirements to be considered a triggering innovation.

I suggest that increasing returns led to consolidation when a combination of new technologies set off a chain-reaction within the entire business model of drug wholesaling. Due to important feedback relationships within this new model, companies achieved the greatest advantage when multiple new practices and technologies were adopted at roughly the same time. The need to alter multiple aspects of the company at the same time opened a gateway for new entrants that had few preexisting commitments. This explains the advantage of the four highly successful later entrants and limited the ability of small companies to adapt to the new market requirements. Market changes among wholesalers' two primary customer groups – hospitals and retail pharmacies – created incentives for geographic expansion among wholesalers by limiting the business prospects for wholesalers that could not provide the geographic reach or level of service required by customers.

Finally, in apparent contrast to the exit mode during manufacturing shakeouts, consolidation in drug wholesaling occurred primarily via the horizontal intra-industry merger and acquisition of competitors from the same industry. This fact is consistent with the geographic nature of competition in wholesaling, which ensured that many incumbents controlled valuable resources despite their inability to adapt to the new fitness landscape. The prevalence of exit by acquisition requires a broadened perspective on economic selection environments and implies that empirical regularities relating survival to size or profitability may not generalize to service industries.

This paper is organized as follows. In section 2, I develop testable predictions about the consolidation in wholesaling by examining theories developed for manufacturing industries. Section 3 provides an overview of a detailed historical data set that synthesizes data from multiple sources in order to understand consolidation. In Section 4, I provide a 200 year historical account of the evolution of drug wholesaling up to 1996. In Section 5, I analyze process and service innovations prior to and during the consolidation in order to evaluate the relative explanatory power of theories that link consolidation to technological change. Section 6 evaluates the explanatory power of theories developed for manufacturing industries. Section 7 builds on evolutionary theories of industry evolution to interpret the process by which the fragmented drug wholesaling industry consolidated. Section 8 highlights limitations of a single industry focus and suggests directions for future research.

2 Applying theories of shakeouts to wholesaling

Theories developed to explain consolidation in new manufacturing industries have varying degrees of applicability to wholesale distribution. In this section, I discuss the characteristics of wholesale distribution and wholesaler-distributors that imply differences in both the patterns and explanations for consolidation. The first two subsections identify predictions based on three theories of shakeouts. The third and fourth subsections identify additional predictions based on theoretical considerations that have not been considered in manufacturing industries. General observations about the patterns of consolidation in wholesale distribution are drawn from Fein (1997), which analyzes wholesale distribution consolidation patterns in 54 different industries.

2.1 Timing of entry

The wholesale distribution industries shown in Table 1 did not exhibit the pattern of an initial build-up of firms followed by shakeout after a peak. Instead, industry structure was fairly stable for an very extended period of time, despite periods of dramatic innovation at the manufacturing level of the industry. In fact, the activities and functions performed by wholesaler-distributors can be traced directly to merchant wholesalers operating in the pre-Renaissance era (Bucklin, 1972). Thus, it is not possible to document precisely the introduction of the services associated with wholesaling, in contrast to studies that focus on manufactured products for which an "industry birth date" can be identified.

One implication of this distinction is that entry conditions and the timing of entry should be less relevant than subsequent investment decisions. While early mover advantages with respect to particular business decisions or strategies may exist, the relationship between age and survival during a consolidation should be absent in wholesale distribution. In contrast, theories based on new manufacturing industries predict differential survival rates based on entry time relative to a dominant design (Suarez and Utterback, 1995) or to industry birth (Klepper, 1996b). Furthermore, theories postulating that shakeouts are caused by excessive entry relative to market size in new industries (Aaker and Day 1986, Dixit and Shapiro 1986) should have limited explanatory power in older, mature wholesale distribution industries.

2.2 The role of technological change

Since wholesale distribution is a service industry, there is little scope to consider the type of "product innovation" that is featured so prominently in many models of industry evolution. Unlike physical products, services are intangible, perishable, and can not be stockpiled or inventoried (Walker, Boyd, and Larreche, 1992). Substantial variation in the perceived quality of a service can exist between consumption experiences, whereas manufactured products are typically considered to be identical throughout a given production run.

Furthermore, wholesaler-distributors do not incur measurable or explicit R&D expenditures.[2]

Jovanovic and MacDonald (1994) develop a theoretical model in which early entrants employ a common technology in the pre-consolidation period. This technology is superseded by a second generation technology that, once implemented, allows for dramatic increases in scale and draws new entrants to the industry. The successful innovators of this new technology expand their output, causing prices to fall and non-innovators and late adopters to exit (by bankruptcy). Incumbents are assumed to have a greater probability of using the new technology as result of cumulative industry learning, and therefore have a higher probability of survival. Thus, this theory predicts the existence of an innovation that opens up the possibility for increased scale just before consolidation and a subsequent wave of failures among non-innovators.

Predictions about the role of technological change can also be identified using theories of dominant designs. Utterback and Abernathy (1975) propose that technology, embodied in rival product designs, explain observed patterns of entry and exit as an industry develops. When a new product class (industry) is created, many firms enter the market with experimental versions of the product. Each of these product variants represents some combination of product attributes and performance characteristics. There is little investment in R&D directed toward improving production processes because product designs are unstable. The emergence of a dominant product design enforces standardization by making one particular combination of product attributes and performance characteristics implicit in product design. The reduced uncertainty about product form is hypothesized to shift the focus of innovation from product to process improvement, permitting latent economies of scale in production to be realized. After the emergence of a dominant design, firms that are unable to make the transition to greater production efficiency, as well as firms heavily committed to alternative product designs, are forced to exit the industry (Suarez and Utterback, 1995).

When drawing an analogy to wholesale distribution, it is not possible to identity anything that could recognizably be called a "dominant design" based on product features or a product architecture. However, the dominant design theory makes a number of testable predictions about the triggers of consolidation in wholesale distribution. Just before the consolidation, an innovation should emerge that sets performance and service standards for the wholesaler-distributors in an industry. Following the emergence of this innovation, wholesalers should engage in high levels of process innovation to support this new cluster of wholesaling activities. The successful innovators and rapid imitators will increase their scale of operations, forcing the exit of smaller, less efficient companies.

2.3 The geographic nature of competition

As in many service industries, competition in wholesale-distribution occurs in geographically distinct markets (territories). The geographic nature of

[2] I analyzed the financial statements of all publicly held wholesaler-distributors (SIC codes 50 and 51) listed in the *Compustat* database. No wholesaler-distributor reports R&D expenditures in its financial statements.

competition is typically considered to be a function of transportation costs, the bulk of the product, the value of the product relative to freight charges, the presence of a local customer base, and manufacturer distribution policies (Stern and El-Ansary, 1992). For instance, a geographically "small" wholesaler-distributor is defined as a local company that serves one or more Standard Metropolitan Statistical Areas (SMSA) in a single state (Anderson, 1992). Sutton (1997) develops a stochastic model of industry evolution in which there are no strategic interactions between distinct sub-markets within an industry. His notion of independence is closely related to the geographic nature of competition in wholesale distribution.

The regional and geographic nature of competition of wholesale distribution, particularly in the pre-consolidation period, contrasts sharply with manufacturing industries in which each firm is considered to be in competition with all other firms in the industry prior to the shakeout.[3] It also implies that the national number of companies may not accurately depict the true nature of competition in particular regions. For example, a wholesaler-distributor can dominate one region of the country yet account for a very small proportion of national sales. One hypothesis is that consolidation in wholesale distribution simply reflects a national affiliation among previously independent regional companies. The alternative hypothesis is that consolidation led to a fundamental change in market structure and the nature of competition.

2.4 Implications of exit by acquisition

Consolidation occurs through a combination of three interrelated forces – rapid expansion and growth of a few firms, exit of industry competitors due to business failure and dissolution, and exit by horizontal merger or acquisition.[4] Yet exit by acquisition does not appear to have played a role in the shakeouts of technologically progressive manufacturing industries, whereas acquisition has been the most common mode of exit in many wholesale distribution industries.

An important implication of this empirical regularity is that firm characteristics such as size, profitability, or relative efficiency may have *no* effect on the likelihood of exit during a shakeout in which exit occurs primarily by acquisition. This prediction is driven by the counterbalancing influences of size on the decisions of an acquiring company (buyer) and an acquisition target (seller). Whereas the bankruptcy decision is made unilaterally by the equity or debt holders of the exiting firm, an exit by acquisition needs to be consistent with the needs of both the buyer and seller.

Consider a small firm. At a given point in time, a small firm may have higher marginal costs due to a lack of scale economies. But in dynamic sense, small relative size may be the result of early choices and path dependencies

[3] This is not strictly true in manufacturing. For example, concentration was higher in manufacturing industries when measured by regional and local ratios rather than national measures in one of the few studies to examine the issue (Schwartzman and Bodoff, 1972).

[4] I use the terms *merger* and *acquisition* to refer to any transaction that forms one economic unit from two or more previous ones. In practice, the distinction refers to accounting and tax considerations (Copeland and Weston, 1988) as well as post-acquisition integration strategy (Haspeslagh and Jemison, 1991).

that led to low growth and/or poor relative growth prospects. Smaller companies also tend to be privately-held and lack access to capital that is needed for expansion. As a result, managers at small firms may be willing to sell the firm at a substantial discount to avoid bankruptcy. Small size also makes acquisition financially easier for a buyer and presents a lower risk of government intervention on anti-trust grounds. Smaller, regional firms may be compensated for a cost disadvantage by providing specialized services in a local market or single market segment. Such success in a geographic niche can make the smaller firm an attractive target for a company that is expanding, increasing the likelihood of exit by acquisition. Thus, both unprofitable and profitable small firms are likely to exit during a consolidation.

Now consider the prospects for a large firm. Large size is the result of past growth and can temporarily buffer a wholesaler-distributor from survival pressures, making the likelihood of exit by dissolution low. Poor financial performance may conceal a hard-to-imitate and valuable resource such as a large customer base, locked into a specialized computer ordering system or long-term contracts with particular suppliers. Acquisition of a large company offers greater opportunities for operating and financial efficiency gains to a buyer. Acquisition of a large, well-performing competitor serving a complementary market (geographic or otherwise) may be an attractive mode of expansion. Given that a larger company is more likely to be a public company, a hostile takeover is possible even when owners of a successful business (or one with a valuable resource) are reluctant or unwilling to sell. Thus, large companies, both profitable and unprofitable, are also likely to exit during a consolidation.

Most empirical studies of firm survival during a shakeout neither include size as a covariate nor account for different modes of exit, e.g., Baum, Korn, and Kotha 1995; Suarez and Utterback 1995. Empirical studies that include these covariates and control for the mode of exit find limited support for size or profitability-based shakeouts. Mitchell (1994) finds no effect of size on likelihood of exit by merger or acquisition in a sample of medical device companies. Schary (1991) also finds no size effect when examining consolidation in the textile industry during the first half of this century and rejects a model based on the hypothesis that exit is related to profitability. In a sample of Texas banks, Hannan and Rhoades (1987) found that the likelihood of a firm being an acquisition target was not related to any of four different measures of performance. Furthermore, accounting research casts serious doubt on the ability of financial data to predict the likelihood of a firm becoming a takeover target (Palepu, 1986).

These empirical results, combined with the theoretical rationale put forth above, suggests that empirical regularities relating survival to size, profitability, or efficiency may not generalize to service industries such as wholesale distribution. Note that this argument does not contradict the presence of size-based advantages in wholesale distribution. Instead, I am proposing that there may be no systematic relationship between size and likelihood of exit.

2.5 Summary

This section provides the theoretical backdrop with which I analyze the historical development of pharmaceutical wholesaling. The following three

implications about the firm-level dynamics of industry evolution in wholesale distribution were derived:

1. The relationship between age and survival during a consolidation should be absent in wholesale distribution.
2. Technology-based theories of shakeout predict the existence of an innovation that opens up the possibility for increased scale just before the shakeout and a subsequent wave of failures among non-innovators.
3. Firm characteristics (such as size, profitability, or relative efficiency) may have no effect on the likelihood of exit during a shakeout in which exit occurs primarily by acquisition.

3 Data

I focus on the consolidation of a single industry, pharmaceutical wholesaling, to establish detailed empirical regularities about the consolidation process in wholesaling. There are four reasons that I adopt this single industry focus. One, drug wholesaling went through a particularly dramatic and rapid consolidation. Between 1978 and 1995, the number of pharmaceutical wholesalers dropped from 147 firms to 53 survivors while the national market share of the largest six firms increased from an estimated 35% in 1977 to 77% in 1995. Two, since consolidation is a recent (and ongoing) phenomenon, the historical record is substantially more complete than the typical industry studied in prior research. This enables me to synthesize data from key informants, field interviews, and computer databases in order to understand consolidation. Three, the basic functions performed by a wholesaler in one industry channel are essentially similar to functions performed in other industry channels. And as Table 1 demonstrates, consolidation in pharmaceutical wholesaling has progressed farther than many other wholesaling industries. Four, drug wholesaling has been one of the most technologically progressive lines of trade, offering a unique insight into the role of innovation in wholesale distribution. Thus, despite some loss of generality, the overall findings should shed light on the consolidation processes in other wholesale distribution industries.

Wholesale distribution is the primary means by which pharmaceutical manufacturers go to market today. According to the National Wholesale Druggists' Association (NWDA), over 80% of all ethical pharmaceutical sales were handled by wholesalers in 1994, up from 47% in 1977. Prescription pharmaceuticals account for the vast majority of drug wholesalers' sales, although they also distribute health and beauty aids, hospital supplies, and various sundries. Wholesale customers are mainly independent retail drug stores, chain drug stores, and hospitals, and to a lesser extent, mass merchandisers, grocery stores, nursing homes, and alternative health care sites. Wholesalers usually ship products directly to customers on a daily basis, using a wholesaler-controlled trucking fleet.

Unusually detailed historical data about financial and operating trends in pharmaceutical wholesaling is available from the National Wholesale Druggists' Association (NWDA). The NWDA has been the primary trade association for pharmaceutical wholesaling since its founding in 1886. *The NWDA Operating Survey*, published since 1923, contains aggregated financial and operating ratios for all member companies. Various volumes were avail-

able from 1952 through 1994. *The NWDA Fact Book*, which contains both current and historical data, was available for all years in which it was published (1992 to 1996). Other sources, noted throughout the text, include the business press, a handful of academic articles (Oswald and Boulton, 1995), and field interviews with industry participants.

To understand the modern period of consolidation, I compiled a complete census of all companies whose primary business was the wholesale-distribution of ethical pharmaceuticals. To generate this list, I consulted NWDA membership directories for 1978 through 1994. There was a tendency for some companies to join only in financially successful years, so I included any firm that had been a member in at least one year. Four pharmaceutical wholesalers that did not belong to the NWDA were identified by searching five national directories of private independent companies. Captive distribution operations of upstream manufacturers were excluded. This procedure resulted in 153 unique corporate entities operating at any time from start of 1978 through the end of 1995.

Exit data and the identity of the acquiring firm (where relevant) were collected from a variety of archival sources, including the *Investment Dealer's Digest* transaction database, *Mergers & Acquisitions* magazine, state incorporation and bankruptcy filings, annual reports of acquiring companies, and multiple LEXIS/NEXIS news databases. In all cases, precise exit dates (month/year) could be verified from at least two sources. Precise exit date could not be identified for 5 small companies, although these companies are known to be non-survivors. For these firms, exit is assumed to occur in the middle of the company's last year of NWDA membership. Mergers were treated as the exit of two firms and the entry of the new combined entity.[5]

This data collection effort demonstrated the inadequacy of government data for studying industry evolution. Based on my analysis, data from SIC code 5122 (''non-durable wholesaler-distributors of Drugs, Proprietaries And Sundries'') in the *Census of Wholesalers* do not correspond to the data collected by NWDA or the figures reported by other industry sources. The Census data includes many companies whose primary line of business is not drug wholesaling, such as manufacturers of generic drugs, independent retail pharmacy stores, and retail pharmacy chains.

4 An economic history of drug wholesaling

In this section, I provide an economic history of the evolution of market structure in drug wholesaling from the industry's origins in the 1700s through 1995. I pay particular attention to the history and strategies of six companies that were inextricably linked to the triggers of the shakeout. Unlike the em-

[5] I use the term *acquisition* to refer to one firm's purchase of a smaller entity that is absorbed into the acquiring firm. I use the term *merger* to refer the joining of two firms of roughly equal size, i.e., a pooling of interest. Both terms describe transactions that form one economic unit from two or more previous ones. Following an acquisition, the acquiring firm is considered the surviving firm. However, the identity of the surviving firm is indeterminate following a merger. Treating mergers as the exit of two firms and the entry of a new entity does not alter the annual count of firms. This classification scheme has minimal impact here because there were 3 mergers and 85 acquisitions during the consolidation (see Section 4.3).

pirical regularities documented for manufacturing industries, drug wholesaling did not exhibit the pattern of an initial build-up of firms followed by shakeout after a peak. Instead, market structure of drug wholesaling was fairly stable for a very extended period of time prior to the shakeout.

I divide the history of drug wholesaling into three distinct periods. From the industry's origins in the 1700s until 1929, drug wholesalers were small, regional companies acting as regional intermediaries. The second period in the evolution of drug wholesaling started in 1929 with the formation of the first national wholesaler. During the period of economic growth beginning in the 1940s, the United States health care system expanded dramatically and a second national wholesaler emerged. I date the beginning of the third era, the modern period of consolidation, to the entry of Alco Standard in 1978.

4.1 Early history: From the revolutionary war to 1929[6]

The wholesale drug trade emerged in the United States in the mid-1700s. Unlike Europe, the first wholesalers were founded prior to the development of professional retail pharmacy. Early medical practitioners, many of whom both prescribed and dispensed medicines, wanted to use the same preparations as the pharmacists in Europe. Wholesalers imported European products or manufactured products using indigenous plants. To facilitate import, American wholesale firms located near major seaports such as New York, Boston, Baltimore, or New Orleans. In addition to wholesaling, some firms also operated retail apothecaries, filling prescriptions for the few physicians who did not dispense their own medicines.

The rise of non-physician pharmacists began in 1821 with the founding of the first professional pharmacist organization in Philadelphia. State-wide "colleges of pharmacy" were founded shortly thereafter in Massachusetts and New York. Following the Civil War, retail drugstores appeared that were managed by business people or pharmacists rather than physicians. As new territories were settled and transportation routes (canals and railroads) developed, a new category of broker emerged between physician-owned apothecaries, drugstores, and the original wholesale firms. These brokers from the interior of the country typically traveled to the port cities to place orders. Personal visits were necessary to ensure product quality. In 1861, the Philadelphia Drug Exchange was founded to provide a central location for the trading of wholesale drugs.[7]

The prospects for this broker function were apparently so enticing that a surge of new entrants occurred in the 1860s and 1870s, leading to aggressive price competition. The Western Wholesale Druggists' Association was formed in 1876 to "correct excessive and unmercantile competition" and "remove, by concert of action, all evils and customs that are against good policy and sound business principles." At the time, there were an estimated 300 dealers offering

[6] This section synthesizes material from Fay (1987). Feldman and Schreuder (1996), Kremers and Urdang (1951), Reardon and Reardon (1995), Starr (1982), and the following articles: "Your associations and their roots," *Drug Topics*, February 7, 1983: "NACDS and chains: 50 years of success," *Drug Topics*, May 2, 1983.

[7] The exchange eventually grew into a manufacturers' trade association which sought to control competition between the merchants based in Philadelphia (Feldman and Schreuder, 1996).

Table 2. Number of U.S. drug wholesalers and distribution centers

	Number of NWDA companies[b,c]	Number of NWDA distribution centers	Number of companies (start of year)[a]
1886	na	210	
1935	na	214	
1943	na	297	
1952	na	247	
1965	na	357	
1970	144	372	
1975	145	395	
1980	139	347	149
1985	104	327	123
1990	84	263	89
1995	63	224	55
1996	55	233	53

Source: *NWDA Operating Survey*, various years; *NWDA Fact Book* (1992, 1995, 1996); Author's analysis of NWDA membership directories.

[a] These figures, based on my company database (see text), differ from NWDA figures for three reasons. One, NWDA counts the total number of members, regardless of identity. I found that some companies only joined NWDA in selected years, whereas I include these firms as active companies in all years prior to exit. Two, I identified four non-NWDA companies by searching five national directories of private independent companies. Three, individual houses occasionally retained independent NWDA membership following acquisition.

[b] NWDA company counts are as of January 1.

[c] Prior to 1970, an NWDA member was defined as a single establishment (''house'') even if it was part of a multi-establishment company. Although it is not possible to identify the number of companies prior to 1970, there were only a few multi-establishment companies (see text). The NWDA merged in 1970 with the Druggists' Service Council, an organization that had been serving some NWDA members (''houses'') who were not affiliated with McKesson and Robbins. Thus, 1970 and 1975 figures may not be directly comparable.

drugs, medicines, and chemicals at wholesale. The association changed its name to the National Wholesale Drug Association (NWDA) in 1882. An 1886 NWDA meeting reported 210 active wholesale members.

The potential customer base for wholesale firms grew rapidly. By 1929, there were approximately 59,000 drugstores, or roughly one store for every 2000 people, compared to approximately 25,000 drug stores in 1880. Interestingly, there was also roughly one drug store per 2,000 people in 1880 as well. At the same time, new medical technologies and increased demand for hospital services led to the development of for-profit (''proprietary'') hospitals that were managed and operated by physicians. As a result of this growth, the number of hospitals increased from 178 in 1872 to 4,000 in 1910, at which time 56% of the hospitals were proprietary.

During this period, the number of drug wholesalers appears to have grown very slowly, judging by the limited growth in the number of ''houses'' between 1886 and 1935 (Table 2). (Each house represented a single distribution location.) Since entry and exit data are not available for this period, I examined the founding periods for 129 companies that were operating at the start of 1978 and for which founding date information is available (Table 3, Column 2). Although these data are censored because firms exiting before 1978 are not

Table 3. Founding date and exit rate for drug wholesalers operating at the start of 1978[a]

Founding period	Number of companies	Total exits	Exit rate	Exits by merger or acquisition[a]	M&A exit rate
1797–1859	8	5	62.5%	5	62.5%
1860–1889	10	7	70.0	7	70.0
1890–1899	11	8	72.7	7	70.0
1900–1909	8	6	75.0	5	71.4
1910–1919	11	8	72.7	6	66.7
1920–1929	12	9	75.0	7	70.0
1930–1939	16	9	56.3	7	50.0
1940–1949	17	11	64.7	11	64.7
1950–1959	17	9	52.9	8	50.0
1960–1969	10	6	60.0	6	60.0
1970–1977	9	8	88.9	7	87.5
Unknown	18	14	77.8	13	76.5
Total	147	100	68.0%	89	65.4%
Average year:	1925.6				
Median year:	1932				

Sources: Author's analysis.
[a] Excludes companies that exited by business dissolution or for which exit mode is unknown. See text for details.

counted, it does appear that the total number of firms was fairly steady in the period prior to the modern consolidation period. The pattern of exit suggests that there was offsetting entry throughout this period.

4.2 The emergence of large wholesalers: 1929 to 1977[8]

The first national drug wholesaler was formed through a 1929 consolidation led by McKesson and Robbins. The company was founded in 1833 as Olcott, McKesson & Co., and initially served clipper-ship captains who came to stock their medicine chests. During the Civil War the firm added a liquor distributing business, and it later added a chemical distribution division. In 1924, the death of the founder's son, John McKesson, Jr., prompted a three-way split of McKesson & Robbins (as the company had been renamed in 1853). Although the New York wholesale drug operation was shut down, the "manufacturing and special drug sales" division was purchased by F. Donald Coster for $1 million dollars. In April 1929, Coster orchestrated a merger with 64 other wholesale drug firms operating in 31 cities, producing a company with 6,000 employees and 25% of the national market share in wholesale drug distribu-

[8] This section synthesizes material from Fay (1987), Kremers and Urdang (1951), Morison and Drohan (1978), individual company listings in the *International Directory of Company Histories* (1988, 1992, 1996), and the following articles: "McKesson Program Pays Off At Retail." *Printer's Ink*, April 17, 1959: "How McKesson & Robbins, Nation's Largest Drug Wholesaler, Functions." *Advertising Age*, October 16, 1961: "The Reluctant Dragon of the Drug Industry," *Fortune*, November 1962: "Foremost-McKesson: The Computer Moves Distribution to Center Stage," *Business Week*, December 7, 1981: "McKesson at turning point as it turns 150," *Drug Topics*, June 20, 1983: "Leaping to the top of the IS world." *Computerworld*, June 17, 1991.

tion. Five more companies were acquired from 1930 to 1937. Following a series of scandals,[9] the company was reorganized under private ownership in the early 1940s.

McKesson & Robbins was essentially a national affiliation of regional companies at the time of the reorganization. Each drug house was operated by its former owners as a separate division. Each owner was a "vice-president" of McKesson & Robbins and made his or her own buying and selling decisions without any corporate-level oversight. This began to change in 1947 with the hiring of former Ohio State professor of marketing Herman Nolen as chief buyer. Nolen discovered that 168 of McKesson's 6000 suppliers accounted for 85% of the volume and virtually all of the profit. McKesson's New York headquarters began sending out a weekly "national sales calendar" of items that were to be "sold hard" by each house. A few years later, buying and selling functions were consolidated under Nolen, although the division managers were still responsible for managing their own profit and losses.

During the 1940s and 1950s, McKesson grew into a full line drug wholesaler, handling virtually every product sold by retail drugstores, including a full line of pharmaceuticals and health and beauty aids (HABAs). McKesson was well-positioned to capitalize on the 90% increase in drug store sales that occurred between 1950 and 1960. By 1961, McKesson serviced 33,000 drug stores and 5,000 hospitals, and had annual drug distribution revenues of $415 million. In further testament to its market dominance at that time, one out of every five drugstores in the United States had been designed as a new store or modernized by McKesson's retail pharmacy design service.

To a lesser extent, growth was fueled by changes in the hospital market. By 1946, most proprietary hospitals had been converted to non-profit organizations. In 1945, Congress passed the Hill-Burton Act, which provided federal funds for the construction of new hospitals and the repair of aging hospitals. As a result, the number of beds per capita rose and a financial cushion was created for financially marginal operations. The passage of Medicare and Medicaid in 1965 fueled further growth by reimbursing hospitals based on costs (as determined by the hospitals themselves). Until the modern period of consolidation, most hospital purchases were made directly from manufacturers.

In 1967, Foremost Dairy implemented a strenuously-resisted hostile takeover of McKesson & Robbins. McKesson filed an antitrust suit with the FTC which charged that the takeover would subvert competition between McKesson and Foremost's two small drug distribution subsidiaries. Although the suit was dropped after Foremost had acquired 40% of McKesson's stock, the FTC delayed the merger until July 1967. In exchange for approving the deal, the FTC required that Foremost-McKesson seek FTC approval before making any new drug related acquisitions. This agreement substantially effectively halted the firm's acquisition activity in drug wholesaling until 1982.

A second large drug wholesaler, The Bergen Brunswig Corporation, was created when the Bergen Drug Company acquired The Brunswig Drug Company in 1969. The Brunswig Drug Company was founded by Lucien Brunswig, who was born in France in 1854 but began his career at age 17 as an apprentice to a U.S. druggist. He founded his own retail drug store in

[9] Coster committed suicide in 1939 after he was revealed to be a former convict named Philip Musica. Subsequent investigations discovered that Coster had embezzled $3 million from the company.

Kansas in 1875 and sold it profitably a few years later. Brunswig then traveled to Fort Worth, Texas, where he started a drug store serving both retail and wholesale customers. In 1882, George Finlay invited Lucien to join the New Orleans wholesale drug firm, Wheelock-Finlay. Upon Finlay's death in 1885, Brunswig took over the operation. In 1888, Brunswig sent his partner, F.W. Braun, to open one of the first wholesale drug companies in Los Angeles, then a growing town of 30,000. After a highly successful San Diego branch was opened in 1890, Brunswig sold the profitable New Orleans operation and moved to California in 1903. The Brunswig Drug Company subsequently expanded to Arizona. By the time Roy Schwab succeeded Brunswig in 1943, the company was considered one of the most innovative drug wholesalers, despite its small size. By 1960, the company had grown to 14 divisions throughout the southwestern United States through both acquisitions and internal expansion.

The Bergen Drug company was founded in 1947 in Hackensack, NJ, by Emil P. Martini, Sr. After Martini's death in 1955, Emil P. Martini, Jr., took over the company and quickly began expanding geographically with the acquisition of Drug Service, Inc., of Bridgeport, CT in 1956. Between 1957 and 1959, Martini started new operations in three California cities. By 1960, Bergen was supplying 5,000 pharmacists and hospitals. In May 1969, Bergen acquired the Brunswig Drug Corporation, forming the Bergen Brunswig Corporation. In 1970, the combined entity acquired 12 drug wholesalers, transforming itself into a national wholesaler.

Despite some entry and exit during this period, the total number of companies remained relatively stable throughout the 1970s. By 1970, the NWDA had 144 drug wholesaler members operating 372 distribution centers (Table 2). At the start of 1978, there were 147 drug wholesalers operating in the United States. The two largest wholesalers were McKesson, with an estimated 25% of the $4.9 billion distribution market, and Bergen Brunswig, with estimated sales of $403 million and an 8% share. No other drug wholesaler had more than $100 million in annual sales. A majority of these smaller, regional companies had a single location and were operated by the original company founder or his descendants.

4.3 The era of consolidation: 1978 to 1996

By the end of 1995, only 53 survivors remained, a net decline of 64% from the start of 1978. Excluding three companies created by merger, only six companies entered between 1978 and 1981. After 1981, no new drug wholesalers were founded, in sharp contrast to the historical trend (Table 3). Of the 103 total exiting companies, 85 companies (83%) were acquired by another pharmaceutical wholesaler. Seven firms exited by business dissolution and five companies exited in an undetermined manner. Six companies exited by merger, forming three new companies. Figure 1 summarizes the entry and exit patterns during this period.

The sharp decline in the number of companies was primarily due to the acquisitive activities of four companies. Eighty-five of the wholesalers that exited between 1978 and 1995 were acquired by another pharmaceutical wholesaler. Four pharmaceutical wholesalers accounted for 50 of these 85 acquisitions (Table 4). These four companies were Alco-Standard (later

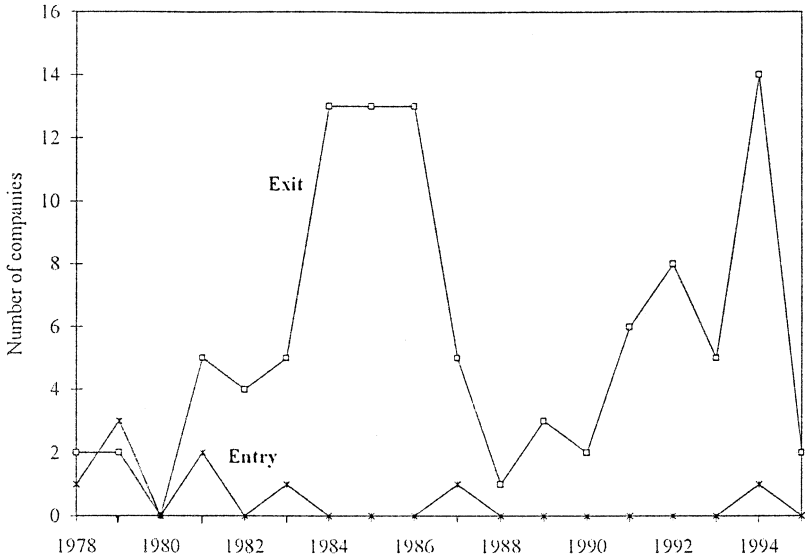

Fig. 1. Entry and exit of drug wholesalers, 1978 to 1995. Source: author's analysis

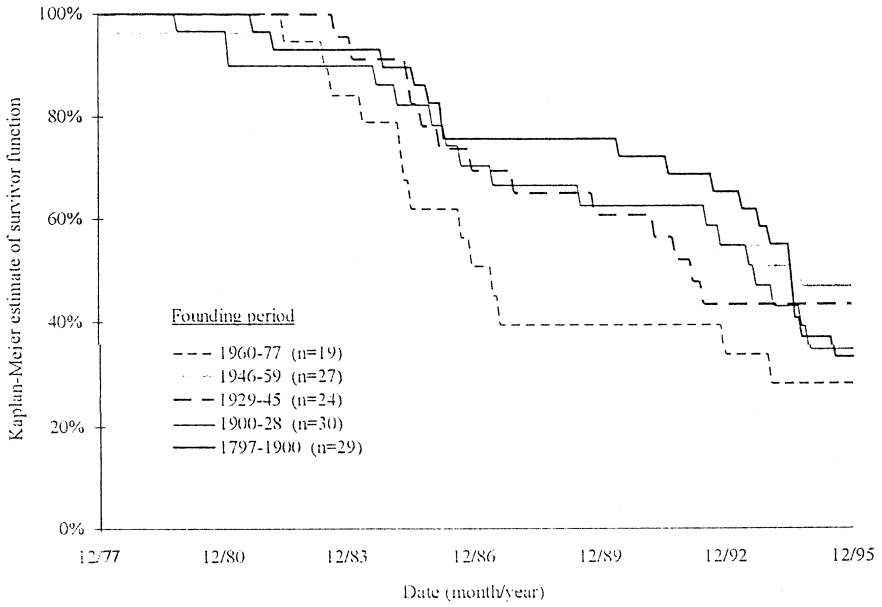

Fig. 2. Estimated survivor functions for drug wholesalers operating at the start of 1978. Companies exiting by business dissolution or for which exit mode is unknown are treated as censored observations

Table 4. Acquisition activity of firms making three or more drug wholesale acquisitions, 1978 to 1995

Company	Number of acquisitions	Total revenues of acquired companies ($1995 millions)[c]	Average acquisition date[g]
Alco-Standard (Amerisource)	17	$1,024[d]	9/84
Bergen Brunswig Drug Company	11	3,019	10/87
FoxMeyer Corporation[a]	11	2,125[e]	1/86
Cardinal Health	11	5,214	7/89
Harris Wholesale Drug	5	186[f]	1/86
Bindley-Western Drug Company	4	586[e]	2/90
Neuman Distributors	4	545[e]	1/89
Commons Brothers	4	229[e]	8/93
D&K Wholesale Drug Corporation[b]	3	432	3/95
McKesson Drug Company	3	926	2/85

Source: Author's analysis.
[a] Does not count the 1981 merger of Fox-Vliet Drug Co. and Meyer Brothers Drug Co. that formed FoxMeyer.
[b] Does not count the 1987 merger of Delta Wholesale Drug and W. Kelly Company that formed D&K.
[c] Sum of acquired companies annual revenues in the year prior to acquisition. Revenues inflated to constant 1995 dollars using the Producer Price Index for prescription drugs.
[d] Excludes 3 acquired companies with missing sales data.
[e] Excludes 1 acquired company with missing sales data.
[f] Excludes 2 acquired companies with missing sales data.
[g] Mathematical average of acquisition dates.

known as Amerisource), The Bergen-Brunswig Drug Company, FoxMeyer Corporation, and Cardinal Distribution (later known as Cardinal Health). No other pharmaceutical wholesaler made more than 5 acquisitions of another pharmaceutical wholesaler during this period. These four companies were among the six largest pharmaceutical wholesalers in 1995 (Table 5). Following a surge of acquisitions in 1994 (Fig. 1), the largest six wholesalers had 77% of the national market share in 1995, with a sharp drop-off in size between the sixth and seventh largest firm (Table 5).

Given the impact of the active acquirers, I date the beginning of the consolidation to the 1978 entry of the first acquirer, Alco Standard. The majority of drug wholesalers in the pre-consolidation period were privately-held firms and therefore not subject to hostile takeover. Thus, most of the exits (by acquisition) resulted from mutual agreement between buyer and seller.

The presence of the four active acquirers means that the consolidation cannot really be described as a "combination of combinations" (Stigler, 1950). However, two significant acquisitions and two as-yet-uncompleted mergers took place in the final stages of the consolidation. In 1992, Foxmeyer acquired Harris Wholesale, a moderately acquisitive company (Table 4). Then, in late 1996, McKesson acquired Foxmeyer Drug through bankruptcy court proceedings for $23 million plus the assumption of $575 million in debts and other liabilities. Foxmeyer had filed for bankruptcy court protection from creditors in mid-1996 after cost overruns and unanticipated operational problems delayed the implementation of a new $65 million computer system and fully

Table 5. Market share of largest ten drug wholesalers, 1995

Company	Sales (millions)	Market share
1. McKesson	10,793	18.8%
2. Bergen Brunswig	10,386	18.1
3. Cardinal Health	8,153	14.2
4. FoxMeyer	5,521	9.6
5. AmeriSource	4,776	8.3
6. Bindley Western	4,532	7.9
7. Neuman Distributors	1,037	1.8
8. Walker Drug	700	1.2
9. Kinray Inc.	535	0.9
10. Drug Guild	494	0.9

Source: Company annual reports; *NWDA 1995 Fact Book*.

automated distribution center.[10] Consolidation is now continuing among the largest firms. In August 1997, Bergen Brunswig and Cardinal announced their intention to merge. One month later, McKesson and Amerisource announced a merger. As of late 1997, the antitrust implications of both transactions were being investigated by the Federal Trade Commission.

Note that the consolidation occurred despite record sales growth. Aggregate sales of wholesalers increased (in constant 1995 dollars) from $20.6 billion[11] in 1980 to $57.5 billion in 1995, a compound average real growth rate of 7.3% per year. The proportion of sales going through wholesalers also increased substantially. In 1977, 41% of manufacturer sales were made directly to customers, bypassing wholesalers. Wholesalers handled only 49% of pharmaceutical sales. By 1995, 80% of all ethical pharmaceutical sales were handled by drug wholesalers. Direct sales by manufacturers accounted for less than 15% of annual sales.

4.4 Company histories

To lay the groundwork for the synthesis in Section 7, I briefly describe the histories of the four active acquirers that came to dominate the industry along with McKesson and Bergen Brunswig. Bergen Brunswig was the only active acquirer that had been a large, national wholesaler prior to the start of the consolidation.

Alco Standard entered the drug wholesaling business in 1978 with the acquisition of The Drug House, a regional wholesaler based in Pennsylvania. Prior to 1978, Alco Standard had been a highly diversified conglomerate with no drug wholesaling operations. Fragmentation offered Alco an opportunity to apply its consolidation strategy. Alco Standard had already acquired 100 small, mostly privately-held companies ranging from a maker of plastic auto parts to a paper distributor. Tinkham Veale II, Alco's chairman and founder,

[10] "When Things Go Wrong." *The Wall Street Journal*. November 18, 1995.

[11] 1980 sales are inflated to 1995 dollars using the Producer Price Index for prescription drugs. Nominal dollar sales were $6.5 billion in 1980.

described this philosophy in the following way: "The smaller businessman in America has been forced to spend more and more of his time doing things that he didn't know and understand well, rather than things he did well – making and selling the product."[12] It offered its acquisitions a network through which legal, accounting, marketing and other operations are conducted from corporate headquarters, leaving the managers of the acquired companies to run their businesses.[13]

Between 1978 and 1984, Alco acquired seven more regional drug wholesalers throughout the southeastern and midwestern United States. Alco Health Services Corporation was spun off as a separate public company in 1985. Seven acquisitions followed in 1985 and 1986. A highly-leveraged management buyout in 1988 put a temporary halt to acquisition activities, as the high debt burden translated into a net loss for fiscal years 1989 through 1994. (One further acquisition was made in 1991.) The company went public as Amerisource in 1995 and has since resumed its acquisitive expansion strategy with the purchase of two pharmaceutical wholesalers in 1995 and 1996.

Foxmeyer was formed when Colorado-based Fox-Vliet Drug Co. merged with Missouri-based Meyer Brothers Drug Co. in 1981. At the time, the combined entity had estimated sales of $150 million, roughly 2% of national drug distribution sales. By the time Foxmeyer was purchased by the National Intergroup conglomerate, it had become the third largest drug wholesaler in the United States.

Bindley Western, the sixth largest drug wholesaler in 1995, traces its roots to E. H. Bindley and Company, a small drug wholesaler founded in 1865. In the mid-1960s, Bill Bindley, the great-grandson of the founder, believed that the coming era of chain drug stores offered possibilities for expanding the family business. However, his father, the president of E. H. Bindley, viewed this expansion as too risky. So, with $50,000 in borrowed funds, Bill Bindley founded Bindley Western in 1968 in the basement of his father's company. By the late 1970s, Bindley Western had reached nearly $100 million in sales by specializing in distribution to chain warehouses.

Cardinal Distribution was formed when Monarch Foods was acquired in 1971 by Robert D. Walter, a 26 year old Harvard Business School graduate. Walter believed that the food distribution business was "in-bred" and could benefit from more professional management.[14] Cardinal entered the drug wholesaling industry in 1979 with the acquisition of Bailey Drug Co., an Ohio-based wholesaler with estimated sales of $20 million. In 1988, when Cardinal sold its food business to concentrate on health products, it had drug wholesaling revenues of $700 million, primarily concentrated in the mid-west and east coast. In 1991, Cardinal began expanding into the southeastern United States. Cardinal achieved national market coverage in 1994 when it merged with Whitmire Distribution Corporation, a California based pharmaceutical wholesaler whose $3 billion in annual revenues were concentrated in the western and central United States.

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[12] "Playing partners with Alco," *Business Week*, May 8, 1978.
[13] "Alco Keeps Adding Family Businesses To Its Collection." *The New York Times*, October 12, 1981.
[14] "Cardinal Management Has Know-How In Computers, Accounting, Finance, Production, Marketing, Retail," *Supermarket News*, July 4, 1983.

5 Innovation in drug wholesaling

In this section, I document the patterns of innovations in drug wholesalers to provide basic data with which to evaluate the explanatory power of theories that posit technological events as the trigger of consolidation. Drug wholesalers engage in two types of innovation: *cost-reduction process innovation* and *added-value service innovation* to develop new services for customers and suppliers. Both process and service innovation in drug wholesaling have been enabled by exogenous developments in computing and communications technologies. Drug wholesalers also attempted to imitate or match the services and business processes of rivals. The presence of third-party suppliers of equipment used to run a wholesale distribution business appears to have aided imitation and the diffusion of knowledge.

5.1 Cost-reduction process innovation

Since employee costs in warehousing and transportation have been the single largest cost after product acquisition costs in drug wholesaling, process innovation has focused on improving personnel productivity to reduce costs of operation. Increases in labor efficiency reflect two types of activity changes: fewer people doing the same amount of work (due to automation and capital substitution) and a reduction in the number of employees necessary to reach a given level of sales (due to increases in the marginal product of labor). In practice, these distinctions can be indistinguishable. Process innovation reduces the costs of operation for a given level of output or makes it feasible for a firm to grow from being smaller to being larger over time with a stable number of employees.

Tracking millions of individual items as they move from a pallet on a warehouse loading dock to a storage shelf to a tote box designated for an individual customer is extremely complicated and vulnerable to human error. Full automation is very difficult since a typical wholesale pharmaceutical customer order contains less than a full case of any single item. Even so, the efficiency of warehouse and physical distribution operations among pharmaceutical wholesalers has improved steadily since at least 1950. By one measure of warehouse personnel productivity, the number of invoice lines picked from stock per picking manhour[15], productivity gains have increased at a steady rate throughout the last 45 years (Table 6, Column 2). The biggest productivity jump occurred with a 58% increase between 1980 and 1985. There were 15 years of relative stability prior to 1975 and another period of relative stability after 1985. A similar jump is evidenced in the handling cost per invoice line, which peaked (in constant dollars) at $4.42 in 1975 and then sharply declined (Table 6, Column 4). The greatest decline occurred between 1980 and 1985, when costs dropped by 34%. Further evidence is provided by the shrinking proportion of gross profit taken up by compensation costs (Table 6,

[15] Each type of product is listed on a separate line of a customer's printed order form. Thus, an "invoice line" refers to some quantity of a single product on a customer's order form (invoice). "Stock" refers to items available for picking from various warehouse locations. Thus, this productivity measure is computed by dividing output (number of invoice lines taken from warehouse stock) by input (number of hours spent picking the items from warehouse stock).

Table 6. Labor productivity in drug wholesaling

Year	Invoice lines picked per picking manhour[a]	Handling cost per invoice line	Handling cost per invoice line ($1995)[b]	Total compensation as % of gross profit
1950	18	$0.44		
1955	21	0.49		
1960	26	0.58		
1965	28	0.63	$3.01	
1970	26	0.82	4.09	49.4%
1975	30	1.04	4.42	44.7
1980	39	1.17	3.62	38.9
1985	60	1.25	2.39	36.2
1990	55	1.90	2.38	34.1
1995	50	2.35	2.35	33.2

Source: *NWDA Operating Survey*, various years.
[a] Median number of invoice lines picked from stock per picking manhour.
[b] Inflated to constant 1995 dollars using the Producer Price Index for prescription drugs.

Column 5), although there is no clear time period in which declines are substantial.

Many warehouse innovations during this period reconfigured the work processes for how products were picked off shelves. In strict orderpicking, each order picker completes one order at a time, potentially traveling over the entire warehouse to complete the order. ''Mispicks'' result when customer orders get mixed up or when items are miscounted. The period of consolidation saw growing use of two different picking techniques.[16] In batch picking, each order picker picks items for several orders simultaneously, sorting while picking. In zone picking, each order picker is assigned to a particular zone in the warehouse, regardless of the customer order. The size of the zone depends on activity levels and throughput. Another innovation was the introduction of night picking. Products are picked off shelves and put in a basket at night for shipment to customers the following morning, enabling wholesalers to service more customers. More recent innovations include lightweight wearable computers. A mainframe computer transmits a customer's shopping list to a small display screen mounted on the (human) picker's forearm, which includes the exact location of the item to be picked.[17] By 1991, 90.2% of all distribution centers were using night picking. As late as 1995, there were a variety of picking methods in use (Table 7), suggesting that there was either uncertainty about the relative efficiency of different methods or path-dependent lock-in to a particular method in some warehouses. However, no single picking technique stands out as a major innovation.

Some efficiency improvements can be traced to the substitution of information technology for human processing and activities in areas such as order processing, billing, inventory control, delivery route scheduling, and tracking warehouse movement. The Brunswig Drug Company was reportedly the first wholesale drug company to introduce computerized punchcards for keeping

[16] ''Orderpicking: a course-in-print, Part 3,'' *Modern Materials Handling*, December 1990.
[17] ''McKesson Drug curing inaccuracy of warehouse labor with wearable PCs,'' *Computerworld*, May 11, 1192.

Table 7. Percent of distribution centers using different picking methods

Picking method	1991	1995
Zone picking	74%	70%
Batch picking	38%	49%
Both zone & batch picking	8%	57%
Night picking	90.2%	na

Source: *NWDA 1992 Fact Book, NWDA 1995 Fact Book*.

track of inventories. As described in a 1950 report by NWDA Committee on Operations (Fay, 1987), Brunswig operated a 60,000 square foot warehouse in California built for punched card procedures. The master file had 85,000 cards sorted into 36 tub files with a total capacity for 1,500,000 cards. The hand-sorted cards were sent to the tabulating machine company's office in Seattle for computation. Despite the company's relatively small size at the time, Brunswig apparently automated to cope with the complex management of over 21,000 items from 1,200 suppliers. By 1968, approximately two-thirds of NWDA members had some sort of electronic data processing systems of varying levels of sophistication. By 1975, median data processing expenses for all drug wholesalers were 1.0% of net sales (Table 8).

Not all efforts at warehouse productivity improvement were successful. In 1958, Brunswig Drug was also the first wholesaler to use "Gertrude," an automatic order filling machine (Fay, 1987). Activated by tab cards, the system sent up to 1000 items down a sloping chute to a series of conveyor belts leading to packing. However, the system proved to be too expensive. Foxmeyer's attempt to build a fully-automated, national distribution center (described above) led to the firm's bankruptcy. Other wholesalers only began opening fully automated distribution centers in the early 1990s.[18]

By decomposing the drop in operating expenses, we can see the effect of warehouse automation and other productivity improvements. Between 1950 and 1980, warehouse expenses hovered above 2% of net sales. But from 1980 to 1994, this portion of operating expenses dropped to less than 1% of sales, roughly the same net decline (−62%) as the 57% decline in total operating expenses. As a result of this simultaneous decline, warehouse expenses have actually increased slightly as fraction of total operating expenses since 1952. In 1950, warehouse expenses were 22% (= 2.70/12.50) of total operating expenses compared to 24% (= 0.87/3.69) in 1994 (see Table 8).

The construction and operation of much larger distribution centers was a consequence of rather than a cause of shakeout. The number of distribution centers declined at a fairly steady rate from a peak of 395 in 1975 to 224 in 1995 (Table 2), yet median sales per distribution center only began to diverge from the pre-1980 trend in 1988 (Fig. 3). This was the result of larger companies replacing local distribution centers with regional warehouses and renovating older warehouses. For example, McKesson reduced the number of distribution centers from 80 in 1978 to 56 in 1983, 47 in 1989, and 36 in 1995. Bergen Brunswig opened seven regional distribution centers between 1986 and 1994, replacing 18 older, less efficient facilities. Amerisource, the most active

[18] "Technology helps drug wholesalers weather recession." *Drug Store News*, October 28, 1991.

Table 8. Breakdown of operating expenses for drug wholesalers, 1952–1994

Year	Total operating expenses[b]	Expense category[a]					
		Administrative	Selling	Data processing	Warehouse	Delivery	Buying
1952	12.50%	5.50%	3.20%	na	2.70%	1.10%	na
1954	13.82	6.12	3.54	na	2.79	1.36	na
1960	13.67	6.27	3.38	na	2.55	1.46	na
1965	12.41	5.64	3.13	na	2.24	1.40	na
1970	12.32	5.75	2.84	na	2.33	1.41	na
1975[c]	11.47	3.58	2.75	1.00%	2.55	1.49	na
1980	8.53	2.02	1.56	1.02	2.29	1.40	0.28%
1985	6.17	1.62	1.09	0.72	1.60	1.00	0.20
1990	4.72	1.30	0.70	0.50	1.24	0.84	0.15
1994	3.69	1.07	0.48	0.43	0.87	0.57	0.12

Source: *NWDA Operating Survey*, various years.
na = expense category not broken out in operating survey.
[a] All figures are industry-wide averages, computed as a percentage of net sales.
[b] Sum of columns 3 to 8 (except for rounding error).
[c] Median values.

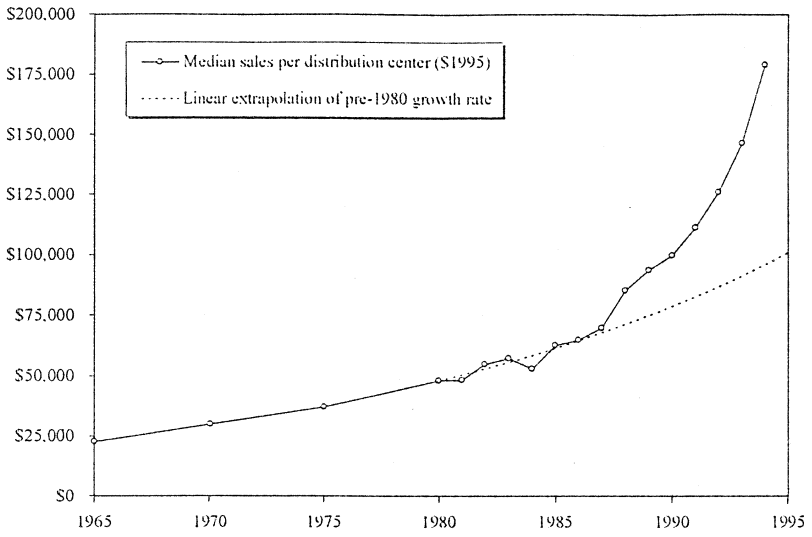

Fig. 3. Median constant dollar sales per distribution center. Source: NWDA 1995 Fact Book; inflated to constant 1995 dollars using the Producer Price Index for prescription pharmaceuticals

acquirer during the consolidation, consolidated its warehouses from 31 in 1989 to 14 in 1996. Thus, the growth in distribution center size occurred at a relatively late stage in the consolidation.

Larger warehouses have had lower operating expenses as a percentage of sales since 1960 (Table 9), although the advantage of larger distribution centers began to widen in 1980. By 1985, the smallest distribution centers had

Table 9. Operating expenses and distribution center size, 1952–1993

Year	Small distribution center size[a]	Operating expenses for small D.C.s	Large distribution center size[b]	Operating expenses for large D.C.s	Ratio (Small to large)
1954	$2	14.3%	$10	14.3%	1.00
1960	2	15.4	10	14.1	1.09
1965	2	13.3	10	11.9	1.12
1970[c]					
1975	5	12.3	18	11.2	1.10
1980	8.5	11.4	45	7.9	1.44
1985	10	10.9	80	5.6	1.95
1990	20	7.5	140	4.6	1.63
1993	60	5.2	250	4.0	1.30

Source: *NWDA Operating Survey*, various years.
[a] Upper bound for smallest size category defined in annual operating survey, in millions.
[b] Lower bound for largest size category defined in annual operating survey, in millions.
[c] Missing.

an operating expense ratio that was nearly twice the ratio of the largest distribution centers. The diminishing advantage after 1985 reflects the virtual disappearance of small distribution centers.

5.2 Added-value service innovations

Beginning in the mid-1970s, drug wholesalers developed a number of service innovations that applied computing and communication technology to buying and selling activities. Since these innovations appeared just before the modern era of consolidation, they are likely candidates for triggering consolidation. The two companies that were relatively large prior to the consolidation, McKesson and Bergen Brunswig, were the first to develop essentially equivalent electronic systems for direct order entry. I begin by briefly outlining the early development and functions of each company's system.

The sales cycle at Bergen Brunswig prior to 1974, described by Hill and Swenson (1994), was typical for drug wholesaling before the introduction of electronic ordering systems. A salesperson would call on a drug store, in person or over the phone, and then write up a detailed order from the druggist. The salesperson would call a distribution center and read out the stock numbers and quantities to an order clerk. Within a few hours, the order would be manually picked from the warehouse shelves and shipped. There were many inefficiencies inherent in this system, such as an ordering process that was time consuming, labor intensive, and subject to many opportunities for human error. In addition, purchasing and order entry staff were duplicated at each warehouse.

In 1974, Bergen Brunswig's first attempt at electronic order entry for retail customers was a large machine that was placed on rollers and used to electronically key in stock numbers. This was soon replaced by the DART (Data Acquisition Recording Terminal), a 12 lb. unit that recorded stock numbers and order quantities on a cassette tape. The tape was played back over the phone to the distribution center. By computerizing the order process, this

system eliminated the order clerk. Manual keying was eliminated with the introduction in the early 1980s of a bar coding system and scanner that was developed for Bergen Brunswig by the Singer Corporation. Customers used a hand-held laser scanner to read shelf labels and key in order quantity. Hill and Swenson (1994) report that this system reduced the order time for a pharmacist from 2 hours to 20 minutes. Later improvements included a light weight scanner that downloads data into an on-site computer. The data were then transmitted by modem to a distribution center, which immediately reported on stock availability. To speed diffusion of the new technology, Bergen Brunswig used quotas and financial rewards to encourage salespeople to convert customers.

McKesson developed a similar system, Economost, sometime between 1970 and 1975 (Clemons and Row, 1987). Initially, Economost was only used in northern California, where it competed with the traditional sales force. In 1975, the system was rolled out nationally with minimal modifications at an estimated cost of $50,000. The percentage of orders received electronically jumped from 15% in 1975 to 99% by 1983.[19] The Economost service was extended to hospitals an the Econolink service, which allowed hospitals to check McKesson's inventory via automated telephone link. Hospitals could use the system to request immediate delivery, reserve a drug, or trigger alternative sourcing.

Both of these systems enabled independent drugstores to computerize accounts receivable and offer charge accounts to their customers, a service which would have been unaffordable without the assistance of drug wholesalers. Electronic ordering also created opportunities for the development of new value-added services for retail pharmacists, such as organizing merchandise according to a planogram, determine which products are quick and slow movers, updating prices based on their own pricing formulas, and collecting more quickly from third-party payers.[20] Bergen Brunswig began advising retail clients on product and shelf arrangements shortly after introducing their ordering system.[21]

Electronic linkages between wholesalers and suppliers also grew during this period. Bergen Brunswig reportedly pioneered the electronic transmission of purchase orders in 1971 with a link to Eli Lilly & Co. As early as 1981, McKesson had direct computer links with 32 vendors, up from only 1 in 1976. The advantages of these systems were quickly felt in internal operations. For instance, the number of purchasing employees at McKesson dropped from 140 people in 1978 people to only 12 in 1983.

Available evidence indicates that the ordering innovations of McKesson and Bergen Brunswig were imitated fairly quickly as the four other large wholesalers grew.[22] Alco introduced retail support services in 1982. Cardinal introduced computer assistance for its retail customers in 1989, shortly after it sold its food business to focus on pharmaceuticals. This late introduction was consistent with Cardinal's explicit strategy of being a technology follower,

[19] "McKesson at turning point as it turns 150." *Drug Topics*, June 20, 1983.
[20] "A revolution in the way pharmacy is practiced." *Drug Topics*, May 2, 1983.
[21] "Bergen Brunswig writes a winning prescription." *Sales and Marketing Management*, January 17, 1983.
[22] "Discovering the Drug Distributors." *Fortune*, February 8, 1982: "For Drug Distributors, Information is the RX for Survival," *Business Week*, October 14, 1985.

preferring to let other wholesalers work out the bugs first.[23] The fact that these systems were computer-based may have made them easier to imitate because third-party suppliers could develop low-cost systems that could be purchased by all but the smallest drug wholesalers. For example, I.L. Lyons began offering a system developed by Honeywell in 1982 even though it was a regional wholesaler with relatively small revenues of $100 million.[24]

6 Evaluating theories of shakeouts

The shakeout in drug wholesaling was consistent with many of the empirical regularities identified in previous research (Klepper, 1996a). In particular, there has been a sharp drop in the number of firms, a virtual cessation of entry once the shakeout begun, and a transition from a fragmented to an oligopolistic industry structure. This shakeout occurred during periods of industry growth, consistent with prior research (Klepper and Graddy, 1990; Gort and Klepper, 1982; Willard and Cooper, 1985) but in counterpoint to studies of exit from declining industries (e.g., Harrigan, 1982). Despite similarities in the pattern of industry evolution, there were important differences between the typical manufacturing industry and drug wholesaling. As a result, theories developed to explain consolidation in new manufacturing industries do not have substantial explanatory power when applied to the shakeout in drug wholesaling.

6.1 Timing of entry

Unlike manufacturing industries that have undergone shakeouts, there was no relationship between timing of entry and eventual market dominance in the consolidation of drug wholesaling. Of the six largest companies in 1995, only McKesson and Bergen Brunswig were large national wholesalers before the consolidation and could be considered early entrants. Both companies retained their leadership position through 1995, although McKesson's market share declined during the consolidation. Two of the six largest companies in 1995, Foxmeyer and Bindley Western, were small regional companies prior to the consolidation period. The remaining two companies, Alco Standard and Cardinal, entered the drug wholesaling industry through acquisition to leverage capabilities that had been developed in other, related industries.

Figure 2 graphically shows the relationship between the timing of exit and year of founding for the 147 drug wholesalers operating at the start of 1978. For ease of interpretation, the companies are grouped into the same five strata that are shown in Table 3. For each strata, the Kaplan-Meier estimate of the survivor function[25] was computed for exit by merger or acquisition. Although

[23] "Cardinal Rule," *Financial World*, January 31, 1995.

[24] "Drug Firm's Network of Systems Lets Pharmacists Work at Stand-Alone Minis," *Computerworld*, October 11, 1982.

[25] The Kaplan-Meier method, a non-parametric maximum likelihood estimator, is appropriate when survival times are censored (Collett, 1994). In these data, the 12 companies exiting by business dissolution or for which exit mode is unknown are treated as censored observations. Thus, this analysis evaluates the hazard of exit by acquisition, which was the dominant exit mode, while accounting for the presence of the other 12 companies. The survival times for companies exiting after December 1995 are right-censored.

the latest entrants had a slightly lower hazard rate beginning in 1981, the null hypothesis of no difference in the survivor functions is accepted (Wilcoxan test, $\chi^2 = 3.98,\ p = 0.41$). Note that the Alco Standard, Foxmeyer, and Cardinal do not appear in this analysis because they entered the industry after the start of 1978.

These results contrast with models that predict survival rates vary with entry time relative to either a dominant design (Suarez and Utterback, 1995) or industry birth (Klepper, 1996b; Jovanovic and MacDonald, 1994). Furthermore, the pattern of exit due to the acquisitive actions of a few firms is not a feature of any theoretical model reviewed in section 2.

6.2 Process innovation as a trigger of the shakeout

In terms of the technological explanations for shakeout, there were no specific candidates for a process innovation that triggered consolidation. Successful process innovation was occurring in drug wholesaling at least as early as 30 years before the consolidation began. If the consolidation had been triggered by a specific process innovation that improved productivity, then average productivity levels should have increased from 1985 through 1995 due to the exit of 68 presumably "inefficient" firms. However, the rate of productivity improvements slowed shortly after the start of the consolidation, in contrast to theories that point to a specific technological event as the trigger for consolidation. Although information technology systems for warehouse operations were important drivers of productivity gains, these systems were readily available from multiple suppliers of equipment used to run a distribution business. In 1975, just prior to the consolidation, even companies with sales of less than $5 million were spending 1.3% of net sales on data processing. It also appears that many process innovations, such as picking methods, diffused rapidly. Thus, theories that predict the existence of a technological process innovation and a subsequent wave of failures among non-innovators do not have significant explanatory power in the shakeout of drug wholesaling.

6.3 Service innovation as a trigger of the shakeout

Electronic ordering systems appeared at about the right time to be considered a trigger of consolidation but did not have the impact predicted by either the dominant design or technological milestone theories. Available evidence indicates that the ordering innovations of McKesson and Bergen Brunswig were imitated fairly quickly. As I.L. Lyons demonstrates, even relatively small companies could offer these services to customers. Clemons and Row (1987), evaluating the impact of electronic ordering on the market structure of drug wholesaling, conclude: "... while the profitability of the entire industry has improved dramatically, it is not obvious that any player has obtained 'competitive advantage,' that is, persistent high profitability relative to competitors. McKesson does not appear to enjoy substantially higher profitability than other large national and regional competitors, nor do the major competitors in the industry seem to enjoy significantly greater profitability than do smaller players" (p. 44).

The presence of third-party information technology providers also limited the ability of companies to gain a competitive advantage from service innova-

tions. For example, the NWDA developed standardized business documents for chargeback transactions and chargeback reconciliations between manufacturers and wholesalers in 1982.[26] These documents were created in response to a change in Medicare product billing policies that resulted in the distribution system floating more than $100 million on any given day. Around the same time the two documents were adopted by the NWDA, Ordernet Services, Inc., a Columbus, Ohio-based value-added network provider, began specializing in the transmission of these documents between pharmaceutical wholesalers and manufacturers. By 1987, the company's network had more than 300 pharmaceutical wholesalers, and handled 90% of all purchase orders and 85% of the total dollar volume of orders in the pharmaceutical industry.

7 Evolutionary processes in the shakeout of drug wholesaling

In this section, I evaluate the evolutionary processes that led to industry consolidation in drug wholesaling. The nature of historical evidence makes it difficult to reach definitive conclusions. However, the patterns of exit, innovation, and growth suggest a handful of key forces that were operating in the evolution of drug wholesaling. These forces not only highlight the similarities and contrasts between manufacturing and wholesaling industries but also suggest elements to be included in more formal modeling of the evolution of market structure in a service industry.

As in theories that link market structure to firm R&D efforts, I found evidence for increasing returns to firm size conferred by innovation (Klepper, 1996a; Shaked and Sutton, 1987). However, an explanation based on increasing returns does not explain why the consolidation began when it did, nor can it account for the presence of late entrants who grew to dominate the industry along with the two largest incumbents. A further puzzle is posed by the presence of numerous important innovations in drug wholesaling, but no single process or service innovation that meets the requirements to be considered a triggering innovation.

I suggest that increasing returns only led to consolidation once reinforcing feedbacks emerged between particular innovations in wholesaling. These feedbacks required simultaneous adoption of multiple technological innovations, limiting the ability of incumbent firms to adapt to the new "rugged" selection environment (Levinthal, 1996). The need to simultaneously alter multiple aspects of the organization opened a gateway for new entrants that had few preexisting commitments, explaining the advantage of highly successful later entrants and a lack of early entry advantages. Changes in customer markets created further feedback effects that were both industry growth factors as well as triggers of consolidation for smaller companies.

Finally, in apparent contrast to the exit mode during manufacturing shakeouts, consolidation in drug wholesaling occurred primarily via the horizontal intra-industry merger and acquisition of competitors from the same industry. This fact is consistent with the geographic nature of competition in wholesaling, which ensured that many incumbents controlled valuable resources despite their inability to adapt to the new fitness landscape.

[26] "Meganets mesh industries," *Network World*, May 11, 1987.

7.1 Increasing returns and firm size

Traditional notions of scale economies measure advantages to a company once it has grown to a given size or geographic scope, but do not specify the conditions that make it feasible or profitable for a firm to grow from being smaller to being larger over time. But as Section 5 demonstrates, scale economies were *endogenously* created by the innovative activities of drug wholesalers. For instance, the innovative efforts of the two largest companies created workable electronic ordering systems to meet customers requirements. This observation is consistent with the evolutionary perspective, which distinguishes between the (static) incentives to be large and the (dynamic) incentives to grow.

Furthermore, the evolution of drug wholesaling exemplifies the self-reinforcing, ''rich-get-richer'' dynamic that is featured prominently in shake-out theories developed for technologically progressive manufacturing industries (Klepper, 1996a; Phillips, 1971). For drug wholesalers, the returns from developing both cost-reducing process innovations and value-added service innovations were proportional to revenues. Once a firm had acquired access to a new technique, either by innovation or imitation, it could apply that technique to its entire capacity. In essence, this was an appropriability advantage to larger firm size (Nelson and Winter, 1982, p. 282).[27] Larger firms had an advantage in being able to spread fixed costs across many customers to generate competitive economies of scale.

The early innovative efforts of McKesson and Bergen Brunswig are consistent with the hypothesis that larger firms had greater incentives to invest in the development of new services. Once McKesson had developed the Economost system in California, it could roll it out to all of its retail customers with relatively little incremental investment. The larger companies were able to extend their advantage further through acquisitions that broadened their information technology capabilities. In 1982 and 1983, McKesson acquired Dresden Davis, a company that collected information about physician prescribing practices, and 3PM, which provided data processing computer systems and services for drugstores. Foxmeyer acquired TBL, a company that developed microcomputer systems for pharmacies, in 1983, and acquired Pharmassist, a firm that specialized in providing computer services to drugstores, in 1984. McKesson also acquired Spectro Industries, a $200 million regional wholesaler, just after Spectro's acquisition of a pharmacy computer systems producer.

7.2 Increasing returns within the wholesaling business model

Instead of a single factor, I suggest that the consolidation of drug wholesaling was triggered when a combination of new technologies set off a chain-reaction within the entire business model for drug wholesaling. Due to important feedback relationships within this new model, companies achieved the greatest advantage when multiple new practices and technologies were adopted at

[27] This argument assumes that the relevant knowledge can be articulated, packaged, and understood enough to enable successful transfer between different parts of the organization (Winter, 1987; Szulanski, 1994).

roughly the same time. Adopting just a few of the new practices or a single technology did not yield the same benefits, limiting the ability of incumbent firms that made only incremental attempts to adapt to the new selection environment. This set of innovations was quite powerful because it led to dramatic reductions in operating costs as well as improved services. Furthermore, the need to alter multiple aspects of the company at the same time opened a gateway for new entrants that had few preexisting commitments. This explains the advantage of the four highly successful later entrants and the poor ability of small companies to adapt to the new market requirements.

The notion of feedback effects is closely linked to complementarities among organizational activities. Two activities are complements if doing one of them increases the returns from doing the other (Milgrom and Roberts, 1990). In other words, the marginal returns to adopting a particular process or service innovation are increasing in the levels of the other complementary activities. This logic suggests the presence of "systems of interdependent practices" rather than the individual elements that make up a firm's strategy and structure.

To understand the increasing returns behind this cycle, consider the advances in computing and communications technologies in the 1970s that enabled the development of electronic ordering systems to retail customers. These systems had a direct effect on operating costs because superfluous human processing tasks, such as operators at each warehouse location, could be eliminated. However, there was also a second-order feedback effect between electronic ordering and improvements in warehouse productivity. Once a customer's order was in electronic form, it could be resorted to conform with the location of products in a warehouse. A document can then be created that tells employees where items are located in the warehouse, a seemingly straightforward task that could not be easily accomplished when orders were submitted on paper. Thus, on-line ordering systems led to increased warehouse productivity by improving the speed of strict orderpicking. This offers one possible explanation for the otherwise unexplained jump in warehouse productivity that occurred between 1975 and 1985 despite any obvious process innovation.

Going further, on-line ordering systems improved the potential effectiveness of other new picking techniques. Consider the new picking techniques discussed in section 5.1. The major advantage of batch picking is a reduction in intra-warehouse travel time per item. In just one trip through the warehouse, the order picker completes several orders. However, because batch picking does not maintain order integrity, it requires the extra step of sorting accumulated items. The advantage of zone picking is that the travel time per line item is reduced since the order picker covers only a small part of the entire warehouse. However, as in batch picking, zone picking requires the additional sorting step.[28] Adoption of either technique increase in efficiency when pickers can apply bar-coded labels to the items and scanners used for automated sorting. For example, after Bergen Brunswig receives an order electronically, the system creates pricing labels and order picking documents that tell employees where items are located in the warehouse, which items can be handled with an automated picking machine, and which items are in the company's controlled substance drug cage.[29]

[28] "Orderpicking: a course-in-print, Part 3," *Modern Materials Handling*, December 1990.
[29] "Customer closeness at Bergen Brunswig, McKesson," *Computerworld*, February 19, 1990.

Furthermore, a wholesaler can decrease inventory costs by generating data about anticipated customer ordering patterns based on analysis of historical data. This increases the profitability of automating warehouses that enable inventory to be turned more quickly. Electronic systems also encouraged drug wholesalers to redefine the selling function by shrinking the outside sales force. The remaining field salespeople now had to be knowledgeable about technical issues, leading to an upgrading of salesforce qualifications and new types of value-added services. More highly-skilled salespeople could provide a broader range of consulting-type services for retail customers, such as assistance in setting prices, service merchandising, planograms, and other various fundamental retail management services. Thus, the indirect effect of increasing salesforce qualifications reinforces the direct effect of a switch to electronic ordering systems. A whole range of other possible interaction effects could be considered. For example, the benefits of hiring more skilled managers can be linked to the increased operational complexity introduced by automation.

A further implication for industry evolution is that successful innovation may not be a marginal decision. When the profitability from doing a set of activities is greater than doing any one (or even a subset) of the activities alone, models which focus on a single technological event will not adequately capture evolutionary dynamics. Perhaps this is one reason that the selection of a single "dominant design" is so difficult. It also suggests an analogous concept for a service industry, a "dominant business model." A dominant business model standardizes the way certain channel functions are performed, making certain activities and services implicit in strategy and structure. However, the presence of complementarities among these activities underlying a dominant business model imply (at the limit) an all-or-nothing adoption.

Why was it so difficult for all but the two largest incumbents to adapt to the new environment? One possibility is suggested by a recent simulation model of industry evolution. Levinthal (1996), drawing on NK models of genetic evolution, simulates different patterns of industry evolution based on the degree to which organizational attributes exhibit complementarities. When interactions between organizational attributes are low, then minor modifications based on better performing organizations were associated with an increased survival probability for the firm making the modifications. When the degree of complementarity changed in the middle of the simulated industry evolution, the likelihood of survival was closely related to an organization making a "long jump," which appears in the model as a random respecification of all attributes.

The analogy to the evolution of drug wholesaling is clear. The two large incumbents, by dint of their innovative efforts, altered the fitness landscape by creating an environment with strong complementarities between technologies. New entrants saw an opportunity to adopt all critical elements of the new business model as an explicit business strategy. Thus, both Cardinal and Amerisource entered the industry with the stated intent of bringing new management techniques to drug wholesaling. Each firm had extensive experience in other wholesale distribution industries. Bindley Western was founded to take advantage of emerging opportunities created by the changes in customer markets.

Only the two smaller firms that merged to form Foxmeyer were apparently able to make the necessary "long jump" into the new business model. With rare exceptions, the other incumbent companies were small, private compa-

Table 10. Financial performance of drug wholesalers, 1950–1994

Year	Return on net worth[a]	Gross profit margin
1950	n.a.	17.1%
1955	n.a.	17.2
1960	n.a.	17.3
1965	n.a.	15.5
1970	8.5%	14.4
1975	8.8	13.1
1980	12.7	11.2
1985	12.0	8.6
1990	13.9	7.1
1994	12.7	5.4

Source: *NWDA Operating Survey*, various years.
n.a. = not available
[a] Net profit after taxes as a percentage of net worth.

nies that could not (or would not) change. These smaller firms may have adopted a few elements of the new model in a piecemeal fashion. However, the cost and service advantages of firms using the new business model put pressure on less efficient wholesalers to exit the industry. Solid customer relationships made these companies appealing targets for acquisition. As I discuss in section 7.4 below, many of the small wholesalers would have been forced to liquidate their businesses without these relationship resources.

7.3 Feedbacks with changes in customer markets

In this section, I explain how market changes among wholesalers' two largest customer groups – hospitals and retail pharmacies – altered customer preferences for the way in which wholesaling activities were performed. These changes led to industry consolidation for two reasons. One, the emerging needs of larger customers created incentives for geographic expansion among wholesalers. Two, customer consolidation limited the business prospects for wholesalers that could not provide the geographic reach or level of service required by customers.

During the period of consolidation, hospitals increased their purchases through drug wholesalers from 42% of total purchases in 1982 to 88% in 1993.[30] One reason for this shift was a recognition that purchases through wholesalers were more efficient than direct purchases from manufacturers[31]. Wholesalers provided asset management, logistics support, and on-line order-

[30] *1983 Lilly Hospital Pharmacy Survey* and *1994 Lilly Hospital Pharmacy Survey* (Indianapolis: Eli Lilly and Company).
[31] For example, the 1986 Lilly Hospital Pharmacy Survey reported that hospitals making more than 39% of their purchases through wholesalers had a higher inventory turnover rate than hospitals that made between 20–39% of their purchases from wholesalers. A higher inventory turnover rate reduces inventory holding costs. inventory holding costs could include factors such as interest on investments in inventory, storage costs, handling costs, insurance costs, and/or the costs associated with obsolete products.

Table 11. Pharmaceutical wholesalers' customer mix, 1975–1995

Year	Independent drug stores	Chain drug stores[a]	Hospitals	Mass merchants/ Food stores	Other[b]
1975	65.0%	20.7%	10.8%	1.6%	2.0%
1980	59.4	25.8	11.9	2.0	0.9
1985	50.0	27.3	19.5	2.0	1.2
1990	36.4	36.2	20.4	3.8	3.2
1995	28.0	36.8	26.5	3.0	5.7

Source: *NWDA Operating Survey*, various years.
[a] Includes chain drug warehouses. In 1990 and 1995, figures include "non-stock sales," which were primarily to chain drug warehouses.
[b] Includes nursing homes, clinics, and other customers.

ing systems. As a result, hospitals increased from 12% of drug wholesalers' sales in 1980 to 26% (see Table 11).

At the same time, hospitals faced health-care cost containment pressures due to factors such as the introduction of Medicare's prospective payment system in 1983 and attempts by the private sector to control costs. Hospitals attempted to leverage their buying power by banding together into cooperative purchasing groups or through mergers and acquisitions (Reardon and Reardon, 1995). Purchasing groups and hospital chains typically purchased for member hospitals located in multiple geographic locations. Thus, these organizations wanted products from multiple manufacturers available in multiple geographic regions. It was more efficient for them to deal with a national wholesaler that could provide this access. Smaller, regional wholesalers were at a disadvantage in contract negotiations when customers desire broader geographic coverage across multiple territories. Direct purchases from a single manufacturer offered geographic coverage but limited product line breadth.

Many hospitals also set up prime vendor contracts to encourage their pharmacy departments to consolidate purchases with one or two wholesalers. Such a policy enabled the hospital to fully leverage bargaining power in order to obtain discounted prices or reduced service fees.[32] This appears to have become the standard practice. A 1991 survey found that hospital pharmacies dealt with only 1.35 wholesalers and 4.8 manufacturers at any one time (Beier 1995). The larger wholesalers also had the financial resources to meet the inventory and stocking needs of large customers,[33] making it feasible for hospitals to rely on a single supplier.

Pharmaceutical wholesalers' other major client group, retail pharmacies, went through a consolidation beginning in the early 1980s. Independent

[32] In some cases, wholesalers were forced to supply products on a "cost-minus" basis to hospitals. When this happened, the wholesaler relied on cash flow management from advance payments to generate profits. Only large distributors with substantial financing skills can compete in this manner.
[33] For example, an Amerisource executive is quoted in 1996 as follows: "Being national is how you play the game. A larger wholesaler can offer such benefits as a secondary warehouse service. In case one warehouse is out of stock or there's a disaster, we can fill orders out of alternative warehouses." (Quoted in "Is Bigger Better?" *Drug Topics*, September 2, 1996)

pharmacies faded as chains began to expand rapidly and mass merchandisers increased the size of their pharmacy department. Between 1982 and 1993, the number of independent pharmacies dropped by 23% from 33,950 to 26,267 while the number of chain drug stores declined by only 8% (from 18,550 to 17,029). Meanwhile, the market share of independent pharmacies fell from 41% of retail sales to 29% between 1984 and 1993, while chains grew from 59% to 71% of sales[34]. The concentration of sales among chain drug stores has also been growing. Pending mergers announced in 1996, the largest five drug store chains represent approximately 73% of all chain drug stores.[35]

This had two effects. One, independent pharmacies became less important, declining from two-thirds to less than 30% of drug wholesalers' sales between 1975 and 1994 (Table 11). This decline put pressure on wholesaler gross margins, which had traditionally been higher for independent chains.

Since chain stores also demand fewer value-added services than their independent counterparts, wholesalers received lower margins from chain customers than from independent pharmacies. This shift contributed to the decline in wholesaler gross margins (see Table 10). The second effect of retail pharmacy consolidation was a push by chain drug stores for broad market coverage from as few suppliers as possible. Like hospital sales, retail pharmacy sales became a high volume, low margin business. Large retail chains gained greater leverage and began to demand discounts, although they remained a relatively constant proportion of aggregate wholesale distribution sales. Chain stores typically contract with only one pharmaceutical wholesaler, a further advantage for the larger, nationwide wholesalers. Major chain stores continued to negotiate prices directly with manufacturers during this period.

These changes reflected positive feedbacks between the supply-chain strategies of customers and the growth incentives of wholesalers. Geographic expansion among wholesalers also encouraged customers to increase their usage of the wholesale channel, driven by the efficiencies and purchasing leverage gained when dealing with a wholesaler that can provide access to multiple manufacturers across multiple geographic regions. This led to further growth of the larger wholesalers, and so on. The combination of customer consolidation and supply-chain pressures favored nationwide, hyper-efficient drug wholesalers who could serve geographically dispersed chains and hospitals at a low cost. The power of larger customers squeezed margins, but survivors have been able to maintain overall profitability due to the concomitant drop in operating expenses (Table 10).

Thus, changes in customer market structure have been both an industry growth factor for wholesalers as well as a trigger of consolidation for smaller wholesalers. In fact, the proportion of pharmaceutical manufacturer sales going through wholesalers has increased from 47% in 1970 to 57% in 1980 to 81% in 1994, suggesting that the demand curve for wholesaling was determined endogenously as a result of the growing capabilities of wholesalers.

In sum, the advantages to a wholesaler of building a national distribution network would have been much lower if (contrary to fact) purchasing deci-

[34] "A year of subtle, smart progress – Chain drug industry 1993 retailer overview," *Drug Store News*, April 25, 1994.

[35] "Merger Mania Among Drugstores is Likely to Continue," *The Wall Street Journal*, January 2, 1997.

sions had remained geographically fragmented and essentially local. Customer consolidation, along with the concomitant change in purchasing requirements, provided incentives for wholesalers to expand geographically. As I describe above, a relatively small number of companies responded to these incentives.

7.4 The role of acquisition

In this section, I explain why acquisitive growth was used to respond to the geographic growth incentives from customer markets. Acquisition was the most common mode of exit for wholesalers during the shakeout in drug wholesaling. Of the 103 total exiting companies, 85 companies (83%) were acquired by another pharmaceutical wholesaler. Yet exit by acquisition does not appear to have played a role in the shakeouts of technologically progressive manufacturing industries.

There are three possible empirical explanations for this difference between historical manufacturing studies and the more recent changes in wholesaling. One, the historical record may not be sufficiently complete to identify the way in which manufacturing firms exited during a shakeout. These data limitations may be particularly acute for empirical approaches that use historical directories to determine organizational existence over time. Two, many of the shakeouts included in previous research occurred during historical periods with an overall low prevalence of mergers and acquisitions, so any exit was more likely to occur by business failure. For instance, merger and acquisition activity was very high during the merger wave of 1887 to 1904 and then remained fairly low for manufacturing companies until the 1960s (Scherer and Ross, 1990). Many of the shakeouts included in Utterback and Suarez (1993) or Klepper and Graddy (1990) occurred between these two merger waves. Three, empirical research has been strongly influenced by theoretical models that view exit as a negative organizational outcome, regardless of the way in which exit occurs (Ghemewhat and Nalebuff, 1985; Jovanovic, 1982). For instance, Suarez and Utterback (1995) define non-survival to be exit by either merger or failure based on the implicit assumption that the all of the resources of exiting firms lose value once a dominant design emerges.

A different explanation emerges when we consider how the geographic nature of competition in wholesale distribution influences the ability of a firm to expand. A wholesaler-distributor can grow within a single industry in two ways: (1) internal expansion, such as opening a branch in a previously unserved geographic region or increasing sales at existing locations, or (2) acquiring a wholesaler-distributor from the same line of trade that operates in a new geographic market for the acquiring firm.

Based on interviews with industry participants, I have concluded that the ability of a drug wholesaler to grow by internal expansion was limited by the geographic nature of competition in wholesaling. Acquisition in pharmaceutical wholesaling was an attempt to gain control of some or all of the resources that were semi-permanently attached to a second organization. Examples of these resources included physical assets, local managerial talent, customer relationships. These resources could not be purchased separately from a purchase of the entire company.

To illustrate the impact of these resources, I describe how the loyalty of local pharmacy or hospital customers influenced the acquisition decision. This

loyalty could have been based on customer preferences, switching costs, geographic proximity, or the reputation of a wholesaler (Aaker 1995). Strong customer relationships, and the activities underlying superior customer linking capabilities (Day, 1994), were a powerful competitive advantage that was difficult and costly to duplicate. One study found that a five percent increase in the year-to-year customer retention rate increased total lifetime profits from a typical industrial distribution customer by 45 percent (cited in Reichheld, 1996). In geographic markets with high levels of customer loyalty, acquisition may have appeared to be the least expensive, or only, way to increase market share. A wholesaler that tried to enter a new geographic market *de novo* faced an adverse selection problem because the customers most likely to switch were less loyal, and hence less valuable, than the customers that did not switch. Since the relationships between trading partners in business to business markets were characterized by a high degree of loyalty, the cost of acquiring customers through acquisition was lower than the cost of inducing customers to switch.

8 Conclusion

The consolidation of drug wholesaling brings to light a new set of empirical observations that can be incorporated into formal models of industry evolution. It also illustrates the ways that consolidation in a non-manufacturing industry differs from the new manufacturing industries studied in prior research and the implications of these differences for evolutionary theory.

The research reported in this paper suggests a number of promising areas for future investigation. The concept of reinforcing feedbacks among different business activities suggests interesting extensions of the resource-based theory of the firm. Dierickx and Cool (1989) suggest that imitability can be inhibited when the accumulation of a valuable resource depends on the level of a complementary resource. In their view, imitability is not constrained by a low initial level of the desired resource, but instead by the low initial level of the complementary resource that is required for development. In the drug wholesaling industry, this reasoning suggests an additional reason why incumbents did not survive as independent companies. The path-dependent and cumulative development of organizational resources may have locked many incumbents out of adopting a new bundle of complementary activities. Unfortunately, prior research has relied primarily on detailed company case studies to investigate these effects (Milgrom and Roberts, 1995; Porter, 1996). Further operationalization and empirical research is needed to investigate complementarities and related theoretical models, such as the NK model.

The prevalence of exit by acquisition during consolidation suggests a broadened perspective on economic selection environments. Nelson (1995) argues that much of the predictive power of an evolutionary theory lay in its specification of the systematic selection mechanisms. However, exit by acquisition appears to occur for quite different reasons than exit by bankruptcy. In a typical evolutionary model, the survival of an organization implies that the repertoire of routines and assets continues to be replicated through time (Winter, 1995). In wholesale distribution, the growth of more successful firms occurs through spatial replication of an existing activity structure on a larger scale, such as the expansion of capacity or the construction of a new distribution center. Alternatively, a firm shrinks and eventually exits by dissolution

because its routines result in less profitable products and services, so that revenues go below the operating costs.

In contrast to this concept of economic selection, a firm exiting by merger or acquisition is not necessarily less profitable. While competitive selection pressures drive differential growth and exit by dissolution, organizational buyer selection drives exit by merger or acquisition through the market for corporate control. Little research has been conducted on the implications of these different selection environments.

In addition, drug wholesaling did not evolve solely by the growth of successful firms and the shrinkage or failure of unsuccessful firms. Instead, a few firms induced a shakeout by becoming the consolidating agents. Yet there is no well-developed theory of the determinants of the choice between expansion via internal growth or acquisition (Hennart and Park, 1993), suggesting a related area for further theoretical investigation.

During the consolidation of drug wholesaling, very few of the transactions were challenged by the government due to anti-trust concerns. In drug wholesaling, gross margins dropped by nearly 60% despite increased concentration of market share. In theory, the few wholesalers that become the dominant forces in an industry with high barriers to entry could have attempted to leverage this position into more favorable gross margins over time. The shift to more intense, national competition among survivors, along with increased customer bargaining power, appear to have limited the ability of drug wholesalers to raise margins. Return on investment remained relatively stable (see Table 10). However, the final stage of consolidation has raised new anti-trust concerns. As noted in Section 4.3, the Federal Trade Commission has challenged the two proposed transactions that would combine the largest four companies into two companies.

The evolutionary processes described in this paper could also be applied to industries in which substantial innovation occurred at another vertical level in the distribution channel. For instance, there exist industries in which wholesaler-distributors have lost share to retailers that have created in-house distribution systems. These so-called "power retailers" (Lusch and Zizzo, 1995) concentrate on one or more closely related merchandise lines. Examples include Toys R Us in toys, Petco in pet supplies, Staples in office supplies, and Home Depot in home improvement retailing. A key source of competitive advantage for these companies is the ability to buy in very large quantities in select product categories, giving them a very prominent position in the channel. This purchase volume has caused many power retailers to backward integrate and create in-house distribution systems in which wholesaler-distributors play a small role. Power retailers have also triggered consolidation among the small and medium-sized retailers that were traditional wholesale distribution customers. Porter (1996) has suggested that the more successful power retailers have benefited from the same type of feedback effects described here. However, there is little research on how these companies affect the evolution of market structure. Another interesting area of future theoretical research is to understand what level in the vertical value chain is likely to be the source of innovation.

In sum, the consolidation of drug wholesaling suggests new empirical patterns and highlights important theoretical issues for future research. Similar evolutionary processes may be operating in the dramatic shakeouts that are currently occurring across many non-manufacturing industries in the United

States, including funeral homes, commercial banking, and automobile dealerships, to name just a few. Although we may lack some degree of historical perspective, these changes in market structure offer us a unique historical opportunity to study empirically the processes and mechanisms of industry evolution in real-time.

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