Operating Under a Liquidity Crunch: The Impact of LBOs on Product Availability in the Supermarket Industry

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Abstract

The structure of financing can impact a firm's operations in important ways. This paper examines how leveraged buyouts affect a supermarket's provision of product availability – an important dimension of quality in the retail sector. Using U.S. consumer price index microdata to measure the prevalence of out-of-stocks, I find that supermarket leveraged buyouts, which reduce liquidity, lead to increases in out-of-stocks of 10 percent. While it is difficult to determine conclusively, the pattern of stores and products that experience the greatest increases suggests the additional stockouts are on average value-reducing. While other aspects of these transactions may have made them worthwhile, the findings presented in this paper suggest it is important for firms to also consider these sorts of real effects on their operations when setting financial policy.

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1 Introduction

The last two to three years have seen a resurgence of private equity activity and leveraged buyouts. More than 500 private equity deals worth $157.4 billion closed in the first six months of 2006 alone (Barr 2006), and according to data tracked by Thomson Financial, leveraged buyouts totaled more than $80 billion in 2005 and are on track to reach record levels in 2006.[1] In evaluating the importance of private equity as a source of financing, a key question is how and why this sort of financing affects a firm's physical operations and the long-run value of the business.

Research suggests that leveraged buyouts (LBOs) on average lead to increased operating returns – at least in the short-run (Kaplan 1989; Smith 1990). A popular view is that LBOs create value through organizational changes that lead to improvements in firms' operating and investment decisions (Jensen 1989). According to this view, when companies undergo a leveraged buyout, high financial leverage, increased management ownership, and monitoring by active investors such as LBO sponsors provide strong incentives for managers to generate higher cash flows through improved operating performance. Jensen (1989) argues that the LBO organization creates an incentive structure that is superior to that of the typical public corporation in low-growth industries, and studies in the manufacturing sector find that some LBOs are associated with improvements in total factor productivity in the few years following the buyout (Lichtenberg and Siegel 1990; Harris, Siegel, and Wright 2005).

But there are questions about the long-run impact of an LBO. Critics argue that the increased financial leverage associated with LBOs may focus firms on generating short-term cash flows rather than long-run value.[2] Since leverage requires managers to pay out cash generated from current operations, fewer internally generated funds are available for investment and managers may have to forgo profitable investment opportunities (Chevalier and Scharfstein 1996). Furthermore, LBO sponsors – the monitors for value creation – typically cash out of the firm five to ten years after the buyout, potentially also contributing to a short-term orientation (Rappaport 1990).[3] In fact,

[1] Thomson Financial *SDC Merger & Acquisitions* database records a transaction as an LBO if 100 percent of the company is acquired, and either the investor group includes management or the transaction is identified as an LBO in the financial press.

[2] Increased financial leverage may also make firms vulnerable to financial distress, leading to a decline in their competitiveness. Chevalier (1995b) finds evidence suggesting that, following supermarket LBOs, some rivals are able to "prey" on LBO chains, lowering prices to force the LBO firm to exit the market.

[3] Kaplan (1991) finds that approximately 45 percent of the large LBOs completed between 1979 and 1986 returned

studies show that LBOs lead to reductions in investments in capital expenditures (Kaplan 1989) and research and development (Long and Ravenscraft 1993). But existing evidence is silent on the long-term economic consequences of these forgone investments. Do the reductions in investment represent value-enhancing or value-reducing activities?

To get some traction on this question, I examine the impact of leveraged buyouts on retail stockouts (running out of inventory for a given product that is usually offered for sale) in the supermarket industry. The supermarket industry is a natural laboratory to study these questions. Known for strong cash-flow-generating capacity and few profitable growth opportunities, supermarket firms became popular targets for LBO sponsors in the 1980s and early 1990s. This paper examines an important (but often overlooked) investment in the retail sector: investment in retail product availability. I analyze how product availability changes when a supermarket undertakes an LBO, and then use institutional details within the supermarket industry to shed some light on the question of whether these changes enhance long-term value.

Maintaining optimal product availability is a major strategic issue in the retail sector.[4] Estimates suggest that 8.2 percent of a grocery retailer's items are out-of-stock on a typical afternoon (Andersen Consulting 1996, Roland Berger Strategy Consultants 2002).[5] The prevalence of out-of-stocks in retail markets has motivated a growing empirical literature in marketing that analyzes consumer behavior in the presence of out-of-stocks (including Emmelhainz et al. 1991; Anupindi et al. 1998; Fitzsimons 2000; Campo et al. 2000, 2003; and Anderson et al. 2006). These studies focus on the effects of out-of-stocks and find them to be significant. Customers' immediate substitution upon encountering out-of-stocks is estimated to cost the average grocery retailer 1.7 to 3.1 percent of sales in the short-run.[6] Aggregating over the supermarket industry, this translates to \$6 to 12 billion of lost sales per year.[7] The costs are even greater when you include sales lost

to public ownership at some time prior to August 1990. In his sample, the median LBO firm remains private for 6.8 years.

[4] Optimal inventory replenishment in a stochastic environment is also a classic problem – and an active research area – in operations research (see Silver, Pyke, and Peterson 1998; Khouja 1999).

[5] Maintaining the right level of product availability is a long-standing issue in the industry: in 1968, Progressive Grocer reported that more than 20 percent of shoppers leave a store wanting to buy an out-of-stock item, and in their 1996 study, Andersen Consulting found that 48 percent of items they surveyed were out-of-stock at least once a month.

[6] Upon encountering an out-of-stock, consumers substitute in various ways, including purchasing an alternative item (0.4 percent decline in intended purchase expenditure), shopping at another store or cancelling the purchase (1.3 percent), and delaying purchase (1.3 percent; Andersen Consulting 1996).

[7] This figure aggregates retailers' lost intended purchase expenditure, but it does not include the sales gained by

from some consumers shifting future shopping to competing stores. As an investment in future market share, product availability has similar properties to R&D and capital expenditure in other industries.

A challenge faced by any effort, including this one, to document the impact of leveraged buyouts is the paucity of data – both financial and "real" – available about firms undertaking these transactions, especially after the buyouts take the firms private.[8] Firms with public debt or preferred stock outstanding after a buyout file financial information with the SEC, but many supermarket firms do not fall in this category and those that did may be a nonrandom sample of firms involved in LBOs. Furthermore, while financial statements include information on the total value of a firm's inventory, this information is not broken down by retail store or by product – the type of variation that I use to try to understand the source of LBO-induced changes in inventory investment. Instead of using information reported by the firms, I use data that was hand collected by the U.S. Bureau of Labor Statistics for use in constructing the Consumer Price Index.

This paper analyzes the connection between corporate finance and product availability in the supermarket industry with two objectives. The first objective is to document how the level of product availability changed at LBO supermarkets after the transactions – without trying to explain what is driving this change. While there is no pre-existing trend, out-of-stocks increase by about 10 percent at supermarkets that undertake an LBO. The effect is long-lived, lasting on average 10 years or more, and the results are robust to including store and even store-item fixed effects. Furthermore, LBOs have little impact on stockouts for product categories for which inventory is directly managed by distributors, in addition to the retailer.

The second objective is to shed some light on what causes these decreases in product availability. On one hand, agency conflicts, such as those described by Jensen, may lead managers to over-invest in availability relative to the optimum level for shareholders. In this case, the reduction in availability after a buyout may enhance the value of business. On the other hand, the additional stockouts may be caused by liquidity-constraints, similar to those described by Chevalier and Scharfstein (1996). High leverage may lead LBO firms to reduce profitable investments in product

retailers because of out-of-stock at other stores. The number is meaningful from the perspective of an individual profit-maximizing retailer, but not from the perspective of the industry. The decrease in aggregate supermarket sales, which includes both terms, is likely much lower.

[8] Many supermarket firms undertaking LBOs were also private before the transactions.

availability in an effort to boost liquidity.

A key difference between these hypotheses is whether the decreases in product availability reflect a move towards or away from the optimal rate. To address this question, I examine the degree to which the impact of LBOs on product availability is affected by various factors associated with either increased liquidity constraints or increased agency costs – a product's distribution channel, the local competitive environment, the size of the outlet, and the size of the firm undertaking the LBO. I also look at whether LBO firms had unusually low levels of stockouts before the transactions. All five of these analyses provide indirect evidence pointing towards liquidity constraints as the primary factor driving the average increases in stockouts.

This paper illustrates an important relationship between a firm's financing and its operations in the retail sector. The findings are consistent with the empirical literature on capital-market imperfections and inventory investment, including Carpenter, Fazzari, and Petersen (1994), Kashyap, Lamont, and Stein (1994), and Calomiris, Himmelberg, and Wachtel (1995).

The remainder of the paper is organized as follows. Section 2 discusses the causes and consequences of LBO activity in the supermarket industry. Section 3 describes the data and empirical approach. Section 4 presents estimates of the impact of LBOs on supermarket product availability, and Section 5 analyzes potential explanations for why retail inventory management may be affected by an LBO. Section 6 concludes.

2 Causes and consequences of LBO activity in the supermarket industry

Known for strong cash-flow-generating capacity, few profitable growth opportunities, readily-saleable assets, and costly union contracts, supermarket firms became popular targets for LBO sponsors in the 1980s and early 1990s. By 1991, LBO firms accounted for almost a quarter of industry sales, including 19 of the largest 50 supermarket chains. In these transactions, an investment group and often senior management would acquire the firm and contribute 5 to 25 percent of the total financing. The remainder of the financing was typically obtained through bank loans or lines of credit, usually secured by the company's assets, as well as junk bonds, debentures, or unsecured loans (Bongard and Cross 1992).

After a leveraged buyout, the debt-to-equity ratio was typically greater than ten to one (Bongard and Cross 1992). As an example of the financial impact of a highly levered transaction, Figure 1 presents the level of debt taken on by Kroger Co. during its 1988 leveraged recapitalization. The ratio of debt to total assets increased precipitously with the transaction, and the current ratio (the ratio of current assets to current liabilities) – a measure of liquidity – decreased substantially. Even as the firm partially paid down the debt by selling assets over the next few years, the current ratio remained at relatively low levels. The firm remained starved for liquidity even ten years after the transaction.

While supermarket LBOs were generally undertaken in response to unwanted takeover attempts (Chevalier 1995b), a number of factors made supermarket firms attractive to buyout sponsors. While net profit margins typically averaged only 1.0 to 1.5 percent of sales, the acyclical nature of retail food demand provided stable cash flows (Bongard and Cross 1992). The targets' assets were likely not being put to their highest value use; many stores had been built decades earlier on what had since become valuable real estate (Wruck 1992). And, perhaps most importantly, strong labor contracts were crippling many of the major chains.

It seems that the leveraged buyouts in this industry were motivated, at least in part, as a check on union power. The cash flow demands of a firm's enlarged required debt service can be used to create an environment disposed toward eliciting concessions from workers (Bronars and Deere 1991; Perotti and Spier 1993; Matsa 2006). Peter Magowan (1989), then-CEO of Safeway, describes this sort of strategy as a primary factor attracting the buyout firms to the supermarket industry:

> [There was] an expectation that the mere *threat* of selling could be used very advantageously by highly unionized chains like Safeway in their labor negotiations. Either the union would give the retail operators the concessions they needed to compete on an even basis with their non-union competition or their operations would be sold – probably to non-union buyers.

Labor unions were traditionally a powerful stakeholder in the supermarket industry, and 54 percent of store employees were covered by union contracts in the early 1980s (Wruck 1992). But as regional, nonunionized chains became increasingly prevalent, the operating performance of many large unionized chains lagged industry averages (Denis 1994).

The impact of high labor costs on operating performance can be substantial, given the industry's low profit margins and the fact that labor costs account for about 70 percent of nonfood costs (Denis

1994). For example, consider the case of Safeway, Inc.'s 1986 leveraged buyout (Wruck 1992, 1997). In 1985, Safeway paid hourly wages 33 percent greater than the industry average. Back-of-the-envelope calculation suggests that the total annual dollar outflow associated with wage disparity at Safeway was $146.6 million. In some markets, the value of the wage disparity was enough to fund a 6.2 percent price decrease or a store remodeling campaign that completely replaced the firm's assets every 3.3 years. At an interest rate of 10 percent, the $146.6 million represents almost $1.5 billion in perpetuity – or 83 percent of the takeover premium.

In theory, firms may also undertake an LBO in order to force value-enhancing reductions in working capital. For example, reducing the inventory-holding period may be profitable for a firm if it is able to do so without incurring many additional stockouts. While it is possible that a particular supermarket firm had this rationale in mind when undertaking its LBO, there is no systematic evidence that an attempt to reduce inventory levels was an important factor leading to the wave of buyouts in the supermarket industry. In fact prior to the LBOs, stockouts were no less prevalent, on average, at stores owned by firms undertaking the LBOs than at other supermarkets (Figure 4).

While LBO activity was not concentrated in any particular geographic region, it was more prevalent among larger firms and stores, where unions were strong. Table I reports summary statistics in 1990 for three samples of firms: firms that undertook an LBO before 1990, firms that would undertake an LBO after 1990, and non-LBO firms. LBO firms averaged 2 to 6 times as many stores as non-LBO firms, and LBO stores were on average about 50 percent larger than non-LBO stores in terms of square feet, sales, and employment. In light of these differences between LBO and non-LBO firms, most of the estimates reported in this paper use within-firm and within-store variation to identify LBO effects. As it turns out, these fixed-effects estimates are generally very similar to estimates identified using cross-sectional variation with controls for size, metropolitan area, and other firm and store characteristics.

Assets sales were common after a buyout, and it seems many of the LBOs aimed to force the sale of unprofitable divisions – most typically in markets that faced nonunion competition (Bongard and Cross 1992; Wruck 1992; Chevalier 1995b). For LBOs targeted in this way, the ex ante operating performance of stores retained by firms after the buyout was not an important factor in the LBO

decision. This mitigates concerns about buyout endogeneity in analyses with store fixed effects.[9] Furthermore, I show below that there do not appear to be pre-existing trends in stockout rates at LBO firms after controlling for store fixed effects (Table III; Figure 3).

The leveraged buyouts had a significant impact on the target firms. After a buyout, firms often linked managerial compensation more closely to firm performance. For example, instead of benchmarking against other national grocery chains, Safeway began to measure each division's performance against its local competitors (Wruck 1992). Safeway also focused incentives toward rewarding profitability in addition to market share. But there is a risk that strong incentives for current cash flows may discourage profitable investments that pay off down the line. While Safeway structured the incentives for top management to mitigate this sort of conflict, incentive compensation for store managers – those with the greatest direct control over marginal changes in product availability – were based exclusively on targets for current-period sales and profits.[10]

A typical LBO supermarket had insufficient operating cash flow to service its heavy debt burden. Management generally sold assets to make up the difference, but the proceeds were often not enough. The firms typically also reduced investments in capital and cut back "discretionary" expenses such as advertising, maintenance, and repairs (Denis 1994). For example, Kroger reduced the ratio of capital expenditures to total assets by 46 percent in the four years following its recapitalization.

The leveraged buyouts also affected supermarket competition. In a series of papers, Judith Chevalier (1995a; 1995b) shows that the LBOs softened product-market competition. Following an LBO, average price levels increase in metropolitan areas in which the LBO firm's rivals are also highly leveraged, and LBO firms charge higher prices than their rivals. The presence of LBO firms also encourages rival firms to enter and expand their operations. Rivals with low leverage may also attempt to prey on LBO firms: following an LBO in these markets, average prices levels fall and the LBO firm is more likely to exit. Consistent with these results, LBO announcements are

[9] Beyond the issue of endogeneity, however, is one of external validity. Even if we observe the causal effect of the buyouts on the target firms, it may be that other firms with different characteristics would respond differently. In the labor economics literature, this issue is often referred to as treatment effects heterogeneity (Angrist 2004). This paper analyzes how LBOs affected firms that undertook those transactions, but I recognize the possibility that LBOs may impact other firms differently. The takeaway from the analysis is that financial policy can affect a firm's operations, not that it always does.

[10] At the top level of management, half of the bonus earned was paid out in the year in which it was earned; the other half was reserved and paid out two years later, depending on the performance in the two intervening years (Continental Bank Roundtable 1991).

associated with positive stock price responses for rival firms.

The analysis in Section 4 shows that, on average, supermarket firms undertaking LBOs also reduce product availability. While these changes – in capital expenditures, advertising, pricing, product availability, etc. – result in immediate increases in operating cash flows, it is possible that they hurt the firms' long-run competitive position. Section 5 returns to this question in the context of product availability.

3 Data and empirical approach

3.1 Supermarket LBOs

The data on supermarket LBOs used in this study come from two sources. First, Judith Chevalier provided me with a sample of supermarket leveraged buyouts consummated between 1981 and 1990. She compiled this listing from quarterly editions of *Mergers & Acquisitions* and searches of *Supermarket News*, *Supermarket Business*, and *Progressive Grocer*. While these data are of high quality, many of the LBOs in this sample precede my data on product availability, which begins in 1988. I use the Chevalier sample of LBOs for cross-sectional analysis, comparing price and product availability levels at LBO and non-LBO firms.

Second, I obtain a sample of supermarket leveraged buyouts from the Thomson Financial *Securities Data Company's Merger & Acquisitions* database, accessed through SDC Platinum. SDC claims to track more financial transactions than any other source and is used widely by researchers, investment banks, law firms, and media outlets. I include transactions explicitly coded as leveraged buyouts as well as acquisitions by buyout firms.[11] Using these data, which include supermarket LBOs from 1981 to the present, I perform panel analyses, comparing product availability levels at each firm before and after undertaking an LBO.

While not identical, the Chevalier and SDC samples are very similar. The samples are compared in Appendix Table A-I, Panel A. In 1990, 19 percent of the industry (in terms of sales) is recorded as having undertaken an LBO in both data sets.[12] Another 4 percent is included in the Chevalier

[11] The results are qualitatively robust to using only the subset of these transactions that I can independently identify as highly levered using SEC filings and articles in the financial press.

[12] Both the Chevalier sample and the SDC sample also include the Kroger leveraged recapitalization, which resulted in debt levels similar to a typical LBO.

LBO sample but not in the SDC sample, likely representing small buyouts picked up by Chevalier's exhaustive searches of industry publications. Two percent of the industry is recorded as having undertaken an LBO by SDC but not by Chevalier, and 75 percent is marked as non-LBO in both samples.

Figure 2 shows the timing of supermarket LBOs that identify the panel analysis.[13] While LBO activity was most prevalent in the 1980s and early 1990s, it continued until the late 1990s. In all, 33 unique supermarket firms undertook LBOs between 1988 an 2004, accounting for more than 4,700 stores and $90 billion in annual sales (in 2004 dollars).

3.2 Retail product availability

High quality data on supermarket product availability are rare. Anecdotal evidence suggests that most stores themselves do not systematically track availability. The most frequently cited statistics on the prevalence of out-of-stocks come from an Andersen Consulting (1996) study, sponsored by the Coca-Cola Retailing Research Council. The authors performed daily audits of 7,000 items in eight product categories in ten demographically and regionally diverse stores for one month. Such isolated (and often localized) studies do not lend themselves to either cross-sectional or longitudinal analysis at the store or firm level. Due to the cost of conducting wider-scale audits, some studies have attempted to measure out-of-stocks using purchase scanner data (e.g., Gruen, et al. 2002). But such studies risk confusing low availability with low demand, which would bias estimates (Dorgan 1997).

I obtain reliable data on prices and out-of-stocks from the *CPI Commodity and Services Survey*, which is used by the Bureau of Labor Statistics (BLS) to compute the consumer price index (CPI). To calculate the CPI, the BLS collects prices on about 30,000 goods sold at grocery stores each month, where each price is specific to a particular product at a particular establishment. Generally, a product must be available for purchase at the time a BLS surveyor visits the establishment in order to be included in the CPI.[14] If the product is unavailable for sale, the BLS surveyor determines

[13] Figure 1 includes all firms undertaking an LBO during the sample period – irrespective of whether or not they are represented in the CPI sample (discussed below).

[14] For food items (excluding food consumed away from home), surveyors are actually instructed to record an item as available if the retailer respondent says an out-of-stock item will be restocked later that day. This complicates efforts to measure true product availability. Out-of-stocks caused by retailers failing to stock shelves with back room or display inventory will not be reflected in the BLS data. Industry studies attribute 8 to 22 percent of out-of-stocks

whether the establishment expects to carry the item in the future. In this sense, a product may be considered out-of-stock if it is not available for sale, it is continuing to be carried by the outlet, and it is not seasonally unavailable (Bils 2005).[15]

Using these microdata, I examine observations on product availability at the item-store-month level from January 1988 through December 2004. While any particular item is sampled for at most 5 years, the full data set includes about 5 million observations on availability for almost 220,000 unique items at 9,500 stores in more than 8,000 census tracts and 147 metropolitan areas.

I augment the CPI data with detailed store-level information from the Trade Dimensions *Retail Site Database*.[16] The *Retail Site Database* is a leading source of establishment data in the retail food industry. It includes data on ownership, sales volume, selling area, and the warehouse that primarily supplies each of the more than 33,000 supermarkets in the United States.

Using the full sample, the average out-of-stock rate among supermarket respondents is 4.3 to 5.3 percent.[17] It increases over the sample period from 3.6 to 4.4 percent around 1990 to 5.6 to 7.0 around 2004. Two factors relating to BLS data collection procedures seem to explain why these estimates are lower than the 1996 industry estimate of 8.2 percent. First, CPI data is generally collected throughout the day on weekdays, whereas out-of-stocks are most prevalent in the afternoon and on Sundays (when they reach an estimated 10.9 percent; Andersen Consulting 1996). Second, for food items consumed at home, the BLS effectively does not record out-of-stocks

to these sort of store shelving issues (Andersen Consulting 1996; Gruen, et al. 2002).

[15] In practice, the determination of an out-of-stock is slightly more subtle. First, I condition on the outlet being available for pricing by the BLS surveyor. Second, I consider items with "different day" prices as being out-of-stock at the time of the surveyor's visit. Third, I restrict attention to observations that are at least three months prior to a product becoming permanently or seasonally unavailable. This is an attempt to address a concern that an item reported as "temporarily unavailable" that becomes "permanently unavailable" before another price quote is successfully obtained may not actually represent an out-of-stock (Bils 2005).

[16] I merge the data sets using the store telephone number, ZIP code, street address, and/or name. I am able to successfully match *Retail Site Database* information to 89.2 percent of the observations of product availability.

[17] The different estimates depend on whether one counts products reported to be temporarily unavailable immediately before the product is reported permanently unavailable. One concern is that the BLS surveyor may initially misinterpret some product cancellations as temporary out-of-stocks. A concern in the opposite direction is that some products that are repeatedly unavailable because they are out-of-stock may become classified as permanently unavailable. If a product is repeatedly unavailable, it may trigger an instruction to the surveyor to begin pricing a new item at the next visit. However, analysis conducted by Teague Ruder and cited by Bils (2005) suggests that in practice the field agents often continue to price the old version when the product becomes available for purchase before a substitution is executed. Accepting the surveyors' original classification of product unavailability yields an estimated out-of-stock rate of 5.4 percent. Another option is to only count an item as temporarily out-of-stock if it observed to be available at a later date. Under this definition, I eliminate the final observation for each product, because out-of-stock rates for those observations are zero by construction. This methodology results in an overall out-of-stock rate of 4.4 percent. The remainder of paper uses this more conservative algorithm for computing an out-of-stock.

caused by store shelving issues (8 to 22 percent of out-of-stocks).[14,18] While these factors affect the level of out-of-stock estimates, they are unlikely to bias estimates of changes in product availability caused by a leveraged buyout.

3.3 Empirical approach

I examine the impact of a leveraged buyout on supermarket product availability using a difference-in-difference regression approach. The majority of supermarket LBOs were consummated in the mid-to-late 1980s. However, information on retail product availability from the *CPI Commodity and Services Survey* is only available from 1988. In an initial cross-sectional analysis, I examine whether LBO firms offer less product availability than their non-LBO rivals in the same local market.

A number of factors affect the optimal level of product availability for a given retailer and product, including the customers' substitution pattern upon encountering an out-of-stock, the price elasticity of demand, the wholesale cost, the inventory cost, and the variability of demand. Customers' short- and long-run substitution behavior varies with the degree of brand loyalty and product variety in the product category as well as the degree of competition in the retailer's local market. Products facing less elastic demand earn greater markups and are more valuable to keep in stock. Other products are more costly to inventory, such as refrigerated versus shelf-stable products. And some products, such as seasonal items, have less predictable demand.

There are also differences in the optimal product availability rate across retailers. Returns to scale in demand forecasting and order management may reduce the cost of providing product availability in large stores. Stores that are vertically integrated with their primary supplier may face lower wholesale prices and inventory costs. While most stockouts are caused in the retail store (Andersen Consulting 1996; Gruen, et al. 2002), inventory management practices at the store's supplier and the distance from that supplier may also affect the store's optimal stockout

[18] In some situations, it is also possible that a BLS surveyor may record an out-of-stock item as "available" if another similar item is available for purchase. However, the procedures for this sort of substitution are regulated carefully by the BLS. Key characteristics of the product must be the same for the surveyor to execute a substitution. For example, a substitute ready-to-eat cereal product must have the same brand, product name, size, sweeteners, fruit, nuts, flavorings, and more, but it does not have to have the same UPC code. To the extent that the BLS definition of a stockout more closely reflects a consumer's willingness to substitute across nearly identical items (e.g., changes in package design), it may be preferred to a simple SKU-based definition.

rate. Technological advances and other changes over time may also affect inventory costs. To control for these and other factors that affect the optimal rate of product availability, I control for product category, store, and year-month fixed effects as well as a number of item and time-varying store characteristics.

Using item-quote-level data from January 1988 to June 1993, I estimate a linear probability model of an item being out-of-stock.[19] Let $STOCKOUT_{isjt}$ be an indicator for whether product i in store s, firm j, and month t is out-of-stock, and LBO_j be an indicator for whether the firm undertook a leveraged buyout before 1990.[20]

$$STOCKOUT_{isjt} = \alpha LBO_j + X_{is}^c \beta + Z_s \gamma + \psi_t + \epsilon_{isjt} \tag{1}$$

X_{is}^c includes product and store characteristics. Product-level controls include whether the item is seasonal (i.e., not offered year round) and fixed effects for both the day of the week the item was sampled and the product category.[21] Store-level controls include whether the store is affiliated with a chain, total grocery selling space (categorized into 5 groups), the distance from the warehouse that primarily supplies the outlet (categorized into 5 groups), and whether the outlet is vertically integrated with that supplier.[22] Z_s are ZIP code fixed effects, which control for differences in local markets. ψ_t are year-month fixed effects, which account for seasonal, technological, and other national trends in inventory management. The estimates of α are identified off of a large fraction of the sample – 41 percent of the sample corresponds to LBO firms, and the standard errors are clustered at the firm level.[23]

Firm investments in product availability may be influenced by non-financial factors that are

[19] Given the size of the data set and the computer resources available to me at the BLS, maximum likelihood estimation of a probit or conditional logit model is computationally infeasible.

[20] The cross-sectional analysis uses the sample of LBOs collected by Chevalier. While this sample is likely relatively comprehensive, the data provided to me do not include the date of each LBO. In the regressions reported below, the LBO_j indicator equals one for all product availability observations for an LBO firm. Consequently, a small number of observations corresponding to firms that undertook LBOs between 1988 and 1990 are likely misclassified. This may slightly attenuate estimates of the impact of the LBOs.

[21] Product category fixed effects are at the level of BLS "entry level items." The sample includes items from approximately 75 grocery categories, ranging from breakfast cereal to eggs to laundry and cleaning products.

[22] The total grocery selling space categories are: less than 10 thousand square feet, 10 to 20, 20 to 30, 30 to 40, and 40 or more. The distance from warehouse categories are: less than 20 miles, 20 to 40, 40 to 75, 75 to 125, and 125 or more. Store characteristics also include metropolitan area fixed effects in specifications that exclude ZIP code fixed effects.

[23] As compared to the industry, LBO firms are over-represented in the CPI sample, which is focused primarily in densely-populated areas.

correlated with undertaking an LBO. For example, local market competition, which is associated with higher prices and stockout rates, may be a negative predictor of LBO activity. To control for such factors, I also analyze a second, smaller sample of supermarket LBOs for which data on prices and product availability are available both before and after the LBO took place.

Using item-quote-level data from January 1988 to December 2004, I estimate same-store changes in product availability leading up to and following the transaction. I define three indicator variables: $PreLBO_{jt}$ turns on for the two years before an LBO is announced; $AnnounceLBO_{jt}$ turns on after the transaction is announced but before it takes effect; and $PostLBO_{jt}$ turns on after the LBO takes effect. While $PostLBO_{jt}$ reveals the impact of the leveraged buyout, $PreLBO_{jt}$ represents a Granger-type test for pre-existing trends.

$$STOCKOUT_{isjt} = \alpha_1 PostLBO_{jt} + \alpha_2 AnnounceLBO_{jt} + \alpha_3 PreLBO_{jt} + X_{is}^{p}\beta + \omega_s + \psi_t + \nu_{isjt} \quad (2)$$

The X_{is}^{p} matrix of product and store characteristics is X_{is}^{c} plus it includes primary supplier (warehouse) fixed effects. ω_s are store fixed effects.

Similar to the cross-sectional approach, estimates of α_1 are identified off of a large fraction of the sample – 30 percent. Appendix Table A-I, Panel B, reports the means for the other LBO timing variables. These regressors of interest vary at the firm-month level. Because availability observations are likely not independent, simple OLS significance levels may be overstated. To account for contemporaneous correlations across products within a store, I collapse the data to the store-month level (reducing the number of observations from 4,746,458 to 577,981), and re-run the regressions.[24]

4 Impact of LBOs on supermarket product availability

Table II reports ordinary least squares estimates of equation (1) using the cross-section of supermarket firms around 1990. Only the coefficients for the leveraged buyout indicator are reported, but the regressions used to construct these estimates also control for a detailed set of product

[24] At the store level, this analysis excludes product-level controls. Unsurprisingly, omitting these controls does not have a sizeable impact on the LBO estimates. Once a product is introduced into the sample, the BLS generally aims to sample that same product for four or five years. The BLS does not explicitly re-sample when a retailer undertakes an LBO, and there are unlikely to be systematic changes in the characteristics of products sampled following a buyout.

characteristics as well as year-month fixed effects. The results indicate that LBO supermarkets offer less product availability than other firms. LBO firms have 23 basis points more out-of-stocks than other supermarkets (Column 1). Including metropolitan area fixed effects and other store characteristics, the coefficient increases to 32 basis points (Column 2). Using ZIP code fixed effects to control for local market condition, the estimate increases further to 54 basis points (Column 3). Relative to the sample mean of 3.6 percent, these estimates correspond to increases in out-of-stocks of 6 to 15 percent.

Controlling for differences in the level of product availability offered before a buyout has little effect on the results. Estimates of equation (2), using a panel of supermarkets undertaking LBOs after 1988, are presented in Table III. While fewer LBOs occurred during this period, *ex ante* data on product availability allow me to estimate the impact of leveraged buyouts using within-firm, within-store, and even within-item variation.

The results suggest that leveraged buyouts lead firms to reduce product availability. In contrast to the estimates in Table II, the regressions used to construct the estimates reported in Table III also control for a full set of both firm and primary supplier fixed effects. On average, the stockout rate increases by 48 basis points following an LBO (Column 1). Including store fixed effects decreases the estimate slightly to 32 basis points (Column 3). Relative to the sample mean, these correspond to an 8 to 11 percent increase. These estimates are highly statistically significant even after accounting for within store-month heteroscedasticity: estimating these regressions at the store-month level does not have much of an impact on the standard errors (Columns 2 and 4).[25]

An analysis of pre-existing trends shows no evidence of these firms, stores, or items having unusually high or low levels of availability in the two years before the transactions were announced. In all of the specifications reported in Table III, the estimated per-period coefficients are small and not statistically different from zero. The lack of a pre-existing trend suggests both that the decrease in availability was caused by the LBOs and that unusually low levels of out-of-stocks were unlikely to have triggered the transactions.[26]

[25] Accounting for other within-firm heteroscedasticity is unlikely to eliminate the statistical significance of this result. While clustering the standard errors at the firm level is not computationally feasible for these regressions, I have been able to compute them for a store-month-level regression that includes fixed effects for each store but not for each primary supplier. In this regression, the coefficient estimate for the post-LBO indicator indicates an increase in the stockout rate of 54 basis points, with a standard error of 18 basis points ($p < 0.01$).

[26] The test for pre-existing trends with fixed effects assesses whether the level of out-of-stocks differed from the

The impact of leveraged buyouts on supermarket product availability is long-lasting. Figure 3 depicts the timing of the LBO effects. I graph estimated regression coefficients associated with annual indicator variables for the three years prior to an LBO through the 10 years after the transaction. These estimates are from analyses that control for store and year-month fixed effects as well as product characteristics. On average, stockouts begin to increase within a year following an LBO, and they stay high for many years.

The extended duration of the impact of leveraged buyouts on product availability is an interesting part of the story, but it does not imply whether the reduced level of stockouts is beneficial to the firm. While it seems the additional stockouts reflect more than a fleeting transactions cost of the buyouts, they may reflect a range of long-term effects. The LBOs may have led the firms to adopt new (presumable more efficient) ordering practices. Alternatively, with a higher cost of capital as a private firm, liquidity shortages may continue to encumber the firms' operations many years after the buyouts. Recall from the Kroger example in Figure 1, even after firms undergoing highly-levered transactions use the proceeds from asset sales to moderately reduce leverage in the years following the deal, liquidity can remain far below its initial level. This observation is consistent with the general pattern of LBOs in the supermarket industry, where reverse LBOs are rare. According to the SDC Merger & Acquisitions database, only 4 of the 33 supermarket LBOs undertaken between 1988 and 2004 are associated with a subsequent IPO.

Further analysis suggests that the increase in stockouts reflects (at least in part) a change in the firms' investments in product availability and is not fully attributable to changes in the product mix. Table III, Column (5), presents an analysis of within-item variation in the stockout rate. This specification, which includes a fixed effect for each specific item sampled at each store, estimates that the stockout rates increases by 17 basis points following an LBO. Any particular item is sampled by the BLS for at most 5 years, so same-item estimates reflect only short-run effects. This estimate is consistent with the analysis presented in Figure 3 that finds that the LBO effects intensify over the first couple of years after the buyout.

I also address the impact of LBOs on supermarket product variety – an important issue related to product availability. On the supply side, SKU proliferation contributes to the growth in out-of-

historical level for that firm/store/item immediately prior to the transaction. It does not compare the historical level of out-of-stocks at LBO firms to other firms in the industry. That analysis is presented in Section 5.

stocks by increasing the size and complexity of the firm's forecasting problem. And on the demand side, an out-of-stock may not be as costly for consumers when a store offers greater product variety. If LBOs lead firms to increase product variety, then the measured reductions in product availability may not actually represent a decrease in product quality. However to the contrary, evidence seems to suggest that LBOs may decrease product variety.

While I do not have direct measures of product variety, I construct a rough measure of changes in product variety from the *CPI Commodity and Services Survey*. Just as I can observe when a surveyor attempts to sample an item but encounters an out-of-stock, I can observe when the sampled item is instead discontinued by the outlet (that is, marked as "permanently" unavailable). Product cancellations are rare for food items in the CPI sample, occurring in only 0.6 to 1.3 percent of attempted price quotes.[27] While this sort of product cancellation rate is far from perfect, I analyze it as a possible proxy for changes in product variety.[28]

Average changes in the product cancellation rate before and after an LBO are presented in Appendix Figure A1. There is no evidence of a decrease in product cancellations just after the LBOs. To the contrary, product cancellations increase in the years following the transaction. Same-store regression analysis, similar to the specification reported in Table III, Column (3), finds that the product cancellation rate increases by 7 basis points after an LBO ($p < 0.01$). Relative to the mean, this corresponds to a 12 percent increase.

5 Why do stockouts increase?

The empirical evidence presented in the previous section indicates that leveraged buyouts increase out-of-stocks at supermarket firms, and that this effect persists over time, lasting on average 10 years or more. But it is unclear whether this increase is beneficial to the retailer. A key question is whether the increase in out-of-stocks represents a move towards or away from the retailer's optimal

[27] The range on this estimate corresponds to exactly how it is constructed. As explained in footnote 17, there is a possibility that the data confuse out-of-stocks with product cancellations and vice versa. Considering all attempts to sample an item yields a product cancellation rate of 1.4 percent. As a conservative alternative, I only consider attempts for which the item was successfully sampled in the preceding month. This yields a lower estimate of 0.6 percent, and I use this algorithm to construct the variable in the analysis presented here.

[28] The product cancellation rate is an asymmetric measure of product variety. It directly measures product cancellations, but not new product introductions. When I measure an increase in product cancellation, it may be that the firms are actually changing their product mix while increasing product variety.

rate.

5.1 Economic determinants of retail inventory management

While no retailer desires out-of-stocks, reducing them is costly and maintaining 100 percent product availability at supermarkets is certainly not optimal. Optimal stocking decisions trade off expenditures on both inventory costs and monitoring the shelf for the present value of expected lost profits from out-of-stocks. Importantly, the stores consider not only the lost margin from the current purchases of the product but also the impact on consumers' future shopping behavior. Switching supermarkets is thought to be costly for shoppers, who are accustomed to a particular store's layout and a regular food shopping routine. Given these consumer switching costs, a small but important risk of an out-of-stock is that it may trigger the "long-run" substitution of a customer's regular business to another retailer. In this sense, the provision of product availability is an investment in future market share.

While inventory policies are likely influenced by decisions made at the corporate level, such as on incentive schemes and centralized planning (e.g., shelf-space allocation, planogram development), an important feature of product availability is that it is influenced most directly by actions taken much lower in the organization. Studies consistently find that observed out-of-stocks primarily reflect *retailer* operating performance, as opposed to the performance of other parties in the firm or vertical chain. Gruen, et al. (2002) find that 73 percent of out-of-stocks in the United States are caused in the retail store, 11 percent in the distribution center, 13 percent by the supermarket firm's headquarter or the manufacturer, and 4 percent by other causes. Andersen Consulting (1996) estimates that the proportion caused in the retail store is even higher. Retailer operating data analyzed in these studies demonstrate that 51 to 73% of out-of-stocks are due to inaccurate forecasting (e.g., maintaining too little inventory) or ordering errors (e.g., failing to sufficiently monitor the shelf inventory and not reordering when demand exceeds forecast), and another 8 to 22% are due to failing to restock the shelf with available backroom or display inventory.

Customer substitution patterns, inventory costs, and other factors affect the optimal level of product availability for a given product and retail location, but liquidity constraints and agency problems may lead a firm to deviate from the optimal level. The high leverage assumed by a firm during a leveraged buyout may lead cash-constrained firms to cut positive-NPV investment

(Chevalier and Scharfstein 1996). By increasing the firm's cost of capital, taking on the additional debt may decrease investment in product availability, because it increases both the costs of holding inventory and the firm's discount rate. First, suppliers may reduce trade credit to LBO firms that they perceive to be a greater repayment risk. Even when trade credit terms do not change, greater cash flow demands of debt service increase the shadow cost of inventory, leading firms to reduce inventories to boost liquidity (Hubbard 1998). Second, an increased discount rate leads LBO firms to have a greater preference for current, relative to future, profits. Recall that setting product availability trades off cost today (e.g., financing inventory and monitoring shelves), benefits today (i.e., margins from the sale of that product minus margins earned on the customer's substitution), and benefits in the future (i.e., margins from incremental future sales). Thus, an increased discount rate leads LBO firms to under-value the future benefits and reduce inventory.

Agency problems may also lead firms to deviate from optimal levels of product availability. Separating ownership and control creates an agency problem that may, among other things, depress operating performance and lead a firm to either over-invest or under-invest in product availability. Managers – at both senior and junior levels – may not always act in the best interest of shareholders. Unlike more transparent investments, such as acquisitions or many capital expenditures, investments in product availability are largely undertaken deep in the organization at the store level. Motivated senior management can influence these investments, but the monitoring of store managers is almost certainly imperfect.

In theory, agency problems may manifest themselves in conflicting ways. On one hand, shirking managers may take insufficient precautions against stockouts. For example, firms may fail to invest in effective demand forecasting or retailers may fail to effectively monitor the shelves (e.g., by "filling the holes" on the shelf with other products but failing to reorder the out-of-stock item; Andersen 1996). On the other hand, managers may over-invest in product availability. Some store managers may invest in too much inventory in pursuit of "the quiet life" free of customer complaints, and other "empire-building" managers may over-invest in product availability to maximize market share rather than profits.

In a model with agency problems, there are several reasons why undertaking an LBO may push the firm towards its optimal level of product availability. First, because non-management debt and equity are typically more concentrated after a buyout, the monitoring of managers increases.

Second, increases in management ownership and incentive compensation associated with an LBO may work to align manager and shareholder interests (Jensen 1989). Third, high debt levels may further mitigate agency problems by requiring managers to disgorge "free cash flow" (Jensen 1986). Depending on whether unconstrained managers over-invest or under-invest in product availability, the agency hypothesis predicts a decrease or an increase in out-of-stocks.

The credit-constraints hypothesis and the agency hypothesis differ in their efficiency implications. While the agency hypothesis contends that high levels of debt generate efficiency gains in inventory management, the liquidity-constraints hypothesis holds that debt constrains firms financially, distorting optimal decision-making. The results presented in Section 4 suggest that, on net, these effects increase the level of out-of-stocks at LBO firms. As in the literature that documents changes in capital expenditure, R&D, and retail prices, it is difficult to know for sure whether these cuts in investment enhance or reduce long-run value. In an effort to shed some light on this question, the next two sections examine differences in the impact of LBOs on supermarket stockouts across products, firms, stores, and markets to assess whether these patterns appear to reflect one hypothesis or the other.

5.2 Empirical tests of the liquidity constraints hypothesis

According to the liquidity constraints hypothesis, one reason that taking on additional debt may decrease investment in product availability is because the costs of holding inventory increase. Thus, one prediction of the liquidity constraints hypothesis is that stockouts will increase the most for products that a firm has to inventory for long periods of time.

The major distribution channels used for grocery products are displayed in Figure 4. Most grocery products are distributed by manufacturers to retail stores through warehouses, which may be owned either by the retailer or an independent operator. Other products are delivered directly to retail stores, bypassing the retailers' warehouses, and shelf inventory for these "direct store delivery" (DSD) items is usually managed jointly by the manufacturer's distributor and the retailer. Major DSD categories include carbonated drinks, bread, snacks, cookies, and crackers.

A major difference between warehouse and DSD distribution is that the manufacturer's distributor typically plays the lead role in store-level category management, merchandising, and managing

the shelf inventory for DSD products.[29] The degree of the retailers' involvement in inventory management depends on the replenishment arrangement in place with the distributor. While the retailer always "checks-in" and approves deliveries when they arrive, the retailer often does not initiate orders. In some arrangements, the route driver doubles as a salesperson who monitors the shelf and replenishes as needed; in others, an account manager for the distributor forecasts sales requirements and works with the store manager to develop an order for the store. Because DSD distributors often have a good deal of autonomy over replenishment, leveraged buyouts likely have less of an impact on DSD as compared to warehouse items.

I estimate the impact of LBOs separately for product categories that are typically distributed through a warehouse versus direct store delivery. Panel regressions with store fixed effects are reported in Table IV, Panel A. While the stockout rate for warehouse-supplied categories increases by 40 basis points following an LBO, the prevalence of out-of-stocks does not increase for DSD categories. The DSD point estimate is negative and not statistically significant. Given the distributor's active role in DSD replenishment, the differential impact of leveraged buyouts on the availability of warehouse-supplied products provides a useful robustness test in that it is consistent with the retailer bearing responsibility for the increased stockouts.

A further breakdown of warehouse-supplied products is also relevant to the liquidity constraints hypothesis. Some retail stores are vertically integrated into wholesaling, and others are not. It is relatively common for supermarket firms to own wholesaling assets in markets where they have a large retail presence, but these warehouses often serve independent retailers as well. Even within the same firm, there is often variation in vertical integration across stores.

Estimates of the impact of LBOs for warehouse-supplied products in integrated and non-integrated stores are presented in Table IV, Panel A. The results show a larger impact on product availability at integrated stores. The stockout rate for warehouse-supplied products in integrated stores increases by 64 basis points following an LBO, whereas the estimated increase in non-integrated stores is only 19 basis points (and not statistically different than zero). The difference between these estimates is economically meaningful and statistically significant at the 2

[29] There are also differences in the nature of products chosen to be distributed through each channel. Compared to warehouse-supplied items, DSD products tend to have shorter shelf life, higher volume, higher promotional intensity (and demand variability), lower value density, and greater merchandising difficulty due to greater weight or fragility (Boston Consulting Group 1998).

percent level.

The differential impact of an LBO on stockouts at integrated stores can be interpreted as evidence of financial constraints influencing retail inventory management. According to the liquidity constraints hypothesis, greater cash flow demands of debt service following an LBOs increase the cost of holding inventory. While the basics of the integrated and non-integrated supply chains are broadly similar (both types of products are typically delivered from the factory to a distribution center and from there to the retail store), integrated stores take ownership of the products earlier in the supply chain. With most products spending more time in the distribution center than on the store shelf, much of a non-integrated store's total inventory costs are actually financed by the independent wholesaler. Based on estimates reported by the Boston Consulting Group (1998), integrated supermarkets finance a typical product for 34 days as compared to 14 days for non-integrated retailers. Thus when retailers are liquidity constrained, there is a greater incentive for integrated stores to cut back on inventories than for non-integrated stores.

Liquidity constraints may also help explain the negligible impact of LBOs on stockout rates for DSD products. In addition to distributors playing an important role in managing replenishment for DSD products, they also bear most of the inventory costs. On average, retailers hold a DSD item for only 8 days.[30]

The liquidity constraints hypothesis also predicts that LBO-induced changes in stockout rates will vary with the degree of local market competition. In contrast to a monopolist, a competitive supermarket has an incentive to invest in a reputation for product availability (Dana 2000). Thus the liquidity constraints hypothesis maintains that, after undertaking an LBO increases a firm's discount rate, the stockout rate will increase more at a store facing greater local market competition.[31] LBOs lead firms to take fewer precautions against long-run consumer substitution – customers moving their regular business to another retailer – and there is greater risk of long-run

[30] Some retailers have recently begun selling select DSD goods on consignment using scan based trading. In these arrangements, wholesale sales are not booked until the item is scanned at the checkout register, leaving inventory costs financed entirely by the distributor.

[31] Note that this argument is not about static differences in the optimal stockout rate at stores with market power. In fact, the impact of market power on the optimal stockout rate is ambiguous. Greater margins associated with market power make lost sales due to out-of-stocks more costly, but market concentration also reduces the shadow costs of an out-of-stock by limiting customers' substitution possibilities. Rather than being about baseline comparisons, the argument presented here is that changes in the firm's discount rate have a greater impact on firms for which reputations for availability are more valuable. While changing the discount rate does not affect the current-period trade-off, it does slant the firm's intertemporal calculus toward the present.

substitution in competitive markets. The agency hypothesis, on the other hand, does not necessarily correlate with the level of competition in a market (although ad hoc arguments could be made either way).[32]

I examine the differential impact of supermarket leverage buyouts on stores facing greater local market competition. Empirically, I consider a store a "monopoly" if there are no competing stores in the same census tract, and I consider it "competitive" otherwise.[33] Table IV, Panel B, reports estimates from separate panel regressions for monopoly and competitive stores; both regressions include store fixed effects. The results are consistent with the liquidity constraints hypothesis. LBOs are associated with a 63 basis point increase in out-of-stocks at competitive stores, but only a 19 basis point increase at monopoly stores. The difference between these estimates is economically meaningful and statistically significant at the 1 percent level.

5.3 Empirical tests of the agency hypothesis

The agency view of leveraged buyouts holds that firms choosing to undertake an LBO have relatively high agency costs (Jensen 1989). In the supermarket industry, these agency costs may lead managers to, among other things, deviate from the firm's optimal level of product availability. In this scenario, the relative *ex ante* prevalence of stockouts at LBO firms may indicate whether agency problems tend to induce managers to over-invest or under-invest in product availability. For example, if firms undertaking LBOs had unusually low stockout rates before the buyouts, increased out-of-stocks following the transaction would likely represent a move towards the optimum. One way to look at this is to compare the pre- and post-LBO stockout rates of LBO firms with industry averages.

Figure 5 presents this comparison. Because mean stockout rates have changed over time and LBOs were adopted in various years, unconditional sample means are difficult to interpret. Instead, I regress the stockout rate on indicator variables for each year before and after an LBO was

[32] For example, one could speculate either that managers "try too hard" to reduce out-of-stocks when placed in a competitive environment, or that managers of stores with market power use monopoly rents to placate consumers with high product availability. Scharfstein (1988) shows that the effect of market competition on managerial slack depends on the specification for manager preferences.

[33] Census tracts typically have between 2500 and 8000 residents and are designed to be homogeneous with respect to population characteristics, economic status, and living conditions (U.S. Census Bureau, *Geographic Areas Reference Manual*, April 19, 2000). Under this definition, 58 percent of observations in the CPI sample are for monopoly stores.

undertaken at a firm, year-month fixed effects, and controls for product and store characteristics.[34] In contrast to the analysis used to construct Figure 3, these regressions do not include store or firm fixed effects, so that the LBO timing variables are identified off of contemporaneous comparisons with other firms not undertaking an LBO. The results show that firms undertaking LBOs had, on average, levels of out-of-stocks nearly identical to those of other firms in the industry. In particular, they do not appear to have had unusually low stockout rates before the buyouts.

Another approach is to examine the differential impact of LBOs on firms and stores that are likely to have the greatest agency costs. Agency costs have long been associated with firm size. In large firms, low levels of management ownership may distort incentives, and dispersed ownership is thought to make monitoring senior management more difficult (see, for example, Contintental Bank Roundtable 1991).

Another sort of principal-agent problem exists lower down in supermarket organizations – how to properly motivate store managers and other store employees to exert the optimal amount of effort. Recall that these are the employees who are thought to have the most direct impact on product availability (Andersen Consulting 1996; Gruen, et al. 2002). A variety of economic models predict that these agency costs increase with store size. For example, smaller establishments are generally considered to have an advantage in judging the quality of workers (Stigler 1962; Garen 1985).

Table 5 reports average product availability rates separately for warehouse-supplied and direct-store-delivered products at firms and stores of various sizes. Results are reported for two alternative measures of firm size: one based on the number of stores (Panel A) and the number of states in which a firm operates retail establishments (Panel B).[35] The latter measure reflects notions that monitoring is more difficult and agency problems are more severe when stores span a wider geographic area. Square feet of grocery selling space is used to rank stores by size.[36]

[34] Product characteristics are whether the item is seasonal (i.e., not offered year round) and fixed effects for both the day of the week the item was sampled and the product category. Store characteristics are total grocery selling space (categorized into 5 groups), the distance from the warehouse that primarily supplies the outlet (categorized into 5 groups), whether the outlet is vertically integrated with that supplier, and metropolitan area fixed effects.

[35] Firms are considered "large" if they have at least 1300 stores or operate in at least 20 states, "mid-size" if they have between 250 and 1299 stores or 5 and 19 states, and "small" if they have fewer than 250 stores or 5 states. About a third of the sample of firms undertaking LBOs is in each of these categories.

[36] Stores are considered "large" if they have at least 40,000 square feet of grocery selling space, and "small" otherwise. Large stores compose about a third of the LBO sample.

The results find that, for each category of firm and store size, there are more stockouts of warehouse-supplied products than of DSD products, with the differences ranging from about 20 percent more to about 50 percent more. There are at least three reasons why stockouts may be more prevalent for warehouse-supplied products. First, these products may have different optimal stockout rates. As compared to warehouse supplied products, DSD products tend to have shorter shelf life, lower value density, greater demand variability, and are often heavier and more fragile (Boston Consulting Group 1998). These factors increase inventory costs and likely increase the optimal stockout rate for DSD products. However, DSD categories are also known to have a greater inventory elasticity of demand, which may lead to a lower optimal stockout rate than for warehouse-supplied items.[37] Greater SKU velocity may also impact the optimal stockout rate for DSD products.[38] While these factors may explain differences in optimal stockout rates for DSD and warehouse-supplied products, they do not explain why these differences would increase with firm or store size.[39]

Second, DSD vendors may have a different objective function than retailers. Even for the same grocery product, a different level of availability may be optimal for manufacturers than for retailers, because the costs of a consumers' response to an out-of-stock may differ. A stockout is less costly for a retailer than for a manufacturer when it leads consumers to substitute to a competing brand offered at the same outlet, whereas a stockout is relatively more costly for the retailer when it leads consumers to purchase the product at a competiting outlet. Consumer studies find mixed results on the relative prevalence of cross-brand versus cross-store substitution.[40] Because manufacturers' distributors often take an active role in replenishment for DSD products, it is possible that this sort of a divergence of interests explains some of the difference in stockout rates between DSD

[37] DSD purchases tend to be more impulse driven, and consumers are less likely to pantry-load or forward-buy DSD products (Boston Consulting Group 1998).

[38] Boston Consulting Group (1998) finds DSD items turn an average 12 units per store per week, compared with an average of 9 units for warehoused categories. More frequent sales may increase the optimal stockout rate because more frequent deliveries are more costly. On the other hand, greater intended purchase expenditure makes out-of-stocks more costly.

[39] If anything, one might expect the relationship between the optimal stockout rates to go the opposite way from what is observed in the data. For example, if it is less costly for larger firms and stores to make more frequent warehouse deliveries, the differential stockout rates should be smaller, not larger, at these establishments.

[40] Based on a sample of 375 consumers who encountered an out-of-stock, Emmelhainz et al. (1991) find that 32 percent purchased a different brand and 14 percent went to another store. Based on a more recent survey of more than 23,000 consumers covering 11 grocery categories, Gruen, et al. (2002) report that, overall, 20 percent switch brands and 32 percent switch stores, but for salted snacks – the only clearly DSD category included in their study – 25 percent switch brands and 21 percent switch stores.

and warehouse-supplied categories. To the extent that consumers may be more likely to find a suitable substitute at a larger store, this explanation is consistent with the correlation between the warehouse-stockout premium and store size. But it is less obvious that this explanation predicts that the difference will grow with firm size.[41]

Third, agency costs may be larger for warehouse-supplied products. DSD vendors tend to have flatter organizational structures than supermarket firms, and DSD representatives are often compensated based on sales for their route, providing an entrepreneurial incentive to cull slow moving products and aggressively manage product availability. When it comes to inventory management, DSD vendors are generally considered to be more sophistocated than the store employees who typically manage replenishment for warehouse-supplied products (Boston Consulting Group 1998). The final column of Table V shows that the stockout rates for warehouse-supplied products exceed those for DSD products. One interpretation of the higher stockout rates for the warehouse-supplied items is that agency costs lead retailers to *under*-invest in product availability. Consistent with this interpretation, the difference is larger at larger firms and stores.

According to the agency hypothesis, leveraged buyouts reduce agency problems by providing managers with strong incentives to generate higher cash flows through improved operating performance (Jensen 1989). In this scenario, the difference between stockout rates for warehouse-supplied and DSD products may be expected to decrease following an LBO, with greater decreases at the firms and stores that had greater agency problems before the buyout. I assess this hypothesis using a triple-difference regression framework with store fixed effects. I regress a stockout indicator (times 100) on the full set of interactions of (1) an indicator for whether the firm has undertaken an LBO, (2) an indicator for whether the product is sourced through a warehouse, and (3) indicators for firm or store size, as well as store fixed effects and the other controls for time, product, and store characteristics specified in equation (2). The results are reported in Table VI.

Table VI, Panel A contains estimates from analysis using the number of establishments to measure firm size. The last two coefficients provide a regression analog to the unconditional differences-in-differences implied by Table V. The results find that, even after controls for product characterists

[41] If larger firms also command a greater proportion of local retail markets (which is not obviously the case), then cross-store substitution may not be as costly for larger firms, leading to relatively higher differences in stockout rates for warehouse-supplied versus DSD products at larger firms.

and store fixed effects, stockouts of warehouse-supplied products exceed stockouts of DSD products by more at larger firms than at mid-size or smaller firms. The remainder of the reported coefficents describe the impact of undertaking a leveraged buyout. On average, LBOs are associated with a 29 basis point increase in the overall stockout rate plus an additional 31 basis point increase for warehouse-supplied products. Looking across firms, changes in overall stockout rates following an LBO are not statistically different at larger versus smaller firms; however, LBOs are associated with greater reductions in the warehouse-stockout premium (i.e., the degree to which stockouts of warehouse-supplied products exceed stockouts of DSD products) at larger firms.

A similar pattern exists when comparing firms based on geographic span (Panel B) and when comparing stores based on square footage (Panel C). These differences may reflect the impact of overcoming greater agency costs at larger firms.[42] Under this interpretation, it seems agency costs lead retailers to *under*-invest in product availability and that LBOs help to mitigate these problems in ways similar to those suggested by Jensen (1989). However, on average, these reductions in agency costs seems to not have been enough to overcome the liquidity contraints associated with undertaking the LBO, leading average stockout rates to increase.

5.4 Summary

The empirical tests presented in this section are summarized in Table VII. The alternative models offer distinct predictions for which firms and stores will display the greatest changes in product availability after a leveraged buyout. The agency hypothesis also suggests that stockout rates may differ systematically at LBO firms, relative to their peers, before undertaking the transaction. In Table VII, circles mark the theoretical predictions that are consistent with the empirical results. While this sort of evidence is indirect, all five empirical tests are consistent with the additional stockouts being on average value-reducing. As agency costs seem to lead supermarkets to under-invest in product availability, the results suggest that marginal investments in supermarket product availability have positive returns. While LBOs seem to help improve operating performance by encouraging investment in retail product availability at firms and stores where agency costs are

[42] Absent arguments for liquidity constraints, there is no obvious reason why a leveraged buyout would differentially impact either (1) the optimal stockout rate for DSD versus warehouse-supplied products, or (2) the objective function of retailers versus DSD vendors.

most severe, it seems most likely that liquidity constraints are responsible for increasing stockout rates overall after supermarket LBOs.

6 Conclusions

The driving force behind efficiency and value creation in leveraged buyouts – taking on large debt obligations that discipline managers – can also impose real costs on business strategy and flexibility. Smith (1990) finds that "improved" working capital management – including a reduction in the inventory-holding period – provides an important source of improved cash flow following an LBO. The results presented in this paper suggest that, in the supermarket industry, this sort of benefit in current cash flows reduces product availability and may destroy long-run value.

The estimates suggest that leveraged buyouts increase the incidence of retail out-of-stocks by about 10 percent, and the effects appear to persist over time. Using industry estimates for the mean stockout rate, this corresponds to an increase from about 8 to 9 percent. A large empirical literature in marketing finds that stockouts have significant competitive effects, and estimates presented in this paper suggest the average increase in stockouts is even greater when local markets are more competitive – specifically when the competitive risks of losing customers are the greatest.

But the fact that stockouts increase does not imply the buyouts were a mistake. Operating profit improvements from asset sales, increased retail prices, or even improvements in other dimensions of productivity may have made the deals worthwhile. The lesson from the analysis presented in this paper is not that supermarket buyouts in the 1980s and 1990s necessarily featured too much debt. In fact, many of these transactions succeeded in forcing managers and labor unions to take actions that they were unwilling or unable to take otherwise. But once a company becomes highly leveraged, a focus on servicing debt obligations can also have unintented impacts. The findings presented in this paper highlight that it is important for firms to consider the liquidity effects of leverage on a firm's operations when setting financial policy.

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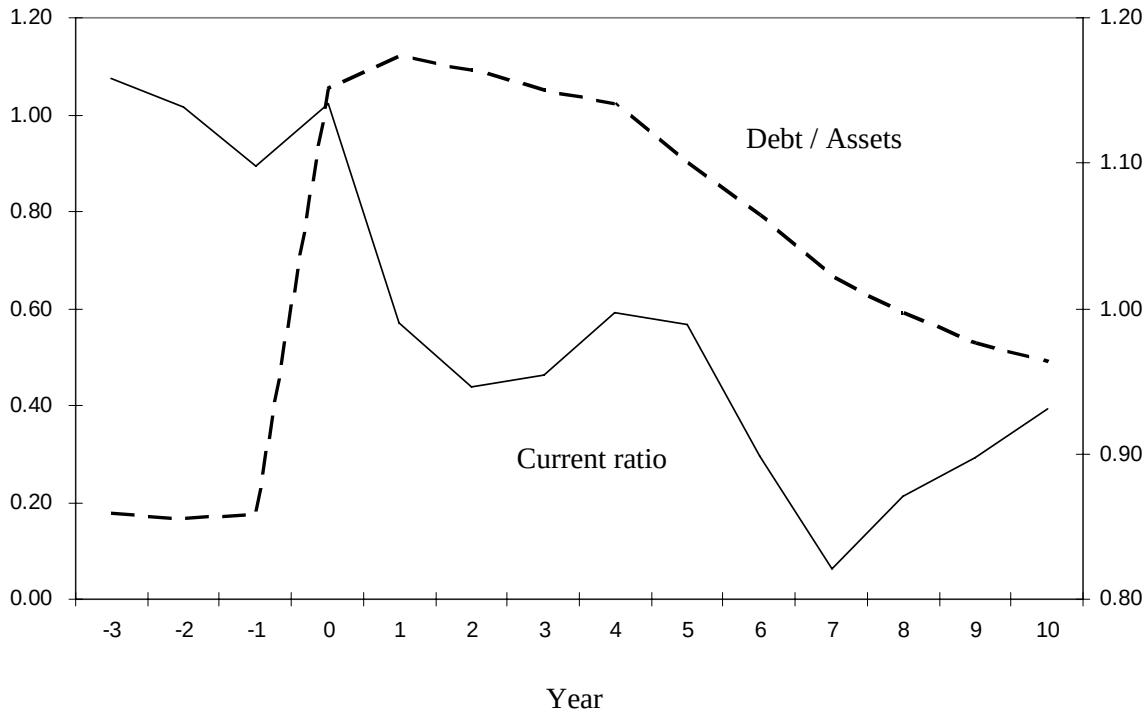
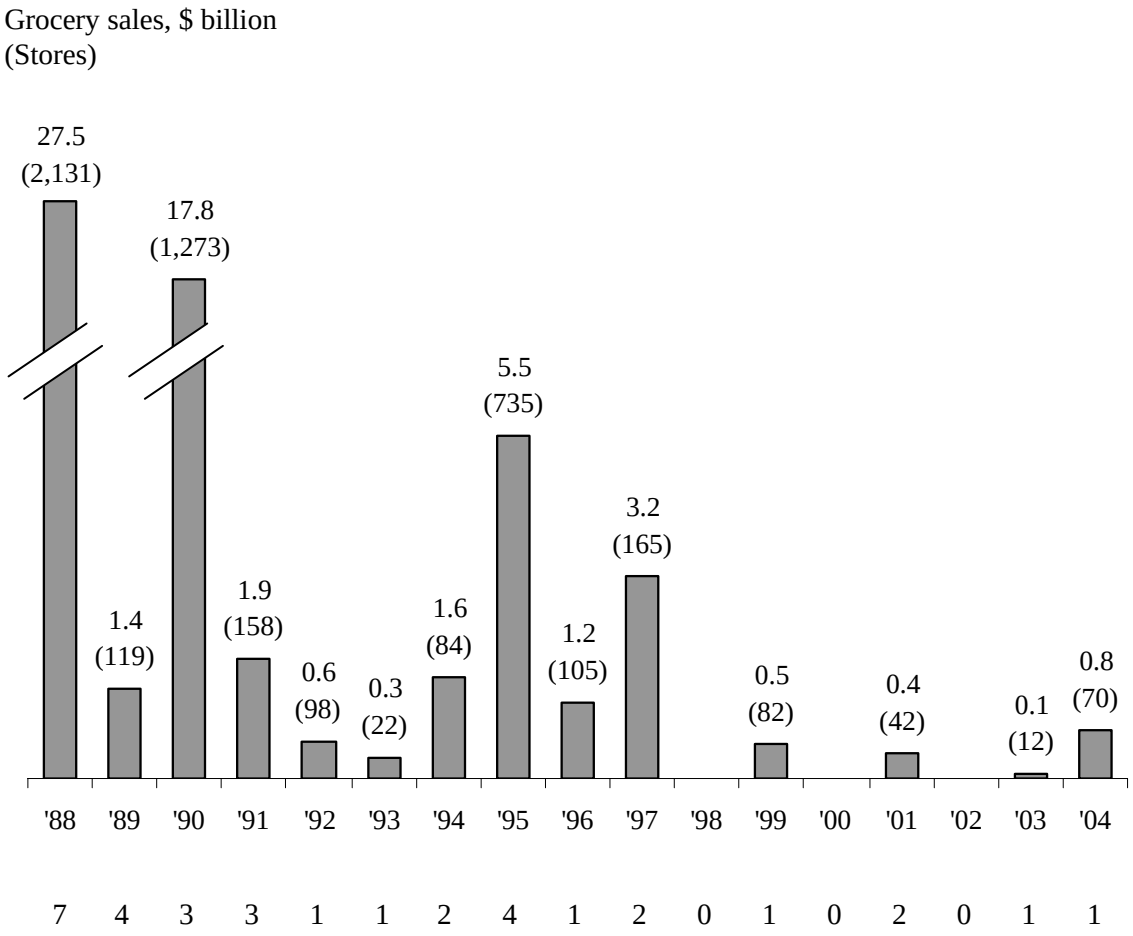
Figure 1: Debt/Assets and the Current Ratio at Kroger Co., 1985-1998



Source: Company filings with the U.S. Securities and Exchange Commission

Note: This figure shows the ratio of debt to total assets and the current ratio (the ratio of current assets to current liabilities) at Kroger Co., in the three years before and the ten years after their 1988 leveraged recapitalization.

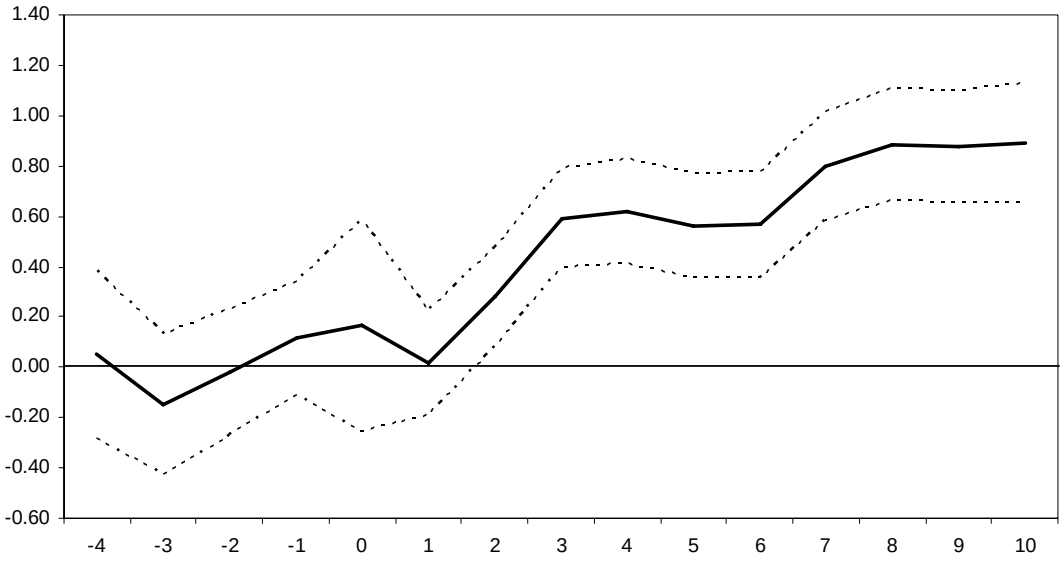
Figure 2: Supermarket LBOs, 1988-2004



Source: Thomson Financial *SDC Mergers & Acquisitions* database

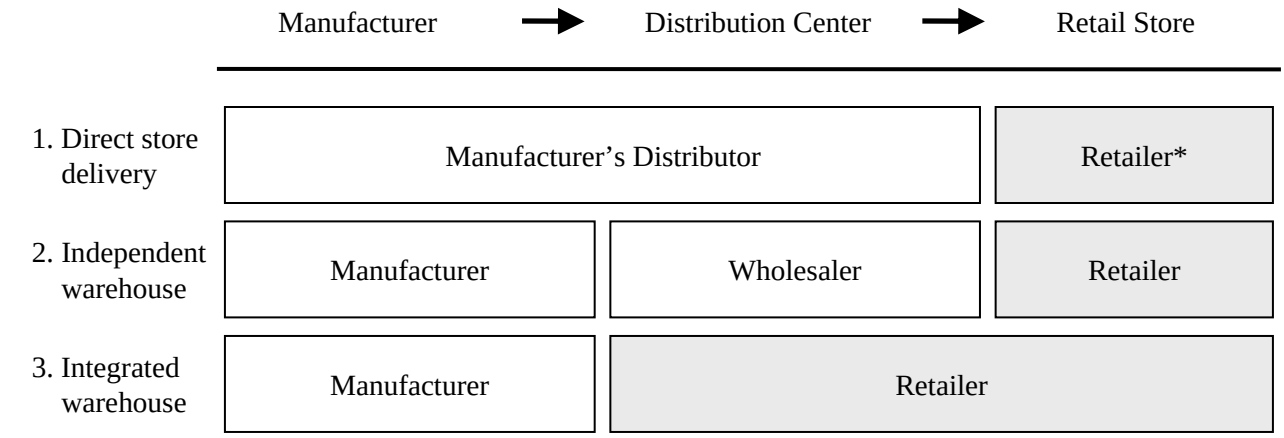
Note: This figure depicts the timing of supermarket LBOs undertaken between 1988 and 2005. The subset of these firms included in the CPI sample provide identification for the panel empirical approach.

Figure 3: Changes in Stockout Rates Following LBOs, 1988-2004



Note: This figure depicts regression coefficients and 95 percent confidence intervals from a regression examining the probability of an item being out-of-stock. An indicator for whether the item is out-of-stock (multiplied by 100) is regressed on separate indicators for each of the four years before and ten years after a firm undertakes an LBO, store fixed effects, and a set of additional controls. The LBO variables are defined based on information from Thomson Financial. In addition to store fixed effects, the controls include various product, store, and time characteristics. The product controls are a seasonal item indicator and product category fixed effects. The store characteristics are store size, distance from primary supplier, an indicator for whether the store is vertically integrated with that supplier, and a chain/independent indicator. And the time characteristics are fixed effects for the day of the week and the year-month. The mean stockout rate in this sample is 4.3 percent.

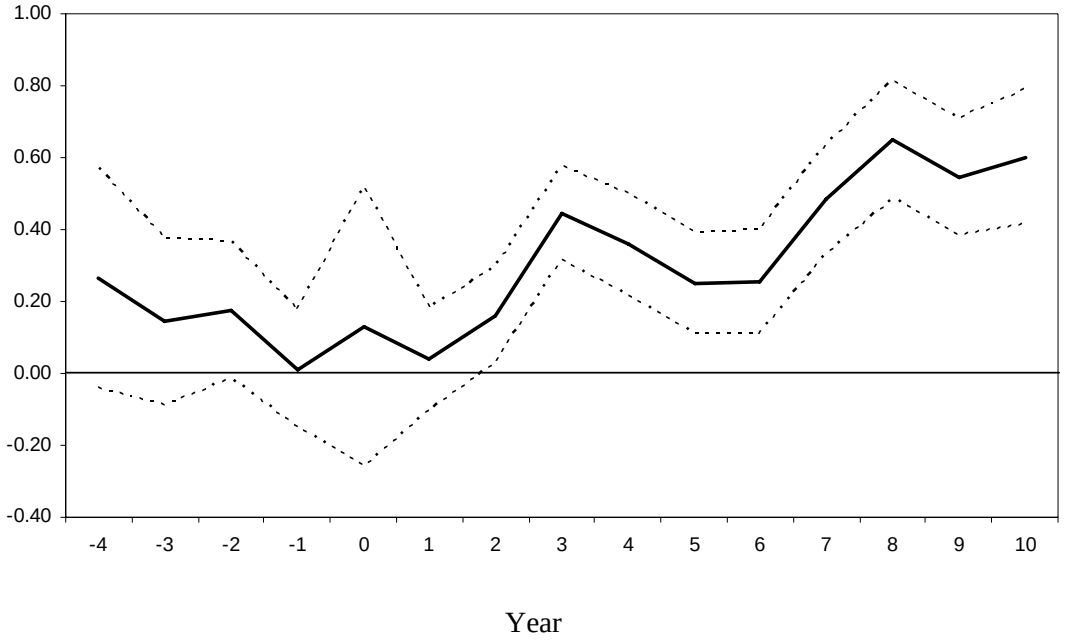
Figure 4: Product Ownership in Grocery Distribution



* While retail inventories of DSD products are typically owned by the retailer, merchandizing and replenishment are often managed jointly with the distributor.

Note: For each of three common distribution channels used for grocery products, this figure shows which entity owns the product (and bears the associated inventory cost) at different stages in the distribution process.

Figure 5: Differences in Stockout Rates Between LBO and non-LBO Firms, 1988-2004



Note: This figure depicts regression coefficients and 95 percent confidence intervals from a regression examining the probability of an item being out-of-stock. An indicator for whether the item is out-of-stock (multiplied by 100) is regressed on separate indicators for each of the four years before and ten years after a firm undertakes an LBO, and a set of controls. The LBO variables are defined based on information from Thomson Financial. The controls do *not* include firm or store fixed effects; the reported coefficients can be interpreted as the cross-sectional differences between LBO and non-LBO firms at various points in time, relative to the LBO. The controls include various product, store, and time characteristics. The product controls are a seasonal item indicator and product category fixed effects. The store characteristics are store size, distance from primary supplier, an indicator for whether the store is vertically integrated with that supplier, and a chain/independent indicator. The time characteristics are fixed effects for the day of the week and the year-month. The mean stockout rate in this sample is 4.3 percent.

Table I

Firm and Store Characteristics for LBO and non-LBO firms, 1990

This table reports the means and standard deviations (in parentheses) of various firm and store characteristics in 1990 for three mutually exclusive samples of supermarket firms: firms that had already undertaken an LBO by 1990; firms that had not yet undertaken an LBO but did after 1990; and firms that never undertook an LBO. The data on firm and store characteristics are from Trade Dimensions, and the information on supermarket LBOs are from Judith Chevalier and Thomson Financial.

	Firms that LBO before 1990	Thomson Financial	Firms that do not LBO
A. Firm characteristics:			
Stores	171.8	47.2	26.0
	(298.3)	(48.0)	(88.6)
States with at least one store	4.13	1.95	1.85
	(5.79)	(1.43)	(2.88)
B. Store characteristics:			
Grocery selling space (1,000 sq ft)	29.7	30.4	20.3
	(14.0)	(19.3)	(13.5)
Weekly grocery volume ($1,000)	238.0	216.5	150.5
	(153.3)	(169.9)	(133.1)
Employment (FTEs)	70.7	63.1	43.8
	(48.8)	(58.6)	(41.0)
Checkout counters	8.84	8.79	6.92
	(3.60)	(4.03)	(3.95)

Table II

Relative Stockout Rates at LBO firms, January 1988 - June 1993

This table reports coefficient estimates and standard errors (in parentheses) from linear probability regressions of a grocery item being out-of-stock. Each observation represents a firm-store-product-month. An indicator for whether the item is out-of-stock (multiplied by 100) is regressed on an indicator for whether the firm is recorded as having undertaken an LBO in the Chevalier sample, and a set of controls. Controls in all regressions include the following product & time characteristics: a seasonal item indicator and fixed effects for product category, day of week, and year-month. Where indicated, controls also include ZIP code fixed effects and/or the following store characteristics: store size, distance from primary supplier, an indicator for whether the store is vertically integrated with that supplier, a chain/independent indicator, and metropolitan area fixed effects. In this sample, the mean stockout rate is 3.6 percent. The standard errors are clustered at the firm level.

	(1)	(2)	(3)
LBO firm	0.23	0.32	0.54
	(0.17)	(0.17)	(0.18)
Observations	1,641,888	1,641,888	1,641,888
R-squared	0.02	0.03	0.04
Product & time characteristics	X	X	X
Store characteristics		X	X
ZIP code fixed effects			X

Table III

Changes in Stockout Rates Following LBOs, January 1988 - December 2004

This table reports coefficient estimates and standard errors (in parentheses) from regressions examining the probability of an item being out-of-stock. In odd-numbered columns, each observation represents a firm-store-product-month. An indicator for whether the item is out-of-stock (multiplied by 100) is regressed on separate indicators for whether the firm (1) has previously undertaken an LBO, (2) has announced an LBO that has not yet taken effect, and (3) will announce an LBO within the next 2 years, as well as a set of controls. The LBO variables are defined based on information from Thomson Financial. Controls in all regressions include year-month fixed effects as well as the following store characteristics: store size, distance from primary supplier, an indicator for whether the store is vertically integrated with that supplier, a chain/independent indicator, and metropolitan area fixed effects. Where indicated, controls also include the following product characteristics: a seasonal item indicator and fixed effects for product category and day of week. In even-numbered columns, the observations are collapsed to the firm-store-month level, and weighted least squares regressions are computed using those sample means and the number of underlying observations as weights. In these samples, the mean stockout rate is 4.3 percent.

	(1)	(2)	(3)	(4)	(5)
Post-LBO	0.48	0.46	0.32	0.47	0.17
	(0.06)	(0.06)	(0.06)	(0.07)	(0.07)
Announcement period	0.23	0.24	0.19	0.24	0.06
	(0.20)	(0.22)	(0.21)	(0.21)	(0.20)
2 years before announcement	0.06	0.20	0.10	0.26	-0.07
	(0.08)	(0.09)	(0.09)	(0.09)	(0.09)
Observations	4,746,458	577,981	4,746,458	577,981	4,746,458
R-squared	0.04	0.06	0.05	0.20	0.21
Level of observations	Store-product-month	Store-month	Store-product-month	Store-month	Store-product-month
Fixed effects	Firm	Firm	Store	Store	Store-product
Controls:					
Store characteristics	X	X	X	X	X
Product characteristics	X		X		X

Table IV

Changes in Stockout Rates Following LBOs by Distribution Channel and the Degree of Local Market Competition

This table reports coefficient estimates and standard errors (in parentheses) from within-store regressions examing the probability of an item being out-of-stock for different subsets of products and stores. For details on the econometric specification, see Table III, Column (3). Panel A first separates products based on whether they are typically delivered by a manufacturer's distributor directly to the store (DSD) or through a warehouse. In this analysis, products in the following categories are classified as DSD: carbonated drink, bread, snacks, cookies, and crackers (Boston Consulting Group 1998). For warehouse-supplied categories, Panel A then separates stores based on whether the store shares common ownership with the warehouse that primarily supplies the store, based on information from Trade Dimensions. Panel B separates stores based on the degree of competition in their local market. A store is considered to be a "monopoly" if there are no stores under different ownership in the same census tract, and "competitive" otherwise.

A. Distribution channel

	Direct-store-delivery categories	Warehouse-supplied categories		
		All stores	Integrated stores	Non-integrated stores
Post-LBO	-0.15	0.40	0.64	0.19
	(0.25)	(0.07)	(0.09)	(0.16)
Observations	341,193	4,405,265	2,845,151	1,560,114
R-squared	0.06	0.05	0.05	0.05

B. Degree of local market competition

	"Monopoly" markets	"Competitive" markets
Post-LBO	0.19	0.63
	(0.09)	(0.11)
Observations	2,768,978	1,977,480
R-squared	0.05	0.05

Table V

Stockout Rates by Distribution Channel and Firm/Store Size

This table reports, for firms and stores of various sizes, mean stockout rates and the associated standard errors (in parentheses) for warehouse-supplied and direct-store-delivery (DSD) categories. DSD categories are identified in Table IV. The final column contains the difference between these stockout rates and the associated standard error. The first column contains the percent of LBO observations in the given sub-sample.

	% LBO observations	Warehouse-supplied categories	Direct-store-delivery categories	Difference
		A. Firm size (by number of stores)		
Large chain (Stores ≥ 1300)	35	4.97 (0.03)	3.23 (0.08)	1.75 (0.10)
Mid-size chain (1300 > Stores ≥ 250)	34	4.31 (0.02)	3.47 (0.05)	0.83 (0.06)
Small chain (Stores < 250)	31	4.31 (0.01)	3.43 (0.04)	0.87 (0.05)
		B. Firm size (by number of states)		
Large chain (States ≥ 20)	37	4.63 (0.02)	3.43 (0.07)	1.20 (0.08)
Mid-size chain (20 > States ≥ 5)	35	4.32 (0.02)	3.29 (0.05)	1.04 (0.06)
Small chain (States < 5)	28	4.36 (0.01)	3.49 (0.05)	0.86 (0.05)
		C. Store size		
Large store (Grocery ≥ 40,000 sq ft.)	35	4.31 (0.02)	2.98 (0.05)	1.33 (0.06)
Small store (Grocery < 40,000 sq ft.)	65	4.45 (0.01)	3.63 (0.04)	0.82 (0.04)

Table VI

Changes in Relative Stockout Rates of Warehouse-Supplied Products Following LBOs by Firm and Store Size

This table reports coefficient estimates and standard errors from within-store regressions examing the probability of an item being out-of-stock. The econometric specification is similar to the regression reported in Table III, Column (3), with the addition of a full set of interactions of the following indicator variables: post-LBO, warehouse category, and firm size (in Panels A and B) or store size (in Panel C). Note that the main effect warehouse-supplied, firm size, and store size are effectively absorbed by product category and store fixed effects. DSD categories are identified in Table IV, and definitions for the various size categories are in Table V.

	Coefficient	Standard error
A. Firm size (by number of stores)		
LBO * Warehouse * Large chain	-1.05	0.27
LBO * Warehouse * Mid-size chain	-0.66	0.21
LBO * Large chain	0.48	0.30
LBO * Mid-size chain	0.21	0.22
LBO * Warehouse	0.31	0.15
LBO	0.29	0.16
Warehouse * Large chain	1.46	0.21
Warehouse * Mid-size chain	0.05	0.10
B. Firm size (by number of states)		
LBO * Warehouse * Large chain	-0.55	0.23
LBO * Warehouse * Mid-size chain	-0.29	0.21
LBO * Large chain	0.02	0.25
LBO * Mid-size chain	0.09	0.23
LBO * Warehouse	0.35	0.15
LBO	0.28	0.18
Warehouse * Large chain	0.37	0.15
Warehouse * Mid-size chain	-0.03	0.10
C. Store size		
LBO * Warehouse * Large store	-0.44	0.18
LBO * Large store	0.06	0.18
LBO * Warehouse	0.27	0.11
LBO	0.20	0.12
Warehouse * Large store	0.61	0.10

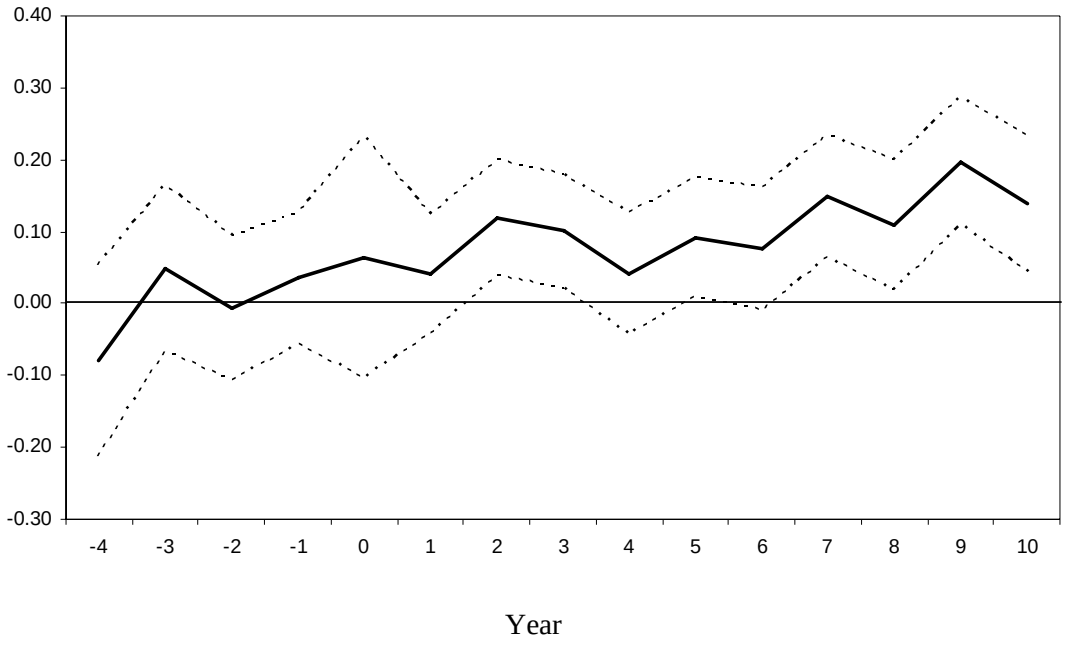
Table VII

Predicted Relative Impact of LBO Under Alternative Models

This table summarizes the empirical tests predictions used to distinguish between the agency and liquidity constraints hypotheses. A + (−) indicates that the characteristic listed increases (decreases) the impact of LBOs on product availability under the given model; a 0 indicates that the model does not predict a relationship with the given characteristic; and a ? indicates that there are versions of the model that can be specified either way. Circles mark the theoretical predictions that are consistent with the empirical results.

	Agency		Liquidity
	Under-invest	Over-invest	constraints
1. Store integrated into wholesaling	0	0	(+)
2. Local market concentration	?	?	(−)
3. Pre-LBO relative stockout level	*above*	*below*	(0)
4. Large firm	(−)	+	0
5. Large store	(−)	+	0

Appendix Figure A1: Changes in Product Cancellation Rates Following LBOs, 1988-2004



Note: This figure depicts regression coefficients and 95 percent confidence intervals from a regression examining the probability of an item being discontinued by a retail outlet. An indicator for whether the item is discontinued (multiplied by 100) is regressed on separate indicators for each of the four years before and ten years after a firm undertakes an LBO, store fixed effects, and a set of additional controls. The LBO variables are defined based on information from Thomson Financial. In addition to store fixed effects, the controls include various product, store, and time characteristics. The product controls are a seasonal item indicator and product category fixed effects. The store characteristics are store size, distance from primary supplier, an indicator for whether the store is vertically integrated with that supplier, and a chain/independent indicator. And the time characteristics are fixed effects for the day of the week and the year-month. The mean product cancellation rate in this sample is 0.6 percent.

Appendix Table A-I
LBO Samples and Summary Statistics

A. Comparison of Chevalier and Thomson Financial samples, matched to the 1990 RSD (stores, $ billion sales)

	Thomson Financial	
	Non-LBO	LBO
Chevalier		
Non-LBO	26,236 (82%) 214 (75%)	347 (1%) 5 (2%)
LBO	1,004 (3%) 12 (4%)	4,482 (14%) 54 (19%)

B. Summary statistics for CPI microdata, matched to Chevalier and Thomson Financial samples

	Chevalier, matched to 1988-1992	Thomson Financial, matched to 1988-2004
LBO in 1990	40.9 %	
Post-LBO		29.7 %
Announcement period		0.2
2 years before announcement		2.4
Out-of-stock rate	3.6	4.3
Grocery selling space (sq. ft.):		
Greater than 40,000	20.0	33.2
30,000 to 39,999	18.3	24.6
20,000 to 29,999	24.2	23.4
10,000 to 19,999	16.4	11.6
Less than 10,000	21.2	7.2
Chain affiliation	83.3	92.9
Distance from primary supplier (miles):		
Greater than 125	12.1	14.4
75 to 124	13.9	14.9
40 to 74	16.3	18.4
20 to 39	16.6	19.0
Less than 20	41.0	33.3
Integrated with primary supplier	61.6	64.7
Seasonal item	4.4	4.0
Observations	1,641,888	4,746,458