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The impact of a manufacturer's financial liquidity on its market strategies and pricing and promotion decisions in retail grocery markets☆

Manoj K. Agarwal [a], Zecong Ma [b], Chang Hee Park [a,*], Yilong Zheng [c]

[a] Binghamton University, P.O. Box 6000, Binghamton, NY 13902, United States
[b] St. Mary's University, 1 Camino Santa Maria, San Antonio, TX 78228, United States
[c] Merrimack College, 315 Turnpike St, North Andover, MA 01845, United States

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ABSTRACT

We investigate how two primary determinants of financial liquidity—leverage and cash holdings—affect a firm's strategic orientation between profit and revenue maximizations, and the consequent tactical pricing and promotion decisions. To this end, we develop a structural model of manufacturers' strategic behavior and marketing mix decisions in retail markets of grocery and consumer packaged goods. Applying the model to comprehensive data on 92 firms' financial structure, and their sales, prices, and promotions for 9,111 UPCs sold at 100 retail stores in the Chicago metropolitan area over 400 weeks, we find empirical evidence in support of our hypotheses that increased leverage makes firms with low cash holdings more profit-oriented while firms with high cash holdings become more revenue-oriented. The ensuing pricing and promotion decisions to implement the strategic orientation are shown to vary with the sensitivity of demand to the marketing instruments and their costs.

1. Introduction

Marketing spending accounts for about 13.2% of total revenues and 11.72% of total budgets for major US firms (CMOSurvey.org, 2021). In 2019, just the advertising expenditures in the US amounted to $240 billion.[1] To finance such huge marketing outlays, firms use internal sources of funds such as cash holdings and external sources of funds such as bank loans, corporate bonds, and equity issuance through initial public offerings (IPO) and seasoned equity offerings (SEO). Prior studies have shown that the sources of financing influence firms' marketing spending. Saboo, Chakravarty, and Grewal (2016) find that IPO firms curtail marketing expenditures to boost profits to impress investors. Kothari, Mizik, and Roychowdhury (2016) report similar marketing budget cuts before SEOs. However, IPOs and SEOs are relatively rare and do not occur frequently as most firms prefer internally generated funds and debt over equity (Almeida & Campello, 2010; Shyam-Sunder & Myers, 1999). Accordingly, firms handle their fund availability by managing liquidity through cash, debt, and other financial instruments (Acharya, Almeida, & Campello, 2013; Almeida, Campello, Cunha, & Weisbach, 2014). Since most marketing expenses are short-term in nature and must be expensed in the year incurred (Srinivasan & Hanssens, 2009), they are also more likely to be funded by liquidity elements (i.e., cash and debt) rather than through IPOs and SEOs (Myers & Majluf, 1984; Myers, 1984).

Liquidity can affect both a firm's strategic goals as well as operations. Firms with higher debt might seek higher profit (Chevalier & Scharfstein, 1996) or higher revenue (Brander & Lewis, 1986), while firms with higher cash may target higher revenue (Fresard, 2010). Similarly, liquidity has been shown to affect firms' operational behaviors such as investments in R&D, labor union bargaining strategy, and the acquisition of other firms (e.g., Almeida, Campello, & Hackbarth, 2011; Brown & Petersen, 2011; Klasa, Maxwell, & Ortiz-Molina, 2009). Limited research in finance and economics shows that higher debt levels are associated with some marketing mix components like higher pricing and lower product quality (Kini, Shenoy, & Subramaniam, 2017; Phillips & Sertsios, 2013). However, there is no comprehensive research on the impact of liquidity on marketing mix decisions and several important questions remain unanswered: (1) How do a firm's debt and cash

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* Corresponding author.
E-mail addresses: agarwal@binghamton.edu (M.K. Agarwal), zma1@stmarytx.edu (Z. Ma), cpark@binghamton.edu (C.H. Park), zhengy@merrimack.edu (Y. Zheng).

[1] https://www.statista.com/statistics/272314/advertising-spending-in-the-us/

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holdings together impact its marketing strategy goals? (2) What is the joint impact of the two liquidity elements on the firm's tactical marketing mix decisions such as the pricing and promotion decisions? (3) What is the channel through which changes in the liquidity elements impact the marketing mix decisions?

In this paper, we seek to address these underexplored questions, focusing on manufacturing firms in the retail markets of grocery and consumer packaged goods (CPG). To consider the possibility that a firm concurrently pursues two different major objectives—revenue and profit maximizations—with different emphasis on them (e.g., Amihud & Kamin, 1979; Fama & Miller, 1972; Mizik, 2010), we propose a latent construct of "strategic orientation," which reflects the firm's relative focus between the two objectives. We then hypothesize that changes in liquidity through the levels of debt and cash holdings shift the firm's strategic orientation, which in turn affects the pricing and promotion decisions—the primary drivers of revenues and profits of CPG manufacturers. Given that a firm's strategic orientation is not directly observable, we build a structural model with a mixed objective function (e.g., Chintagunta, 2002; Natter, Reutterer, Mild, & Taudes, 2007; Sudhir, 2001) that probabilistically accounts for the firm's relative strategic orientation in response to changes in liquidity. Since our data comes from retail markets, we also jointly model the retailer's profit margin decision in order to account for its influence on the observed marketing mix variables. Our empirical estimation of the resulting simultaneous equations allows us to understand the impacts of liquidity (viz. debt and cash holdings) on a firm's latent strategic orientation as well as the observable tactical pricing and promotion decisions.

We apply our model to comprehensive data, consisting of UPC-level retail sales, pricing, promotion and margins data, and firm-level financial data. The UPC-level retail market data were obtained from the University of Chicago's Dominick's database. Because the data do not identify the manufacturer of a given UPC, we manually connect each UPC with its brand and firm using a series of books titled "Brands and Their Companies" published by the Gale Group. We then merge the data with firm-level financial data obtained from the COMPUSTAT database. Using the compiled data on 92 manufacturers' liquidity variables, sales, prices, promotions, and retailer margins for 9,111 UPCs sold at 100 retail stores in the Chicago metropolitan area over 400 weeks, we find empirical evidence that leverage (i.e., the ratio of the debt to market value) and cash holdings jointly affect manufacturers' strategic orientation. Specifically, our results reveal that higher leverage leads firms to be more profit-oriented when their cash holdings are low. In contrast, when cash holdings are high, firms tend to be more revenue-oriented as leverage increases. The ensuing pricing and promotion decisions are then shown to vary with not only the strategic orientation but also the sensitivity of demand to the marketing instruments and their costs. In the market conditions of our data, low-cash firms are expected to implement their profit-oriented strategy by increasing price and decreasing promotion frequency. In comparison, high-cash firms implement their revenue-oriented strategy by decreasing price and increasing promotion frequency.

Our research makes a set of distinct contributions to both the marketing and finance literatures. A recent comprehensive review of the literature on the marketing-finance interface finds that the majority of research in marketing focuses on the impact of marketing on financial outcomes (e.g., stock return, firm risk), and very little on the impact of financial variables on marketing decisions (Edeling, Srinivasan, & Hanssens, 2020). We answer their call for more research on how financial factors affect marketing activities, making both theoretical and substantive contributions. Our findings suggest that firms can benefit by establishing strong coordination between CMOs and CFOs (Edeling et al., 2020; Gordon et al., 2013; Meier, 2016; Rogers, 2017). Second, our work responds to the literature (e.g., Hanssens & Pauwels, 2016) that asks for research to incorporate firms' pursuit of multiple goals. We model the possibility that firms shift their emphasis between the profit and revenue maximization goals in response to the changes in liquidity. Along the line, our model extends existing models of manufacturer and retailer behavior (e.g., Choi, 1991; Kadiyali, Chintagunta, & Vilcassim, 2000; Lee & Staelin, 1997) by incorporating the mixed objective function that specifies firms' strategic shift. Third, our research reconciles two contrasting findings in the finance literature on how leverage affects firm strategies; some studies suggest that firms become more aggressive as leverage increases (e.g., Brander & Lewis, 1986; Kurt & Hulland, 2013; Mitani, 2014), while others argue that firms become more conservative with a higher leverage (e.g., Chevalier & Scharfstein, 1996; Showalter, 1995). Our study shows that both can happen, depending on the level of cash holdings of firms.

The remainder of this article is organized as follows. In Section 2, we discuss the theoretical background of our research and propose hypotheses. Section 3 presents our model. In Sections 4 and 5, we describe our data and present model results. Section 6 provides a discussion of the theoretical and managerial implications of our research. We conclude with the limitations of this study and directions for future research in Section 7.

2. Literature review and hypothesis development

In this section, we review the related literature and propose our hypotheses about the impact of firm liquidity on market strategies. We begin by discussing the need for liquidity management and the two main financial instruments—debt and cash—that firms use to manage liquidity. We then discuss firms' pursuit of multiple goals and our choice to focus on their profit and revenue maximization goals. This is followed by our proposed hypotheses on how liquidity would impact firms' strategic orientation between profit and revenue maximizations.

2.1. Liquidity management and its components

Firms want to manage and maintain liquidity for several reasons. Keynes (1936) describes two main benefits of holding liquid assets. First, firms can save transaction costs of external financing. Second, firms hold liquid assets as a "precautionary" hedge against not being able to fund investments when needed, as the funds may not be available or may be very costly at that time (e.g., Holmström & Tirole, 1998). Firms also have a "speculative" motive to maintain liquidity, in that they want to take advantage of any profitable future investment opportunities (Almeida, Campello, & Weisbach, 2004; Denis, 2011; Duchin, 2010; Opler, Pinkowitz, Stulz, & Williamson, 1999).

Firms can ensure the availability of funds for their operational needs primarily by keeping enough cash and cash equivalents on hand. As another major means to manage liquidity, firms can maintain a high level of debt capacity or reserve borrowing power (Myers, 1984) by keeping the current debt low, allowing them to borrow funds if and when needed in the future (Leary & Roberts, 2010). As such, both debt and cash holdings have been identified as the primary methods of managing liquidity (Acharya et al., 2013). Firms may substitute their current cash balance with unused debt capacity (i.e., by having low debt) in the present, as they could then issue debt in the future if and when they need it. However, the firms may not be able to get more debt in the future as it depends on the economy and firm conditions at that time; hence, debt capacity and cash holdings are not perfect substitutes (Acharya, Almeida, & Campello, 2007).

The costs of higher debt and cash holdings are somewhat different. Due to higher debt, the firm may suffer from lower financial flexibility (Zingales, 1998) and higher distress risk (Parsons & Titman, 2008). Higher cash holdings have an opportunity cost as they could have been invested in less liquid but more productive assets. Interest income from cash holdings can have a possible tax disadvantage due to double taxation, first at the corporate level and then if distributed in the form of dividends, at the individual level. In addition, there may be higher agency costs as managers may be tempted to invest excess cash in value-reducing acquisitions that can increase their prestige and power (Jensen,

1986). Therefore, debt and cash holdings, while related, have different costs and benefits and serve different purposes in a firm's liquidity management.

Each firm has a different level of liquidity that it tries to maintain based on factors such as the costs and benefits of debt and cash holdings, perceived market conditions, projected investment needs, etc. Oftentimes, however, the actual liquidity levels differ from the planned ones. Liquidity is impacted by unanticipated events like increased competition that could result in higher price cuts and/or more promotions leading to lower cash flow. Similarly, lower sales than projected, a sluggish economy, and unanticipated strategic investments, to name but a few, could all lead to lower liquidity. Of course, higher than anticipated liquidity would also be possible.

2.2. Firms' pursuit of multiple goals

Firms often pursue multiple goals like profits, revenues, growth, stock values, social responsibility, employee welfare, etc. (Freeman, 2015; Shetty, 1979). Marketers typically set interim goals on market shares, brand equity, and customer satisfaction, etc. (Farris, Bendle, Pfeifer, & Reibstein, 2010). The literature on the marketing-finance interface has investigated their impact on firm performance metrics such as stock returns and risk (e.g., Edeling et al., 2020) and provided evidence of the marketing goals' alignment with financial goals. However, goals can also conflict. For example, the marketing literature has discussed the tradeoffs between value appropriation and value creation. Value creation invests in customer value for competitive advantage, while value appropriation extracts some profits from the value created. Research suggests that firms need to balance the two efforts, with the stock market preferring an emphasis on value appropriation (Mizik & Jacobsen, 2003). Similarly, research in finance shows that firms' focus shifts between growth and profits depending on the stock market values at that time (Aghion & Stein, 2008).

Different goals may be important to finance and marketing. Marketing managers typically seek to increase sales and finance managers are concerned about financial health (Fischer & Himme, 2017). While finance managers are generally interested in maximizing profits (Fama & Miller, 1972; Jensen, 2002), they could pursue revenue maximization. For example, Amihud and Kamin (1979) find evidence that oligopolistic firms in which managers (compared to owners) have control of the firms try to maximize revenue at the cost of maximizing profits, as it might maximize their compensation and prestige. Similarly, marketing managers may pursue a short-term revenue maximization (instead of long-term profit maximization) due to myopic management (Mizik, 2010) and the agency problems arising from the misalignment between the manager incentive structures and the interest of shareholders.

On the other hand, studies in the retailing domain suggest that retailers are interested in maximizing market shares and sales as well as profits (Chintagunta, 2002; Natter et al., 2007). A recent survey of over 600 CMOs reports that they are interested in both revenue- and profit-oriented goals (CMOSurvey.org, 2010). Along this line, researchers have cautioned that "marketing scholars may no longer assume that profit maximization is the sole goal of marketing" (Hanssens & Pauwels, 2016, p. 175). In sum, both marketing and finance managers are often interested in pursuing multiple goals, mainly related to profits and revenues. Anderson (1982, p. 22) suggests that since both marketing and finance are very specialized functions, the eventual firm objectives "emerge as a series of Simonian constraints that are negotiated among the various functions." Clearly, these negotiations are unobserved, and researchers can only observe the outcomes of the negotiated decisions.

In this research, we focus on the two relevant goals—profit and revenue maximizations—that are known to be important to both marketing and finance functions and often cannot be maximized simultaneously. We assume that a firm optimizes a weighted function of these two objectives, based on the negotiations between marketing and finance.[2] Additionally, we suggest that the weight between profit and revenue maximization goals may vary depending on the liquidity levels of the firm. The marketing department then sets the price and promotion levels to achieve this weighted goal.

2.3. Impact of liquidity on strategic orientation

Both the debt and cash components of liquidity can affect firms' relative focus on profit and revenue. Increased debt commits a higher proportion of a firm's cash flow to repayments, thus reducing funds available to invest. It also makes it harder for these firms to get more funds through debt due to increased bankruptcy risk, and further limits their ability to invest. Prior theoretical research suggests that increased debt could affect firm orientation in two opposite ways. Firms could become more conservative and seek to increase their profitability as a means to reduce their debt level (e.g., Chevalier & Scharfstein, 1996; Showalter, 1995). Alternatively, firms could become more aggressive, going for higher revenue (e.g., Brander & Lewis, 1986; Maksimovic, 1988) due to the so called "limited liability effect" of debt.[3] In prior empirical research on the impact of debt, findings support both types of theoretical predictions: higher debt can result in higher or lower market share. For example, Mitani (2014) reports that higher debt results in higher market shares of firms, suggesting they become more aggressive. In contrast, Chevalier (1995) reports that when supermarkets undergo leveraged buyouts (LBOs), they raise their prices and become less aggressive toward revenues. Similarly, Phillips (1995) reports that firms with higher debt lose market share, while Campello (2006) reports that moderate debt leads to higher market share, but very high debt leads to underperformance. In sum, both theoretical models and empirical findings suggest higher debt can make firms either more or less aggressive and shift their implicit focus between profit and revenue.

The cash component of liquidity can also impact firm goals. Firms desire higher cash levels when investment opportunities, the riskiness of the future cash flows, or the competitive intensity is high (Hoberg, Phillips, & Prabhala, 2014; Morellec, Nikolov, & Zucchi, 2014; Opler et al., 1999). Telser (1966) and Bolton and Scharfstein (1990) develop theoretical models that show that deep-pocketed firms may act in a predatory manner to drive out financially weak firms from the market. Fresard (2010) finds that firms with higher cash holdings have larger market shares especially when market competition intensifies though he does not explore the precise channel through which this is achieved. Kurt and Hulland (2013) show that firms with new equity funds become more aggressive, while Bendig, Willmann, Strese, and Brettel (2018) report that firms who use cash to repurchase shares cut their marketing

[2] While firms and departments can pursue multiple goals simultaneously (Ethiraj & Levinthal, 2009; Meyer, 2002; Mittal, Anderson, Sayrak, & Tadikamalla, 2005), we follow Jensen's (2001) argument that it is challenging and difficult for managers to maximize in more than one dimension at once. Accordingly, we consider a weighted function of the two goals. The weight would be implicitly determined based on the nature of cooperation and competition between the departments (Luo, Slotegraaf, & Pan, 2006).

[3] A firm obtains zero payoffs in case of bankruptcy (with the creditors having first claims), but otherwise gets all the profits after debt repayments. As a result, "… increasing the debt level should cause equity holders to undertake riskier investments, since they can declare bankruptcy in bad states of the world …" (Brander & Lewis, 1986, p. 963).

investments and become less aggressive in terms of going for a larger market share. Thus, higher cash levels seem to be correlated with gains in market share implying a more aggressive strategic orientation and enhanced focus on revenue.

2.4. Interactive effect of debt and cash

Our previous discussions highlight that while higher debt can make firms either more or less aggressive, higher cash seems to make them only more aggressive. We propose that these two primary components of liquidity have an interactive effect on a firm's relative goal orientation between profit and revenue maximizations. Specifically, firms with higher debt face increased pressure to repay debt and interest, as they do not want to violate any covenants related to their debts. A large proportion of debt covenants relate to maintaining financial ratios linked to earnings before interest, tax, depreciation and amortization (viz. EBITDA), such as maximum debt to EBITDA ratio, minimum EBITDA, etc. (Chava & Roberts, 2008). Any violations are reported to the lender as well as to the Security and Exchange Commissions. The consequences of violations range from lenders accelerating the debt payments to intervening in firm management. Thus, cash holdings are more likely to be valuable to financially constrained firms, and firms with high leverage have been found to hold much higher cash (e.g., Denis & Sibikov, 2009; Guney, Ozkan, & Ozkan, 2007).

We therefore conjecture that if their cash holdings are low, firms with higher leverage are more likely to focus on profits (e.g., EBITDA, net profit) rather than revenues, as the firms want to generate sustainable cash flow in order to ensure that they can repay the debt and interest. Accordingly, firms will try to maintain their earnings and ensure that their marketing actions keep them profitable. However, if their cash holdings are high, the firms have enough buffer to repay their debt and interest on time. In that case, firms with higher leverage may act more opportunistically in the market and become more revenue-oriented. We thus hypothesize that the impact of leverage on a firm's relative goal orientation is dependent on its cash holdings as follows:

Hypothesis 1. (*(H1):*) *The increase of leverage leads firms to be more profit-oriented when their cash holdings are low.*

Hypothesis 2. (*(H2):*) *The increase of leverage leads firms to be more revenue-oriented when their cash holdings are high.*

2.5. Impact of liquidity on marketing mix strategies

Prior research in the finance and industrial organization literature has examined the impact of liquidity changes on pricing at the industry level. Among others, Dasgupta and Titman (1998) develop a theoretical model that shows that an increase in leverage can either lead to a firm setting a higher price in a two-period Nash model, or a lower price if their competing lower leverage firm is a Stackelberg follower. Similarly, Showalter's model (1995) suggests that debt can cause industry prices to rise or fall. Phillips (1995) empirically shows that higher debt ratios are associated with higher prices in some industries, while Phillips and Sertsios (2013) report that airlines in financial distress lower prices to increase a short-term market share. Using price index data, Chevalier (1995) reports that supermarkets that undergo leveraged buyouts set higher prices. When it comes to cash holdings, studies report that firms use cash holdings to fund marketing activities such as advertising, improving product quality, the relocation of stores, and the construction of efficient distribution networks (e.g., Campello, 2006; Fee, Hadlock, & Pierce, 2009; Fresard, 2010). Recently, Amountzias (2020) examined the financial liquidity constraints of manufacturing and services industries in the UK from 2007 to 2016 and found that higher liquidity firms charged lower prices.

In comparison to previous studies that have related either leverage or cash holding to marketing activities, our research investigates how the two liquidity elements jointly impact firms' strategic orientation and the consequent pricing and promotion decisions. For motivation and illustration purposes, in Fig. 1, we plot the relationship between debt and promotion frequency for the Coca-Cola Company and PepsiCo, Inc., two of the firms included in our data, between 1993 and 1999.[4] In the figure (and our empirical analysis), we measure debt by the leverage ratio, obtained by dividing total debt by the market value of the firm (Frank & Goyal, 2009), for each quarter. As can be observed in the figure, Coca-Cola increases its promotion frequency as leverage increases. In contrast, for PepsiCo, the promotion frequency decreases as leverage increases. Looking into the firms' cash holdings, we note that Coca-Cola has much higher cash holdings than PepsiCo.

While we conjecture that firms' liquidity levels influence their overall market strategies and in turn marketing mix decisions, we also expect that the tactical marketing decisions are subject to the sensitivities of demand to the marketing instruments as well as their costs. To take the market conditions and factors into consideration, we derive additional analytical results in examining the impacts of liquidity changes on the pricing and promotion decisions.

3. Model

We develop a model to examine how manufacturers' liquidity affects their strategic orientation between profit and revenue maximization goals, and the ensuing pricing and promotion decisions. We employ a structural modeling approach to explicitly account for the following two important modeling issues. First, manufacturers' strategic orientation is not observed. To consider their latent shift between profit- and revenue-oriented strategies, we construct a structural model with a mixed objective function (e.g., Chintagunta, 2002; Natter et al., 2007; Sudhir, 2001). Second, in our empirical context of retail grocery markets, as to be described in detail later, manufacturers' products are sold to consumers through the retailer. Accordingly, it is important to incorporate the retailer's profit margin decision into the model as it can influence consumer demand and in turn manufacturer behavior and the observed marketing mix variables. In what follows, we specify our model, which consists of four components: (1) the consumer demand model, (2) a manufacturer's mixed objective function, (3) a manufacturer's wholesale price and promotion decision model, and (4) the retailer's profit margin decision model.

3.1. Demand model

We employ the vertical Nash game, a model that has been widely used to examine manufacturer and retailer behavior in prior research (e.g., Choi, 1991; Lee & Staelin, 1997).[5] Following the literature, we adopt an aggregate-level consumer demand model and specify the demand for manufacturer i's brand(s) in category j in period t, aggregated across retail stores, as follows:

$$q_{ijt} = \beta_0 + \beta_1 rp_{ijt} + \beta_2 prom_{ijt} + \beta_3 \overline{rp}_{jt} + \beta_4 \overline{prom}_{jt} + C_j + Q_t + Y_t \quad (1)$$

where rp_{ijt} denotes the retail price of manufacturer i's brand(s) in category j in period t, which is the sum of the manufacturer's wholesale price wp_{ijt} and the retailer's profit margin rm_{ijt}. The variable $prom_{ijt}$ is the number of promotions offered on manufacturer i's brand(s) in category j in period t. To consider competition with other manufacturers within the

[4] We elaborate on how we calculate the promotion frequency in section 4.

[5] We also considered the manufacturer-leader Stackelberg game, another popular modeling framework of manufacturer and retailer behavior (e.g., Kadiyali et al., 2000). We did not pursue this model as we found that, under the manufacturer-leader Stackelburg game, the existence of the global maximum of the objective function with respect to promotion depends on the values of model parameters, that is, the second-order condition for promotion is not always negative. Details are available from the authors upon request.

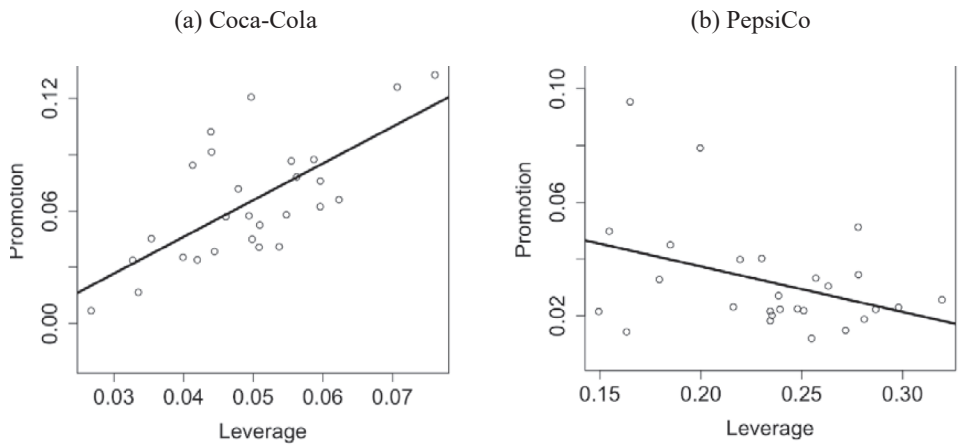

Fig. 1. Relationships between Leverage and Promotion for Coca-Cola and PepsiCo.

category, we incorporate the average retail price and the average number of promotions, $\overline{rp}_{jt}$ and $\overline{prom}_{jt}$, in category j in period t. The parameters β_0, β_1, β_2, β_3, and β_4 are coefficients that capture the sensitivity of demand with respect to each corresponding covariate. We include the sets of dummy variables C_j, Q_t, and Y_t to consider the effects of unobserved category-, quarter- and year-specific factors on demand, respectively.[6]

It is worth discussing our specification of the demand model, given the possibility of aggregation bias (Theil, 1971) that may arise as we aggregate demand across retail stores. We refer to the discussion by Christen, Gupta, Porter, Staelin, and Wittink (1997) who suggest that linear demand models with aggregate-level parameters are not likely to suffer from the aggregation bias regardless of whether marketing activity is homogeneous or heterogeneous (see Table 1 on p. 323). Alternatively, Christen et al. (1997) show that the aggregation bias does not occur in a log-log demand model (or a multiplicative model) when data are aggregated with the geometric mean. We do not pursue the log-log specification because the revenue function, derived from the log-log model, is monotonic in the price and promotion variables.[7,8]

Table 1
Descriptive Statistics of Variables.

Data Source	Variable	Mean	Median	Std. Dev.
Dominick's Database	Retail Sales (in ounces)	168,968	52,157	354,587
	Retail Price (per ounce)	0.337	0.192	0.557
	Manufacturer Price (per ounce)	0.227	0.133	0.339
	Retail Margin (per ounce)	0.110	0.054	0.246
	Promotion Frequency	0.133	0.048	0.282
	Category Average Retail Price	0.352	0.207	0.433
	Category Average Promotion Frequency	0.202	0.082	0.578
COMPUSTAT	Leverage	0.241	0.197	0.191
	Cash Holdings	0.065	0.036	0.075
	Cost of Goods Sold	0.547	0.535	0.183
SIC System	Category Groups (food/beverage = 0; personal/household supplies = 1)	0.346	0	0.476

Note: For all variables, the number of observations is 3,994.

3.2. Manufacturer's mixed objective function

Let us denote manufacturer i's profit and revenue earned in category j in period t by $\pi^m_{p,ijt}$ and $\pi^m_{r,ijt}$, respectively. Given the variables defined in the demand model, $\pi^m_{p,ijt}$ and $\pi^m_{r,ijt}$ can be written as:

$$\pi^m_{p,ijt} = (wp_{ijt} - \delta_1 prom_{ijt} - c_{ijt})q_{ijt} - fc^m_{ijt} \text{ and}$$
$$\pi^m_{r,ijt} = (wp_{ijt} - \delta_1 prom_{ijt})q_{ijt} \quad (2)$$

where δ_1 represents the manufacturer's unit promotion cost (i.e., the average cost involved in the promotion of each product unit sold). To ensure the promotion cost to be positive in our empirical analysis, we reparametrize δ_1 as $\delta_1 = \exp(\dot{\delta_1})$. The term c_{ijt} is the marginal production cost of the manufacturer's brand(s) in category j in period t. The term fc^m_{ijt} denotes the manufacturer's fixed cost in category j in period t.

As we proposed in our hypotheses H1 and H2, a manufacturer may shift between profit- and revenue-oriented strategies in response to its liquidity levels. To incorporate such a potential strategic shift, we build a mixed objective function (e.g., Chintagunta, 2002; Natter et al., 2007; Sudhir, 2001) of manufacturer i's profit and revenue in category j in period t as π^m_{ijt}:

$$\pi^m_{ijt} = \theta_{it}\pi^m_{p,ijt} + (1 - \theta_{it})\pi^m_{r,ijt} \quad (3)$$

where θ_{it} $(0 < \theta_{it} < 1)$ is a parameter that captures the manufacturer's

[6] We also tested our model with the lagged retail price $rp_{ij,t-1}$ and the lagged promotion $prom_{ij,t-1}$ added as predictor variables. It did not result in a meaningful improvement in model fit and our key results remained unchanged. The estimation results are available from the authors upon request.

[7] For example, for a given coefficient for the price variable, a firm's revenue constantly increases or decreases as its price increases, resulting in degenerate solutions in revenue maximization. For illustration, consider a simple log–log demand model: $\log q = \alpha + \beta \log p$, or equivalently $q = e^{\alpha}p^{\beta}$. Then, the revenue function of the model is given by $pq = e^{\alpha}p^{\beta+1}$, which is monotonic in p. Hence, the revenue maximization results in an infinite price or a price being close to zero.

[8] Alternatively, market shares (and hence demand) can be modeled using the random utility model at the individual level, as proposed by Berry, Levinsohn, and Pakes (1995). As discussed in the literature (e.g., Sudhir, 2001), this utility-based modeling approach has advantages over the aggregate-level demand models, in accounting for consumer heterogeneity and unobserved factors that may affect choice behavior. We chose not to pursue the individual-level utility-based modeling approach, given our focus on the impact of leverage on firm behavior, instead of the impact of marketing activity on choice behavior. Our aggregate-level demand model is also computationally preferred given that our empirical analysis deals with 25 different product categories and all competing firms (on average 10.0 firms) within each category, rather than focusing on major brands in a few chosen categories.

time-varying weight between profit and revenue maximization goals. By substituting $\pi^m_{p,ijt}$ and $\pi^m_{r,ijt}$ with their specification in Eq. (2), we obtain the following expression for π^m_{ijt}:

$$\pi^m_{ijt} = (wp_{ijt} - \delta_1 prom_{ijt} - \theta_{it} c_{ijt}) q_{ijt} - \theta_{it} fc^m_{ijt}. \quad (4)$$

To reflect the dependence of θ_{it} on leverage and cash holdings, hypothesized in H1 and H2, we reparametrize θ_{it} as a function of the liquidity variables. However, noting that θ_{it} and c_{ijt} cannot be separately identified in Eq. (4), we instead specify their product term $\theta_{it}c_{ijt}$ using leverage, cash holdings, and variables that are likely to be associated with the marginal production cost. In doing so, we employ the exponential functional form to ensure that $\theta_{it}c_{ijt}$ is positive, given that θ_{it} is contained between 0 and 1 and c_{ijt} is positive by definition:

$$\theta_{it} c_{ijt} = \exp\begin{pmatrix} \tau_0 + \tau_{COGS} COGS_{it} + \tau_{SIC28} SIC28_j \\ +\tau_1 LVRG_{i,t-1} + \tau_2 CASH_{i,t-1} \\ +\tau_3 LVRG_{i,t-1} \times CASH_{i,t-1} \end{pmatrix} \quad (5)$$

where $COGS_{it}$ is the ratio of the cost of goods sold to the sales of the manufacturer in each quarter, $SIC28_j$ is a dummy variable that captures the difference in production costs between product category groups, which will be specified later, and $LVRG_{i,t-1}$ and $CASH_{i,t-1}$ are the measures of leverage and cash holdings in the previous period, respectively. We use these lagged variables to avoid potential reverse causality. These variables are further detailed in Section 4. The parameters τ_0, τ_{COGS}, τ_{SIC28}, τ_1, τ_2, and τ_3 are the intercept and coefficients for the corresponding covariates, respectively.

3.3. Manufacturer's wholesale price and promotion decisions

We assume that manufacturers set the price level and promotional frequency in accordance with their chosen strategic orientation between profit can revenue maximization, captured by θ_{it}. In our vertical Nash game model, a manufacturer is assumed to make the wholesale price and promotion decisions that jointly maximize the mixed objective function in Eq. (4). The first-order conditions for manufacturer i's optimization problem with respect to its wholesale price and promotion decisions are then given by:

$$\frac{\partial \pi^m_{ijt}}{\partial wp_{ijt}} = q_{ijt} + (wp_{ijt} - \delta_1 prom_{ijt} - \theta_{it} c_{ijt}) \frac{\partial q_{ijt}}{\partial wp_{ijt}} = 0 \quad (6)$$

and

$$\begin{aligned} \frac{\partial \pi^m_{ijt}}{\partial prom_{ijt}} &= -\delta_1 q_{ijt} + (wp_{ijt} - \delta_1 prom_{ijt} - \theta_{it} c_{ijt}) \frac{\partial q_{ijt}}{\partial prom_{ijt}} \\ &= 0. \end{aligned} \quad (7)$$

Given that $rp_{ijt} = wp_{ijt} + rm_{ijt}$ and hence we have $\frac{\partial q_{ijt}}{\partial wp_{ijt}} = \beta_1$ and $\frac{\partial q_{ijt}}{\partial prom_{ijt}} = \beta_2$ from Eq. (1), the optimal wholesale price and promotion frequency are given by:

$$wp_{ijt} = \theta_{it} c_{ijt} + \delta_1 prom_{ijt} - \frac{q_{ijt}}{\beta_1} \quad (8)$$

and

$$prom_{ijt} = \frac{wp_{ijt} - \theta_{it} c_{ijt}}{\delta_1} - \frac{q_{ijt}}{\beta_2}. \quad (9)$$

These are the global optimal solutions since the second-order derivatives of the mixed objective function with respect to wholesale price and promotion are both negative, under the assumption of a negative demand sensitivity to price (i.e., $\beta_1 < 0$) and a positive demand sensitivity to promotion (i.e., $\beta_2 > 0$):

$$\frac{\partial^2 \pi^m_{ijt}}{\partial wp_{ijt}^2} = 2\beta_1 < 0 \text{ and } \frac{\partial^2 \pi^m_{ijt}}{\partial prom_{ijt}^2} = -2\delta_1\beta_2 < 0. \quad (10)$$

3.4. Retailer's profit margin decision

To determine the retail margin, the retailer is assumed to maximize its profit from manufacture i's brand(s) in category j in period t given by:

$$\pi^r_{ijt} = (rm_{ijt} - \delta_2 prom_{ijt}) q_{ijt} - fc^r_{ijt} \quad (11)$$

where δ_2 represents the retailer's unit promotion cost that occurs in its merchandizing activity. In our empirical analysis, we reparametrize the retailer's unit promotion cost δ_2 as $\delta_2 = \exp(\delta_2^{'})$ to ensure that the promotion cost is positive. The term fc^r_{ijt} denotes the retailer's fixed cost.

The first-order condition for the optimal retail margin is then given by:

$$\frac{\partial \pi^r_{ijt}}{\partial rm_{ijt}} = q_{ijt} + (rm_{ijt} - \delta_2 prom_{ijt}) \frac{\partial q_{ijt}}{\partial rm_{ijt}} = 0. \quad (12)$$

As we have $\frac{\partial q_{ijt}}{\partial rm_{ijt}} = \beta_1$ from Eq. (1), the optimal retail margin can be written as:

$$rm_{ijt} = -\frac{q_{ijt}}{\beta_1} + \delta_2 prom_{ijt}. \quad (13)$$

Taken together, the system of equations to be estimated in our empirical analysis includes the demand equation in Eq. (1), the reparameterization equation for the term $\theta_{it}c_{ijt}$ in Eq. (5), the optimal wholesale price and promotion equations in Eqs. (8) and (9), and the optimal retail margin equation in Eq. (13).

3.5. Identification

As our model extends the vertical Nash game model by allowing manufacturers' strategic goal to shift between the profit and revenue maximizations through a mixed objective function in Eq. (3), it is worth discussing the identification of the proposed model. Consistent with prior studies that employ structural models of firm behavior (e.g., Kadiyali et al., 2000; Sudhir, 2001; Yang, Chen, & Allenby, 2003), we assume that firms made optimal or close-to-optimal decisions with some unobserved errors. If manufacturers sought to maximize only either profits or revenues throughout the entire data period, the data may not have variations that allow us to identify θ_{it}. However, if there were changes in firms' strategic orientation over time, the model estimation would lead us to find the value of θ_{it} (and hence its determinants) that best fits the data of firm behavior.

As discussed in Section 3.2, in linking θ_{it} to leverage and cash holdings, we reparameterize $\theta_{it}c_{ijt}$ in Eq. (5), because θ_{it} cannot be separately identified from c_{ijt} in Eq. (4). c_{ijt}, the variable manufacturing cost, is positive and independent of any costs related to leverage and cash holdings, which are classified as fixed costs (Bonnet, Dubois, Villas-Boas, & Klapper, 2013; Lee, 2002). Hence, the impact of the liquidity variables, $LVRG_{i,t-1}$ and $CASH_{i,t-1}$, on θ_{it} can be inferred from their estimated coefficients in Eq. (5).

4. Data

We now describe the data used in our empirical analysis. Our data are collected from four major sources: (1) retail scanner panel data, which were obtained from the University of Chicago's Dominick's database, (2) financial data, which were obtained from the COMPUSTAT database, (3) merger and acquisition data, which were obtained from the SDC Thompson Merger and Acquisition database, and (4) a series of books titled "Brands and Their Companies" published by the Gale Group that detail which firms own which brands. The Dominick's database has

been widely used in academic research on the pricing and promotion decisions, price rigidity, the interaction of channel members, and inventory management (e.g., Gelper, Wilms, & Croux, 2016; Kadiyali et al., 2000; Levy, Snir, Gotler, & Chen, 2020; Nagaraja & McElroy, 2018; Pauwels, Hanssens, & Siddarth, 2002; Ray, Chen, Bergen, & Levy, 2006). We manually match each brand in the Dominick's database with its manufacturer using the "Brands and their Companies" books, while taking into account the history of merger and acquisition among manufacturers. We then merge the information on the listed firms with their financial variables using the COMPUSTAT database, which was used in prior studies on the marketing-finance interface (e.g., Rao, Agarwal, & Dahlhoff, 2004; Swaminathan, Murshed, & Hulland, 2008).

The Dominick's database provides the information on retail sales, retail price, retail margin (in percentage) and promotion activities (i.e., bonus buy, price reduction and coupon) at the UPC level for 25 product categories across 100 Dominick's retail stores in the Chicago metropolitan market area over 400 weeks from September 14, 1989 to May 14, 1997.[9] Using the data, we constructed variables measuring weekly retail sales, retail price, retail margin and promotion activities at the UPC level for all product categories over the data period. In doing so, we removed UPCs that have missing information on these four variables. To ensure that the unit price and sales quantity are comparable across different products, we converted all UPC price and margins to a per ounce measure.[10] Overall, this resulted in 14,400 UPCs across 25 product categories.

To match manufacturers' retail data to their financial data, we aggregated our retail data from the week level to the quarter level since most financial information is available quarterly. Among the 14,400 UPCs, we were able to connect 9,111 UPCs to 92 public firms. The remaining 5,289 UPCs were sold by private firms whose financial information was not publicized. Overall, the 92 public firms included in our analysis account for 71.4% of the total sales revenue in the Dominick's database. In matching the brands with the firms, we also included merger and acquisition activity among the firms. Using the SDC Thompson Merger and Acquisition database, we found that during our data period, 452 UPCs changed their ownership once and 194 UPCs changed their ownership twice.

After completing the data matching and merging tasks, we obtain our estimation data set on 25 categories, across 28 quarters between September 1989 and May 1997, for 83 manufacturers with a total of 3,994 observations. We next describe how we operationalize variables used in our analysis. Their descriptive statistics are reported in Table 1.

Retail Sales. Following the literature (e.g., Ailawadi, Lehmann, & Neslin, 2003; Cotterill & Putsis, 2000), we computed the retail sales for each manufacturer in each quarter by summing the retail sales (in ounces) of all UPCs in each category across all stores for each manufacturer over the 13 weeks within the quarter.

Retail Price, Manufacturer Price, and Retailer Margin. In line with the literature (e.g., Ailawadi et al., 2003; Cotterill & Putsis, 2000), we first calculated the net retail price per unit volume for each UPC by dividing the retail price by the size of the package. We then calculated the average category retail price for each manufacturer in each quarter by averaging the net retail price per unit of all UPCs within the category across all stores for that manufacturer over the 13 weeks within the quarter. The dollar retail profit margin per unit volume was next obtained by multiplying the retail price per unit volume by the percentage profit margin. Subtracting the retail profit margin per unit volume from the retail price per unit provided the manufacturer's wholesale price. We then averaged the manufacturer price and the retail profit margin per unit volume across all UPCs within each category across all stores for each manufacturer over the 13 weeks within the quarter.

Promotion Frequency. The Dominick's database includes information about whether a UPC was on any one of three types of promotions—price reduction, bonus buy, and coupon—in each week.[11] To obtain the promotion frequency for each UPC, consistent with the literature (e.g., Gedenk & Neslin, 1999; Walters & Bommer, 1996), we calculated the total number of promotion activities across stores that sold the product and divided it by the number of stores. We then averaged the promotion frequency of all UPCs in each category each quarter for each manufacturer.

Firm Liquidity. Firms use leverage and cash holdings to manage their liquidity levels. We operationalized manufacturers' leverage (*LVRG*), as the ratio of a firm's total quarterly debt (debt in current liability + long term debt) to its quarterly market value (market value of equity + total debt – deferred tax and investment credit) (e.g., Frank & Goyal, 2009). The other financial variable, *CASH*, is calculated as the ratio of a firm's quarterly cash holdings (cash + short-term investments) to its total quarterly book value of assets (e.g., Acharya et al., 2007).

Other Variables. As discussed, we used the average retail price $\overline{rp}_{jt}$ and promotion frequency $\overline{prom}_{jt}$ in each category to consider the effect of manufacturers' competition on the demand specified in Eq. (1). To obtain the category average retail price, we averaged the retail price across all UPCs within the category. Similarly, we computed the category average promotion frequency by averaging the promotion frequency across all UPCs within the category. To control for the differences in the marginal production costs across manufacturers over time, we included *COGS*, which is calculated as the ratio of a manufacturer's cost of goods sold to its total sales in each quarter. Lastly, using the Standard Industrial Classification (SIC) code system, we further categorized the 25 product categories in our data into two groups, food/beverage (SIC codes beginning with 20) and personal/household supplies (SIC code beginning with 28). This variable was used to account for any systematic difference in the production costs between the two product category groups in Eq. (5).[12]

5. Analysis and results

In this section, we present the results of the model. We begin by discussing our estimation approach. Next, we present our main findings with respect to the impact of leverage on manufacturers' strategic orientation. This is followed by analytical results on the pricing and promotion decisions to implement the chosen market strategy.

5.1. Estimation approach

We estimate the system of equations formulated and derived in Section 3. It consists of the equations for consumer demand in Eq. (1), the optimal wholesale price and promotion frequency in Eqs. (8) and (9), and the optimal retail margin in Eq. (13). The term $\theta_{it}c_{ijt}$ in Eqs. (8) and (9) is replaced with its parametric specification in Eq. (5). Then, to allow for observation-level random errors, we add the error terms ε_{ijt}, γ_{ijt}, η_{ijt},

[9] The 25 product categories include analgesics, bath soap, beer, bottled juice, canned soup, canned tuna, cereals, cheese, cookies, crackers, dish detergent, fabric softener, front-end candies, frozen dinners, frozen entrees, frozen juices, grooming products, laundry detergent, oatmeal, refrigerated juices, soap, soft drinks, shampoos, snack crackers, and toothpastes.

[10] We dropped UPCs that defined the unit price as per number of products (instead of ounces) in the database. This resulted in the removal of four product categories: cigarette, toothbrush, toilet paper, and paper towel.

[11] The database does not contain specific information regarding the percentage of price reduction, the types of bonus buy (e.g., buy one get one free, buy one get one half off), and coupon benefits offered.

[12] The food/beverage group includes beer, bottled juice, canned soup, canned tuna, cereals, cheese, cookies, crackers, front-end candies, frozen dinners, frozen entrees, frozen juices, oatmeal, refrigerated juices, soft drinks, and snack crackers. The personal/household supplies group includes analgesics, bath soap, dish detergent, fabric softener, grooming products, laundry detergent, shampoos, soap, and toothpastes.

and ϕ_{ijt} to the equations:

$$q_{ijt} = \beta_0 + \beta_1 rp_{ijt} + \beta_2 prom_{ijt} + \beta_3 \overline{rp}_{jt} + \beta_4 \overline{prom}_{jt} + C_j + Q_t + Y_t + \varepsilon_{ijt}; \quad (14)$$

$$wp_{ijt} = \exp\begin{pmatrix} \tau_0 + \tau_{COGS} COGS_{it} + \tau_{SIC28} SIC28_j \\ +\tau_1 LVRG_{i,t-1} + \tau_2 CASH_{i,t-1} \\ +\tau_3 LVRG_{i,t-1} \times CASH_{i,t-1} \end{pmatrix} + \delta_1 prom_{ijt} - \frac{q_{ijt}}{\beta_1} + \gamma_{ijt}; \quad (15)$$

$$prom_{ijt} = \frac{wp_{ijt} - \exp\begin{pmatrix} \tau_0 + \tau_{COGS} COGS_{it} + \tau_{SIC28} SIC28_j \\ +\tau_1 LVRG_{i,t-1} + \tau_2 CASH_{i,t-1} \\ +\tau_3 LVRG_{i,t-1} \times CASH_{i,t-1} \end{pmatrix}}{\delta_1} - \frac{q_{ijt}}{\beta_2} + \eta_{ijt}; \quad (16)$$

$$rm_{ijt} = -\frac{q_{ijt}}{\beta_1} + \delta_2 prom_{ijt} + \phi_{ijt}. \quad (17)$$

The error terms are assumed to follow an independent normal distribution. The rank and order conditions for identification (Fisher, 1966) are satisfied in this set of equations.

The system of equations includes four potentially endogenous variables—demand q_{ijt}, retail margin rm_{ijt}, wholesale price wp_{ijt}, and promotion frequency $prom_{ijt}$. Noting that the use of endogenous variables as the predictor variables of a model can result in biased estimates of parameters, we take the instrument variable (IV) approach to address the endogeneity problem, which has been commonly employed in prior studies that use similar models to ours (e.g., Kadiyali et al., 2000; Vilcassim, Kadiyali, & Chintagunta, 1999). The first step of the IV method is to find an instrument for each endogenous variable. A good instrument should satisfy two main conditions: it should be correlated with the endogenous variable but uncorrelated with the error term. For demand q_{ijt}, we use the number of UPCs of each firm in each category as an instrument, because the variable is expected to be correlated with the shelf space size and in turn demand but not with the unexplained fluctuation in consumers' demand. For manufacturer price wp_{ijt}, we looked for variables that relate to firms' manufacturing costs in each category and used the ratio of the cost of goods sold to sales of a firm in each quarter (both available from COMPUSTAT) as an instrument. For retail margin rm_{ijt}, we chose to use one quarter lagged retail margin as we did not find other compelling instruments. Similarly, for promotion frequency $prom_{ijt}$, we used one quarter lagged promotion as an instrument.[13] While lagged variables have been a popular choice for instruments in the literature (e.g., Kadiyali et al., 2000; Rossi, 2014; Villas-Boas & Winer, 1999), they are also known to have some limitations (Papies, Ebbes, & Van Heerde, 2017). We tested the validity of the four proposed instruments, using the weak instrument test suggested in prior studies (e.g., Larcker & Rusticus, 2010; Stock, Wright, & Yogo, 2002; Verbeek, 2017). The first-stage partial F statistics for all the four variables were found to be greater than the respective critical value suggested by Stock et al. (2002), indicating that they serve as good instruments in our model.[14] We estimated the system of equations in Eqs. (14)–(17), using the 2SLS and 3SLS methods in PROC MODEL procedure in SAS.[15] We performed the Hausman test (Hausman & Taylor, 1981) to compare our 2SLS and 3SLS estimates. The test statistic rejects the null hypothesis ($\chi^2 = 132.1$, $p < .0001$), indicating that 2SLS is preferred over 3SLS. We therefore focus on the results of 2SLS hereafter.

5.2. Parameter inferences

Table 2 reports the estimates of key parameters included in the system of our nonlinear equations. We first discuss the parameters of the demand model in Eq. (14). As one may expect, we find that the impact of retail price on demand is significantly negative ($\beta_1 = -1.584 \times 10^6$, $p < .01$) while the impact of promotions is significantly positive ($\beta_2 = 1.545 \times 10^6$, $p < .01$). For the two variables included to consider the competition effects, we find that the impact of category average retail price on demand is significantly positive ($\beta_3 = 9.708 \times 10^5$, $p < .01$) while the impact of category average promotion frequency is significantly negative ($\beta_4 = -1.413 \times 10^5$, $p < .01$). These results are therefore consistent with the marketing and economics theory and empirical findings in the literature on the impact of own price and promotion and the impact of competitors' price and promotion (e.g., Kadiyali et al., 2000; Sudhir, 2001; Vilcassim et al., 1999).

Our next results are based on the estimates of parameters that capture the impact of liquidity on manufacturers' strategic focus between profit-orientation and revenue-orientation. Recall that because the strategy shifter θ_{it} and the marginal production cost c_{ijt} cannot be separately identified in Eq. (4), we specify $\theta_{it} c_{ijt}$ as a function of financial variables in Eq. (5). As discussed earlier, since the marginal production cost c_{ijt} is positive and independent of *LVRG* and *CASH*, θ_{it} is proportional to the terms that consist of the liquidity variables (i.e., $\tau_1 LVRG_{i,t-1}$, $\tau_2 CASH_{i,t-1}$, and $\tau_3 LVRG_{i,t-1} \times CASH_{i,t-1}$) in the right-hand

Table 2
Estimation Results for the Proposed Model.

Parameter	Estimate	Standard Error
Demand Model		
Intercept β_0	1.8103×10^5	1.394×10^5
Retail Price β_1	-1.584×10^6 ***	5.362×10^4
Promotion Frequency β_2	1.545×10^6 ***	1.885×10^5
Category Average Retail Price β_3	9.708×10^5 ***	8.102×10^4
Category Average Promotion β_4	-1.412×10^5 ***	2.894×10^4
Strategy Shifter in Manufacturers' Objective Function		
Intercept τ_0	−35.619 **	16.258
COGS τ_{COGS}	7.875 ***	3.028
SIC28 τ_{SIC}	10.808 **	4.399
LVRG τ_1	33.220 **	14.888
CASH τ_2	41.653 **	17.916
LVRG × CASH τ_3	−192.658 ***	70.551
Promotion Costs		
$\delta_1' = \log(\delta_1)$	0.350 ***	0.037
$\delta_2' = \log(\delta_2)$	0.831 ***	0.030

Note: (1) ***: $p < .01$, **: $p < .05$, and *: $p < .10$; (2) The demand model also includes the category-specific fixed effects, the year-specific fixed effects, and the quarter-specific fixed effects. The estimates of the fixed effects are available from the authors upon request.

[13] We considered using the quarterly number of new UPCs introduced by a firm in each category as an instrument for promotion frequency, with an expectation that there may be more promotions when new products are introduced.However, it turned out to be a weak instrument. We also tried two other instruments for retail margin and promotion frequency. First, we tried the two approaches recommended by Papies et al. (2017) for making lagged variables more valid instruments, viz. using longer lags and controlling for consumer stockpiling. Secondly, we tested instruments similar in spirit to the peer-of-peers approach (e.g., Malshe, Colicev, & Mittal, 2020) by using peer categories of peer firms. All these alternatives yield estimation results consistent with those reported in Table 2. More details on the implementations and the test statistics are available from authors upon request.

[14] The partial R^2, the partial F statistic, and the p-value in the first stage regression are 0.029, 116.38, and p<.001 for the number of UPCs; 0.005, 18.69, and p<.001 for the cost of goods sold; 0.120, 475.93, and p<.001 for the lagged retail margin; 0.356, 1409.39, and p<.001 for the lagged promotion frequency.

[15] The SAS codes are available from the authors upon request.

side of Eq. (5). Thus, we can infer how the changes in leverage and cash holdings affect manufacturers' strategic focus. We find that the coefficients for *LVRG* and *CASH* are significantly positive ($\tau_1 = 33.220, p < .03$; $\tau_2 = 41.653, p < .03$), while the coefficient for the interaction term *LVRG* × *CASH* is significantly negative (τ_3 = -192.658, $p <$. 01).

Given that the impact of leverage on the strategy shifter θ_{it} depends on manufacturers' cash holdings (i.e., $\Delta = \tau_1 + \tau_3 \times CASH$), the impact of leverage on θ_{it} is positive when *CASH* is smaller than 0.172 (i.e., $\Delta = 33.220 - 192.658 \times CASH > 0$ when $CASH < 0.172$). In contrast, when *CASH* is>0.172, the impact of leverage on θ_{it} is negative (i.e., $\Delta = 33.220 - 192.658 \times CASH < 0$ when $CASH > 0.172$). In other words, increased leverage makes low-cash firms more profit-oriented, while it makes high-cash firms more revenue-oriented. These results are therefore in line with H1 and H2. When it comes to the impact of cash holdings on manufacturers' strategic orientation (i.e., $\Delta = \tau_2 + \tau_3 \times LVRG$), we find that, for firms with low *LVRG* (<0.216), increased cash holdings make them more profit-oriented, while for firms with high *LVRG* (>0.216), increased cash holdings make them more revenue-oriented.

5.3. Robustness check

In addition to estimating the proposed model, we consider an important modification of the model and check the robustness of our results. Prior research suggests that the high debt of competitors can motivate the focal firm to be more aggressive toward market shares and revenues (Kurt & Hulland, 2013). On the other hand, high cash holdings of competitors can be perceived as a signal of potential aggressive behavior (Benoit, 1984) while the focal firm's behavior will depend on the nature of the intensity of competition and strategic interactions (Fresard, 2010). To incorporate such effects of competitors' financial status into the model, for each manufacturer in each period, we compute the average leverage and cash holdings of its competitors (i.e., other manufacturers within the same product category), add the variables to Eq. (5), and estimate the modified model. As reported in Table A.1 in the online supplementary material, our key results remain unchanged.

5.4. The impact of leverage and cash holdings on pricing and promotion decisions

Our estimation results showed how firms' leverage and cash levels can change their strategic orientation between profit and revenue maximization goals, in support of H1 and H2. We next show how the changes in debt and cash holdings would affect manufacturers' pricing and promotion decisions. A firm's price and promotion decisions will depend on not only its strategic orientation but also the sensitivities of demand to price and promotion frequency, as well as promotion costs. To take these factors into account, we take an analytical approach to examining the impact of liquidity changes on the marketing mix decisions. We first obtain manufacturers' equilibrium wholesale price and promotion level by solving the system of equations in Eqs. (1), (8), (9) and (13). These results are presented in Lemma 1.[16]

Lemma 1. (*Equilibrium*) *Manufacturers' equilibrium wholesale price and promotion are given by:*

$$wp_{ijt} = \frac{\beta_1\delta_2+\beta_2}{\beta_1\delta_1+\beta_1\delta_2+\beta_2}\theta_{it}c_{ijt} - \frac{\beta_1\delta_1}{\beta_1\delta_1+\beta_1\delta_2+\beta_2}\frac{\overline{\beta_0}}{\beta_1} \quad \text{and}$$

$prom_{ijt} = -\frac{\beta_1}{\beta_1\delta_1+\beta_1\delta_2+\beta_2}(\theta_{it}c_{ijt} + \frac{\overline{\beta_0}}{\beta_1})$, where $\overline{\beta_0} = \beta_0 + \beta_3\overline{rp}_{jt} + \beta_4\overline{prom}_{jt} + C_j + Q_t + Y_t$.

As discussed earlier, firms would set their price and promotional levels, consistent with their strategic focus between profit and revenue maximization goals. Lower prices and more promotions generally increase sales and revenue, but not necessarily profits if lower prices and higher promotion costs reduce unit margins (Jehle & Reny, 2011). The impacts of price and promotion on revenues and profits would also depend on how the market demand responds to the changes (i.e., price and promotion elasticities of demand). We therefore expect that the effect of debt and cash holdings on the pricing and promotion decisions would vary depending on the sensitivity of market demand to the marketing mix variables, as well as the promotion costs of manufacturers and the retailer. Given the equilibrium wholesale price and promotion in Lemma 1, we next derive conditions under which manufacturers increase or decrease their wholesale price and promotion in response to the increase of leverage.

In line with the economics and marketing theories and empirical findings in the literature (e.g., Kadiyali et al., 2000; Sudhir, 2001), we assume a negative demand sensitivity to price (i.e., $\beta_1 < 0$), a positive demand sensitivity to promotion (i.e., $\beta_2 > 0$), and positive promotion costs of manufacturers and the retailer (i.e., $\delta_1 > 0$ and $\delta_2 > 0$). Note that these assumptions are satisfied in our empirical analysis. Next, we refer to the magnitude of the promotion sensitivity in relation to the price sensitivity (i.e., $|\beta_2/\beta_1|$) as the ratio of the demand sensitivities to promotion and price or, in short, the promotion-price demand sensitivity ratio hereafter. This ratio reflects the market response that a manufacturer should consider in making promotion and pricing decisions with respect to their impact on demand (e.g., Sethuraman & Tellis, 1991). With the promotion-price demand sensitivity ratio, we obtain the following propositions.

Proposition 1. (*Impact of Leverage on Wholesale Price*) *Given H1 and H2, the increase of leverage leads firms to increase their wholesale price when* (1) *the promotion-price demand sensitivity ratio is in a low or high range, and cash holdings are low; or* (2) *the promotion-price demand sensitivity ratio is in the medium range and cash holdings are high. Otherwise, the increase of leverage leads firms to decrease the wholesale price. Formally,*

$$\begin{cases} \frac{\partial wp_{ijt}}{\partial LVRG_{i,t-1}} > 0 & \text{if } \left|\frac{\beta_2}{\beta_1}\right| < \delta_2 \text{ or } \left|\frac{\beta_2}{\beta_1}\right| > \delta_1 + \delta_2, \text{ and } CASH_{i,t-1} < -\frac{\tau_1}{\tau_3}; \\ & \text{or } \delta_2 < \left|\frac{\beta_2}{\beta_1}\right| < \delta_1 + \delta_2 \text{ and } CASH_{i,t-1} > -\frac{\tau_1}{\tau_3} \\ \frac{\partial wp_{ijt}}{\partial LVRG_{i,t-1}} \le 0 & \text{otherwise.} \end{cases}$$

Proposition 2. (*Impact of Leverage on Promotion*) *Given H1 and H2, the increase of leverage leads firms to increase the promotion frequency when* (1) *the promotion-price demand sensitivity ratio is low and cash holdings are high; or* (2) *the promotion-price demand sensitivity ratio is high and cash holdings are low. Otherwise, the increase of leverage leads firms to decrease the promotion frequency. Formally,*

$$\begin{cases} \frac{\partial prom_{ijt}}{\partial LVRG_{i,t-1}} > 0 & \text{if } \left|\frac{\beta_2}{\beta_1}\right| < \delta_1 + \delta_2 \text{ and } CASH_{i,t-1} > -\frac{\tau_1}{\tau_3}; \\ & \text{or } \left|\frac{\beta_2}{\beta_1}\right| > \delta_1 + \delta_2 \text{ and } CASH_{i,t-1} < -\frac{\tau_1}{\tau_3} \\ \frac{\partial prom_{ijt}}{\partial LVRG_{i,t-1}} \le 0 & \text{otherwise.} \end{cases}$$

As such, in Propositions 1 and 2, the promotion-price demand sensitivity ratio is in a low range when $|\beta_2/\beta_1| < \delta_2$, in a medium range when $\delta_2 < |\beta_2/\beta_1| < \delta_1 + \delta_2$, and in a high range when $\delta_1 + \delta_2 < |\beta_2/\beta_1|$. Cash holdings are in a low range when $CASH < -\tau_1/\tau_3$ and in a high range when $CASH > -\tau_1/\tau_3$. The propositions suggest that, for a given level of cash holdings, the impact of leverage on manufactures' pricing and promotion decisions depends on the demand sensitivities to promotion and price as well as promotion costs. As varying price and/or promotion frequency can impact revenues and profits differently upon

[16] The proofs of the lemma and propositions are provided in the online supplementary material.

the demand sensitivity and promotion costs, the firms may either increase or decrease price and promotions to meet their strategic orientation goals.

We next consider Propositions 1 and 2 in our empirical context. Recall that the estimation results indicate that firms with low (high) cash holdings tend to be more profit-oriented (revenue-oriented) when leverage increases, as hypothesized in H1 and H2. In addition, our data exhibit a low promotion-price demand sensitivity ratio, i.e., $|\beta_2/\beta_1| < \delta_2(|1.545 \times 10^6 / -1.584 \times 10^6| < \exp(831))$. The propositions suggest that, in this market condition, manufacturers with low cash holdings (i.e., $CASH < -\tau_1/\tau_3 = 33.220/192.658 = .172$) implement their profit-oriented strategy by increasing the wholesale price and decreasing the promotion frequency. In comparison, manufacturers with high cash holdings (i.e., $CASH > .172$) implement their revenue-oriented strategy by decreasing the wholesale price and increasing the promotion frequency.

To empirically demonstrate these results, we simulate manufacturers' wholesale price and promotion frequency with different levels of leverage and cash holdings. Specifically, we plug the parameter estimates into Eqs. (1), (8), (9), and (13), and assume that other exogenous variables in the equations take their average value. Then we solve the system of equations to obtain the wholesale price and promotion frequency for different values of *LVRG* (ranging from 0 to 1) and *CASH* (taking a low level of 0.005 or a high level of 0.225, which corresponds to the 5th and 95th percentile values, respectively). Fig. 2 depicts the simulation results. The first two charts in the top panel show the impact of leverage on the wholesale price and promotion frequency, respectively, when a manufacturer has a low level of cash holdings. The remaining two charts in the bottom panel depict the results for the case of high cash holdings. As expected, the simulated patterns of price and promotions shown in the figure are consistent with the analytical results derived in Propositions 1 and 2.

6. Discussion and implications

While corporate liquidity has been shown to affect firms' strategic and operational behavior (e.g., Almeida et al., 2011; Brown & Petersen, 2011; Klasa et al., 2009), limited research has examined the impact of liquidity on marketing actions. In this research, we investigated how the two main determinants of liquidity—leverage and cash holdings—affects firms' strategic orientation and ensuing tactical marketing mix decisions on pricing and promotions. To this end, we developed a structural model that allows a firm's strategic orientation to shift between profit and revenue maximizations, depending on the level of leverage and cash holdings. The model then relates the firm's market strategy to the pricing and promotion decisions through which its strategic orientation is operationalized.

We apply our model to cross-category panel data on 92 firms' financial structure, and their sales, prices, and promotions for 9,111 UPCs sold at 100 retail stores in the Chicago metropolitan area over 400 weeks. Our results show that leverage affects manufacturers' market strategy and the effect is moderated by the level of cash holdings.

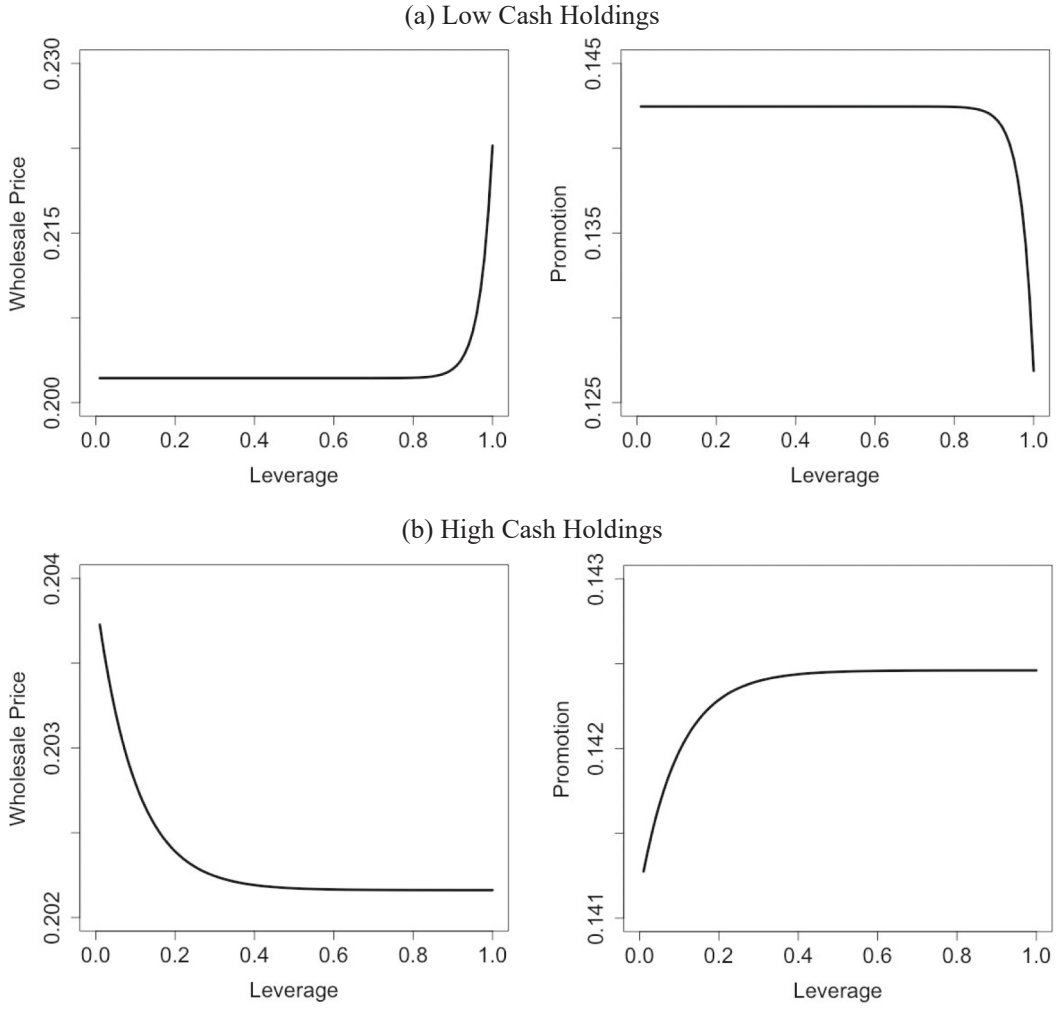

Fig. 2. The Impact of Leverage on Pricing and Promotion Decisions.

Specifically, we find that the increase of leverage leads firms to be more profit-oriented when their cash holdings are low. However, when cash holdings are high, firms tend to be more revenue-oriented as leverage increases. Regarding the impact of the financial variables on firms' pricing and promotion decisions, we provide analytical results that show how the impacts of leverage and cash holdings on the optimal price and promotion levels vary depending on the sensitivity of demand to the marketing instruments and their costs.

Our research makes several important contributions to the literature. First, our results help reconcile the two contrasting prior findings in the economics and finance literatures about the impact of leverage on firm strategy; some studies suggested that firms become more revenue-oriented as leverage increases (e.g., Brander & Lewis, 1986), while others argued that firms become more profit-oriented with higher leverage (e.g., Chevalier & Scharfstein, 1996). Our analysis shows that both can happen, depending on the level of firms' cash holdings. Along this line, our research provides a broader perspective than the prior studies in the marketing-finance literature that have focused on either leverage (e.g., Malshe & Agarwal, 2015) or cash availability (e.g., Bendig et al., 2018; Kurt & Hulland, 2013). We show that both components of liquidity need to be considered to capture their full and joint impacts on firms' market strategies and their implementation through the marketing mix decisions. Second, while previous studies have found that leverage can impact firm behavior and strategies (e.g., Kurt & Hulland, 2013; Malshe & Agarwal, 2015), these studies examined the outcomes at the macro level (e.g., overall marketing spending), not at the tactical marketing level. We show that changes in liquidity also impact the pricing and promotion decisions, complementing the literature on the marketing-finance interface. Third, we answer the calls for incorporating multiple goals (e.g., Hanssens & Pauwels, 2016) in examining firm behavior and addressing where marketing strategy goals come from (e.g., Morgan, Whitler, Feng, & Chari, 2019). Our analysis and findings explicate how firms' financial liquidity policies affect their relative focus on two major goals—profit and revenue maximizations. Managerially, our results suggest that CMOs and CFOs should not operate in isolation from each other. Rather, it is important to establish a strong coordination between them (Fischer & Himme, 2017). For example, when a low-cash firm's leverage increases, the firm may emphasize short-term profitability, as shown in our analysis. This however can result in the firm missing a high growth opportunity. Oftentimes, CMOs have a solid understanding of market trends and know when to be opportunistic and aggressively increase market shares toward a goal of long-term profitability. As such, firms can benefit by encouraging CFOs to communicate with CMOs before making decisions on the planned liquidity levels for upcoming periods.

Given that our findings pertain to manufacturers of CPG sold at retail stores in the Chicago metropolitan market area, it is worth discussing how generalizable our results are. Clearly, one would need national sales and marketing data across all distribution outlets of the manufacturers to really generalize our findings.[17] It is also important to note that, without replicating the results across different types of firms, one must be cautious about broad generalizations. For example, high-tech start-ups often do not hold enough cash and have a high level of debt. Still, many of them are focused on increasing market shares and revenues at the cost of lower profits in the short term. On the other hand, firms that are about to go for IPO can be more focused on profitability to convince investors of the sustainability of the business. Therefore, we speculate that our findings are more likely to hold for established public firms in traditional industries like CPG manufacturers in our empirical context. As discussed earlier, Amountzias (2020) analyzed data from the UK wholesale and retail food, beverage, and tobacco sectors between 2007 and 2016. He measured liquidity using the ratio of the current assets to the current liability. Notably, therefore, the research considered the impact of cash holdings (and other short-term assets), but not the impact of leverage. His analysis revealed that firms with high liquidity charged lower prices. This finding is in line with our result regarding cash holdings that, all else being equal, firms with higher cash holdings target higher revenues (i.e., a negative estimate of $\tau_2 + \tau_3 \times LVRG$ in Eq. (5) for firms with average leverage), providing support for the possibility that our findings can hold in more recent times.

To further explore the generalizability of our findings, we next discuss two important trends in the business environment over the last decades—the increasing importance of customer experience and a significant increase in firms' cash holdings and use of credit lines—and how they may impact our results.

Importance of customer experience. In retail markets, consumers' in-store shopping experience has become increasingly important as a driver of satisfaction and purchase decisions (Reinartz, Wiegand, & Imschloss, 2019). Consumers are now relatively less influenced by price and promotions and more affected by products assortment, quality, and interaction with store staff (Terblanche, 2018). This means that the elasticity of demand to the price and promotion levers investigated in our research could be lower in the current environment, suggesting that if manufacturers' goal is to maximize revenues, they may have to find other marketing levers to increase sales. In our analysis, this trend would result in a smaller magnitude of the coefficients β_1 and β_2 of the demand model and hence a different value of the promotion-price demand sensitivity ratio (i.e., $|\beta_2/\beta_1|$) defined in Propositions 1 and 2. With the changes, as shown in the propositions, the impacts of leverage and cash holdings on manufactures' price and promotions would vary and the direction of the impacts depends on the relative magnitude of β_1 and β_2 as they jointly determine the promotion-price demand sensitivity ratio.

Higher cash holdings and use of credit lines of firms. The finance literature has reported that firms now hold much more cash (e.g., Almeida et al., 2014, Pinkowitz, Stulz, & Williamson, 2016) and increasingly use credit lines to provide short-term funds (Demiroglu & James, 2011). Specifically, Almeida et al. (2014) report that the total cash holdings of S&P 500 non-financial firms have jumped about 600% from $200B to $1,334B between 1996 and 2012. They also report that firms with low credit lines tend to hold much more cash. Our findings point to the interaction between leverage and cash holdings. We find that firms with low cash will tend to focus on profits as leverage increases. In the current environment, this finding would hold for firms that have no or very limited credit lines. We conjecture that firms with high credit lines, which prefer not to hold cash on hand but get funds from the unused credit lines, would act more like firms with high cash holdings and accordingly they are likely to focus on increasing revenues and market shares as their leverage increases.

7. Future research

Several limitations should be acknowledged and perhaps addressed in future research. First, as our research focuses on investigating the impact of a firm's liquidity on its market strategy and marketing mix decisions, we do not explicitly model competitive interactions between firms within the same product categories while our demand model considers the price and promotion levels averaged across the competitors. Future work may extend our research to incorporate the competitive behavior in a game theoretic framework. Second, our research does not consider firms' forward-looking behavior to maximize their profits in the long term. While the long-term profit maximization is theoretically desirable, it has been reported that managers often make myopic decisions for various reasons, including short-term based incentive structure and pressure from shareholders (e.g., Coughlan & Joseph,

[17] We calculated the correlation between manufacturers' quarterly sales aggregated in the Dominick's database and the firms' quarterly sales reported in their financial statements. We found that the two variables are highly correlated with a correlation coefficient of 0.79. We also believe that it is not very unreasonable to assume that, on a quarterly basis, a manufacturer implemented similar overall pricing and promotion strategies nationwide.

2012; Narayanan, 1985). Yet, it would be fruitful to incorporate the possibility of firms' forward-looking behavior into our model and analysis. Third, our data on retail promotions do not contain information about the benefit of coupons offered and the magnitude of a price reduction or discount. The data also do not include information on brand advertising. Upon the availability of such information, future research can examine how liquidity and other financial variables may affect firms' resource allocation across different types of marketing activities. We hope that this study helps generate continued interest of researchers in the marketing-finance interface and enhanced coordination between CMOs and CFOs.

CRediT authorship contribution statement

Manoj K. Agarwal: Conceptualization, Methodology, Investigation, Writing – original draft. **Zecong Ma:** Conceptualization, Methodology, Formal analysis, Investigation, Writing – original draft. **Chang Hee Park:** Conceptualization, Methodology, Investigation, Writing – original draft. **Yilong Zheng:** Conceptualization, Investigation, Writing – original draft.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jbusres.2022.01.022.

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