

**When Life Gives You Lemons: Competition, Diversification, and Firm Resilience**

Retail scanner evidence from the Great Recession and COVID-19 pandemic

by

Gretchen Marie Gamrat

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Dissertation Committee:

John Chalmers, Chair

Brandon Julio, Core Member

Youchang Wu, Core Member

Van Kolpin, Institutional Representative

University of Oregon

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## **DISSERTATION ABSTRACT**

Gretchen Marie Gamrat

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Title: When Life Gives You Lemons: Competition, Diversification, and Firm Resilience

This study explores how product market competition and diversification relate to private and public firm resilience. Using retail scanner data, I construct firm-level measures of competition and product diversification closer to the product level and leverage the 2008 financial crisis and COVID-19 pandemic as sources of plausibly exogenous variation. Private firms tend to be smaller, less diversified, face greater competition and have greater revenue growth volatility. During the 2008 financial crisis and COVID-19 pandemic, higher market competition is significantly correlated with reduced revenue growth and revenue growth volatility. More diversified public and private firms experience reduced revenue growth volatility in non-crisis periods. However, diversification's risk reduction capabilities significantly weaken during the COVID-19 pandemic.

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## CHAPTER I: INTRODUCTION

Firm performance and risk depend, in part, on the product portfolio and the ongoing product selection process. The products themselves influence organizational structure and supply networks. A firm's products determine the markets in which a firm operates and, by extension, the degree of competition faced. In this paper, I ask how market competition and product diversification affect firm resilience during market crises. I focus on crisis periods, specifically the 2008 financial crisis and COVID-19 pandemic, because they present substantial challenges to business operations and are plausibly exogenous, which provides a good setting for testing firm resilience.

Understanding how firms perform during market crises is central to the study of risk management and the broader finance discipline. Firm resilience has captured the attention of industry professionals, media outlets, and academic researchers alike. Large firms devote entire teams to risk management consulting,<sup>1</sup> but what determines firm resilience remains an open question. Media outlets attribute resilience to an array of firm characteristics, including adaptability, liquidity, and serving a higher purpose.<sup>2</sup> In the academic literature, resilience has been tied to leverage, agency theory, and firm reputation, among others.<sup>3</sup> I aim to add to this literature by documenting how product portfolios and market competition affect firm resilience as well as developing new approaches to measuring product diversification and competition.

I use retail scanner data, which include weekly product prices and units sold, to analyze how competition and diversification relate to firm performance through a bottom-up approach. The relevance of a micro-level perspective is highlighted by Hoberg and Phillips's (2022) claims that the majority of recent firm growth occurs within existing operating segments and reliance on historical industry classifications may lead to overstating industry concentration ratios. The existing literature primarily uses Census- and

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<sup>1</sup>KPMG, McKinsey & Company, Ernst & Young, and PwC

<sup>2</sup>Baluch (2023), Dooley and Ueno (2020), and Monson (2020)

<sup>3</sup>See Acharya and Steffen (2020), Almeida et al. (2009), Chevalier (1995), Erkens et al. (2012), Fresard (2010), Kovenock and Phillips (1995), and Lins et al. (2013, 2017)

Compustat-based measures of competition, which may not capture all business segments of a firm. Moreover, empirical evidence is mixed about whether and how competition relates to firm performance.<sup>4</sup> In this study, I investigate how market competition, product diversification, and firm resilience are related.

The retail scanner data, which cover over 50% of food and drug sales and over 30% of mass merchandise sales<sup>5</sup> in the United States from 2006 through 2020, allow direct observation of competitors, products, and performance. Products are classified in groups similar to aisles of a store and linked to parent companies, resulting in a sample of roughly 1,330 private firms and 85 public firms selling goods after filtering. Direct observation of competitors in product markets allows for concentration-based measures of market competition and product diversification closer to the product level.

I measure competition at the level of a store “aisle.” In this context, candy, coffee, and snack foods aisles represent product markets. In each aisle, I estimate competitiveness using a Herfindahl–Hirschman Index, which captures the concentration of market shares across competitors. An aisle with a large number of competitors with similar market shares is considered competitive while an aisle with a few firms generating the majority of revenue is considered more concentrated. Using these aisle concentrations, I create a firm-level competition measure by averaging across each aisle in which a firm generates revenue, weighted by the percentage of total firm revenue from each aisle. The resulting competition metric can be interpreted as the weighted average level of competition faced by a firm in its product markets. Similarly, product diversification estimates the concentration of firm revenue across its aisles. While competition and diversification are partially endogenous to the firm, I take firms as given and leverage crisis period variation to better isolate the connection between competition, diversification, and resilience. I consider resilience the degree to which firm performance is affected by a negative shock. Performance is a relatively broad term so I group performance measures into “internal” and “external” areas. Internal measures reflect firm-controlled decisions, such as product introductions and pricing behavior. External measures are not wholly determined

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<sup>4</sup>See Ali et al. (2008), Bustamante and Donangelo (2017), and Hou and Robinson (2006).

<sup>5</sup>Estimates based on the 2018 Retail Scanner Dataset Manual.

by the firm itself, like revenue growth and realized returns.

To study the interconnectivity of competition, diversification, and resilience, I use double-sorted portfolios and a regression-based analysis. First, I sort firms into portfolios based on “high” or “low” competition and diversification, resulting in four portfolios. I observe cross-sectional variation in the difference between pre-crisis and crisis period portfolio performance. Second, I use a regression-based analysis to further isolate the effect of competition and diversification on firm resilience. I estimate how firm performance relates to competition and diversification, including controls for other firm characteristics such as size and age. Measures of competition and diversification are interacted with indicator variables for the 2008 financial crisis and COVID-19 pandemic. The additional stress introduced by market crises is likely to magnify the underlying relation between competition, diversification, and firm resilience.

My primary analysis uncovers a complex and, at times, unexpected relation between competition, diversification, and resilience. Within internal performance measures, product introduction rates tend to be positively correlated with product diversification levels. While this connection remains statistically unchanged during the 2008 financial crisis and COVID-19 pandemic for public firms, high product diversification has an additional positive impact on product introduction rates for private firms during the 2008 financial crisis and a weakened impact during the COVID-19 pandemic. Consistent with Bertrand competition, firms facing high market competition have reduced estimated product markups and profit margins during non-crisis periods. For private firms, this effect becomes less pronounced during market downturns.

Generally, market competition is not significantly correlated with revenue growth and return volatility during non-crisis periods. However, during the 2008 financial crisis and COVID-19 pandemic, more intense competition is associated with reduced revenue growth and revenue growth volatility for private and public firms when examining the combined non-crisis and crisis period coefficients. Realized stock returns display a weak negative correlation with market competition during COVID-19 but lack a significant relation during non-crisis periods or the Great Recession. Market competition exhibits a positive relation to return volatility

during the Great Recession but not during the pandemic.

Greater product diversification is associated with reduced revenue growth volatility during non-crisis periods, which aligns with the literature on diversification's risk reduction properties (Mansi & Reeb, 2002; Markowitz, 1952; Servaes, 1996). The impact of diversification on revenue growth volatility lessens for private and public firms during the pandemic. Because COVID-19 caused significant supply chain disruptions,<sup>6</sup> I hypothesize this result is due to the increased difficulty of managing the more complex supply networks of diversified firms.

The results in the main analysis suggest a nuanced connection between competition, diversification, and resilience. To summarize the stylized facts, how competition and diversification relate to firm resilience differs across crises. Firm-controlled decisions such as product portfolio changes and pricing behavior are generally more affected by competition and diversification during non-crisis periods while measures of performance not entirely controlled by the firm such as revenue growth and realized returns tend to be more impacted during crisis periods. These connections also differ in magnitude between private and public firms. The negative association of market competition and revenue growth for both private and public firms during crisis periods offers support to the negative relation between competition and returns presented by Bustamante and Donangelo (2017). Additionally, the significant relations of market competition and product diversification to realized return volatility during the Great Recession lends credibility to the explanatory power of retail scanner measures beyond the scope of the NielsenIQ data. While diversified firms are generally less risky, diversification's risk-reduction capabilities are significantly weaker during the COVID-19 pandemic. Due to the endogeneity of competition, diversification, and resilience, I aim to provide a descriptive understanding and use firm performance during market crises to measure resilience. Nevertheless, causality should be inferred with caution.

A secondary analysis is included showing how results differ with alternative measures of competition

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<sup>6</sup>Shih (2020)

and diversification. My findings are sensitive to variations in measurement definitions, which highlights the need for careful consideration when attempting to quantify competition and diversification. Further, I use a matched sample of public and private firms using Mahalanobis distance to identify any cross-sectional differences in resilience due to listing status. Within the matched sample, I observe limited evidence that being publicly listed substantially affects firm resilience.

This study contributes to the literature in two ways. First, it introduces a firm-specific measure of competition that includes both public and private firms. The granularity of the data also enables flexible definitions of a firm’s “industry,” based on their product portfolio. Second, the majority of diversification work relies on segment reporting or textual analysis to estimate diversification. Through direct observation of product portfolios, I construct a bottom-up measure of diversification. This allows for within-segment variation in diversification, an increasingly relevant consideration as recent firm growth predominantly occurs within existing segments.<sup>7</sup>

The remainder of the paper is organized as follows. Section II reviews related work. Section III details data sources and introduces competition and diversification measures. Section III also documents revenue adjustment methods, firm performance measures, and summary statistics. In section IV, I discuss research design and findings using double-sorted portfolios. Section V focuses on regression analysis methods and results. In section VI, I explore alternative definitions of competition and diversification. Section VII constructs and analyzes a matched sample of public and private firms to identify variations due to listing status. Section VIII concludes.

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<sup>7</sup>Hoberg and Phillips (2022)

## **CHAPTER II: RELATED LITERATURE**

This section delves into the existing body of research, situating this study within the broader context of firm resilience, product market competition, and firm diversification.

### **II.I FIRM RESILIENCE**

For the sake of this paper, resilience refers to the degree to which firm performance is affected by a negative exogenous shock. Two shocks are considered, the Great Recession and COVID-19, which differ in causes and economic impact. Prior to the crisis, financial institutions were using innovative new financing methods, such as subprime mortgages and mortgage-backed securities, to extend loans to borrowers who may not have otherwise qualified for a mortgage. The 2008 financial crisis occurred primarily due to the collapse of a housing bubble, which reduced the underlying asset value of these securities. Availability of credit and investor confidence declined. The US federal government enacted new regulatory measures, most notably the Dodd-Frank Act, and provided bailouts to financial institutions and large corporations. Mian et al. (2013) show that declining house prices, which are typically a large component of household wealth, resulted in reductions to consumption. The COVID-19 pandemic directly impacted global health and regulatory efforts to limit its spread, such as lock downs and travel restrictions, disrupted supply chains and production levels. In some industries, production activity was further reduced by work-from-home ordinances. Certain areas such as travel and hospitality were affected more than others like online retail. The monetary component of the U.S. government response included stimulus checks to bolster household income and loans to small businesses. Studying both crises presents an exciting opportunity to observe how sources of resilience vary by crisis.

Existing work documents a wide array of potential determinants of firm resilience, including both financial and reputational factors. During the 2008 financial crisis, Almeida et al. (2009) find that firms with a

high proportion of debt maturing during the crisis performed worse than peers. Using survey data to assess the impact of firm financial constraints on financial plans, Campello et al. (2010) observe that credit constrained firms plan to cut investment levels, even halting existing profitable projects. Lins et al. (2013) note more severe investment cuts in family-controlled firms during crisis, which they argue leads to significant underperformance during the 2008 financial crisis. They attribute this to a desire to safeguard the familial enterprise and wealth. Firms that had strong social capital, proxied by corporate social responsibility activity, had higher stock returns (Lins et al., 2017). Shen et al. (2018) assess a sample of 4,000 private Chinese firms during the 2008 financial crisis and observe higher profits and sales volume among diversified firms. Firms with greater board independence and institutional ownership also underperformed peers (Erkens et al., 2012). In emerging markets, the composition of cross-border cash flows (foreign direct investment versus other international investment types) influences the severity of the credit crunch (Tong & Wei, 2011).

The importance of reputation to resilience became more pronounced during the pandemic. Recent work on the COVID-19 pandemic reveals milder stock return declines for firms with higher ES ratings (Albuquerque et al., 2020), elevated employee satisfaction (Shan & Tang, 2020), and stronger worker and supply chain protections (Cheema-Fox et al., 2021). With the decreased ability to work in person, firms with greater work-from-home feasibility generally performed better (Bai et al., 2021). From a financing perspective, substantial cash holdings (Ramelli & Wagner, 2020), greater financial flexibility (Fahlenbrach et al., 2021), and robust balance sheets (Ding et al., 2021) were also associated with less negative stock return responses to COVID-19. Firms with higher credit ratings returned to capital markets more quickly than low-rated investment grade firms (Acharya & Steffen, 2020).

Though the Great Recession and COVID-19 pandemic have been extensively analyzed, research on resilience extends to other shocks as well. For example, Opler and Titman (1994) find that firms with high debt levels lose market share to competitors during industry downturns. Danes et al. (2007) examine family firms following natural disasters and argue that a businesses owner's gender, in combination with federal

disaster assistance, influences resilience.

## **II.II COMPETITION**

The relation between competition and the firm is complex, with both positive and negative aspects. To organize the related literature, papers are loosely grouped into four categories: capital structure, agency theory, firm risk, and firm performance.

### **II.II.I Capital structure**

Early theory studying the connection between capital structure and product market behavior generally fall into “output and limited liability” and “deep purse” categories. Output and limited liability models and deep purse models are two sides of the same coin. In each, firm leverage influences the optimal level of output. Output and liability models show the incentive of the levered firm to increase output, while deep purse models show the incentive of the levered firm’s rival to increase output.

In output and limited liability models, the managers are the stockholders. Brander and Lewis (1986) model the link between output decisions and leverage. High leverage incentivizes firms to choose output strategies that increase returns in good states and reduce returns in bad states because the increased variance benefits the shareholders. Increases to debt lead to increased production output. Rivals can anticipate this, ultimately ending in both firms increasing debt and output, which lowers aggregate industry profits. This effect remains when extended to a multi-period model (Maksimovic, 1988).

Benoit (1984) develops a model under which monopolists attempt to drive out financially constrained entrants with price wars. The monopolist accepts losses for a time, eventually driving out the new entrant or abandoning the effort. In their model of a duopoly market, Brander and Lewis (1988) suggest that a firm benefits from the bankruptcy of its rival through the rival’s temporary or permanent exit from the market. To increase the probability of a rival’s exit, a firm may opt to increase output, leading to reduced product prices

and rival's revenue. If firm financing is dependent on prior period performance, rivals can prey upon the levered firm to increase the probability of firm exit (Bolton & Scharfstein, 1990). This could take multiple forms, including price reductions or increased advertising.

Empirical evidence seems to suggest that highly levered firms are weaker competitors. Phillips (1995) analyzes four industries in which firms had substantially increased leverage. In three of the four industries, firms that increase leverage either lose market share or fail to gain market share when a rival exits. In the supermarket industry, rivals are more likely to enter a market in which an incumbent firm was the target of a leveraged buyout (Chevalier, 1995). In concentrated markets, highly levered firms are more likely to close plants and less likely to invest (Kovenock & Phillips, 1997). Rivals are less likely to close plants when facing a greater market share of highly levered firms. While excessive debt may lead to losses of market share, moderate debt use correlates with market share gains (Campello, 2006).

### **II.II.II Agency theory**

Public firms are generally more exposed to agency costs through the separation of ownership and control. Agency theory models suggest that competition aids owners in extracting more information about managerial performance and incentivizes greater managerial effort (Holmstrom, 1982; Nalebuff & Stiglitz, 1983). Production cost correlations between competing firms may also lead to the interdependence of product prices, thereby limiting the maximum managerial slack possible (Hart, 1983). Gathering accurate information becomes more costly when managers derive additional utility from additional compensation and aim for maximum compensation for minimum effort (D. Scharfstein, 1988). Giroud and Mueller (2010) present empirical evidence supporting the view of competition as a disciplining force, showing that good governance has a greater effect on firms in less competitive environments.

In a Cournot Principal-Agent model, owners should aim to balance the marginal cost of inducing greater managerial effort with the marginal payoff of increases to efficiency. When more firms are present in the

market, the marginal payoff of increased efficiency decreases (Martin, 1993). Schmidt (1997) proposes two opposing channels through which competition directly affects managerial effort. First, firms facing more intense competition have a greater probability of liquidation, which may induce greater managerial effort. Second, the reduced profitability in competitive industries makes high managerial effort less attractive. He argues that this creates a non-linear relation between competition and effort. Managerial effort increases with competition but starts to decrease when competition becomes too intense.

### **II.II.III Risk**

Competition has been linked to both increased systematic and idiosyncratic risk, to varying degrees. Subrahmanyam and Thomadakis (1980) model how systematic risk is associated with a firm's demand and production variables under varying degrees of monopoly power. They conclude that firms with lower monopoly power (in more competitive markets) will have higher betas. This hypothesis is supported by empirical evidence from Moyer and Chatfield (1983), which analyzes the impact of market power and industry concentration on beta. While individual firm market power is only weakly related to firm risk, industry concentration is strongly negatively associated with the level of market risk faced by firms within that industry. Bernier (1987) revisits the relation of firm-level market power and systematic risk with a new measure of market power: Tobin's  $q$ . He observes a negative relation between market power and beta in earlier years of his sample but does not find a significant relation in the later years.

Gaspar and Massa (2006) propose two channels (market power and uncertainty) through which competition may affect idiosyncratic volatility and find support for both. Overall, firms with greater market power or in more concentrated industries experience reduced idiosyncratic volatility. In a cross-country analysis, Irvine and Pontiff (2009) document intense competition is associated with greater cash flow volatility and greater idiosyncratic stock return volatility. Using a Fama-French three-factor model, Abdoh and Varela (2017) decompose risk into its idiosyncratic and systematic components. After controlling for other rele-

vant factors, they find that increased competition is associated with increased idiosyncratic risk. Further, idiosyncratic volatility increases significantly more than systematic volatility does following industry tariff reductions. Loan spreads are, on average, about 9.5% greater for firms in competitive environments, suggesting that banks consider the increased risk from borrowers' product market competition (Valta, 2012). Possible channels for the increased cost of debt include greater default likelihood for firms in competitive markets and the threat of aggressive competitive behavior by rivals.

#### **II.II.IV Firm performance**

This study is most closely linked to the body of work connecting competition to firm performance. Competition is known to be associated with various elements of firm performance. Among manufacturing firms, increased competition is associated with larger increases in total factor productivity (Nickell, 1996). Matsa (2011) studies the response of supermarkets to the entry of a local Wal-Mart by measuring stockouts as a proxy for product quality. Following the increase in competition, stockouts decreased, implying improved customer experience and quality. Gu (2016) models innovation races between competitors through the decision to continue or scrap a multi-stage research and development (R&D) project in the face of competition. She hypothesizes that the interaction of R&D and competition should have a positive impact on expected returns and finds supporting empirical evidence using a double-sorting approach.

How competition affects performance on an overall firm performance level is still a contentious issue. Hou and Robinson (2006) is the first paper to connect product market competition and stock returns, with the justification that product markets generate the risky cash flows which are priced in financial markets. They estimate the level of industry competition using a Compustat-based concentration measure and find that firms in more competitive industries earn higher returns. The limitations of Compustat-based competition measures are highlighted by Ali et al. (2008). Compustat competition measures are unable to include private firms. Census-based competition measures, which do include private firms, have a correlation of 13% with

Compustat-based competition measures. When the relation between competition and stock returns was re-estimated with Census-based competition measures, the relation was not statistically significant.

Bustamante and Donangelo (2017) revisit the question of how competition and stock returns are related. They propose channels through which competition could affect return performance, centered around reduced markups in competitive markups and the potential impact of entry. Their focus is primarily how *expected* returns differ due to competition levels. To measure competition, they use Compustat but adjust for the probability of observing a public firm in a given market. They find evidence of a negative relation between competition and returns. However, a later study notes that reliance on historical industry classifications, which may not capture all operating segments of a firm, may lead to overstating industry concentration ratios (Hoberg & Phillips, 2022).

Eisdorfer et al. (2022) develop a novel means to measuring competition. Rather than relying on existing industry measures, they analyze the frequency with which a firm is mentioned in the 10-K competition section of other firms. A highly mentioned firm generates abnormal returns of “up to 9% annually” and experiences improvements in total sales growth. This approach is particularly interesting because it measures the competitiveness of a firm, rather than that of an industry.

### **II.III DIVERSIFICATION**

While diversification is often thought of as a risk management tool in portfolio theory (Markowitz, 1952), in this context, diversification refers to the degree of firm focus. Diversification is generally considered endogenous, a result of unobservable variables over time. The literature tends to center on the existence, magnitude, and causes of the diversification discount as well as motivations for diversification.

The diversification discount refers to the alleged value lost through firm diversification. LeBaron and Speidell (1987) use a “chop shop” methodology, comparing the total value of a firm to the sum of its segment values. The estimated aggregate value of segments is greater than the observed firm value. They propose

three potential reasons for this disparity: investor optimism, hidden assets, and agency problems. Berger and Ofek (1995) employ a similar methodology to compare the sum of imputed segment values to total firm value and estimate a diversified firm is valued roughly 15% less than a set of stand-alone firms would be. They argue that the discount is greater when diversification occurs outside of a firm's core business area, meaning unrelated diversification has a stronger negative effect on firm value. Lang and Stulz (1994) use Tobin's  $q$  as a measure of firm value and find a strong negative correlation between diversification and  $q$ . The marginal value loss in  $q$  lessens with each additional degree of diversification, meaning that a firm's initial transition from specialized to diversified produces the greatest value loss. John and Ofek (1995) approach the diversification discount by examining operating performance following asset sales. In general, firms which increase focus by selling assets less related to the firm's specialization experience the greatest increase in performance. Even in the financial services industry, which has significant potential for economies of scope, firms that engage in multiple activities have lower valuations than if they were separated into individual focused firms (Laeven & Levine, 2007).

However, the existence of a diversification discount is not universally accepted. Systematic differences between stand-alone firms and conglomerate segments may decrease the accuracy of chop-shop estimates of firm value. Graham et al. (2002) examine merger and acquisition targets and conclude that targets are often already discounted. Campa and Kedia (2002) argue that the decision to diversify is endogenous and therefore the diversification discount reflects unobservable firm characteristics that lead to diversification. After controlling for the endogeneity of the choice to diversify, the discount is smaller and, at times, a diversification premium. Defining business segments using census data instead of segment data produces a diversification premium (Villalonga, 2004). Lamont and Polk (2001) claim that the observed differences in value are due to the value effect and that discounted firms have higher expected returns. The diversification discount also becomes insignificant when accounting for the increased value of debt thanks to decreased risk (Mansi & Reeb, 2002).

Additional work studies the presence and magnitude of the discount in international markets. Differences in legal environments, cross-border trade, credit availability, and production types may affect the value loss (if any) associated with diversification. Fauver et al. (2004) find industrial diversification reduces firm value in the U.K. and U.S., but has no effect on firm value in Germany. Lins and Servaes (1999) also find no evidence of a diversification discount in Germany but observe discounts of 10% and 15% in Japan and the U.K. respectively. Lins and Servaes (2002) study seven emerging markets and document a discount of about 7% compared to stand-alone firms, a portion of which is due to reduced profitability of diversified firms. T. Khanna and Palepu (2000) focus on Indian firms and diversification, after a certain level, increases performance.

Assuming the diversification discount exists, what causes the value destruction? Existing work primarily focuses on two channels through which diversification reduces firm value. First, there is a strain of literature suggesting that diversification is both a contributing cause and a symptom of agency problems. As firms diversify, managers may extract some private benefit, such as increased entrenchment, new growth opportunities, or lowered firm-specific risk within personal wealth. (Aggarwal & Samwick, 2003; Amihud & Lev, 1981; Hyland & Diltz, 2002; Morck et al., 1990). Diversification also creates internal capital markets which may help all value-increasing projects to be accepted. Stein (1997) argues that credit-constrained firms benefit from diversification through “winner picking”, the ability to shift resources across multiple projects. However, the benefit of internal capital markets can be offset by conflicting aims across managers. D. S. Scharfstein and Stein (2000) model how division managers are likely to engage in rent-seeking behavior to improve wages or bargaining power within the firm, preferring projects that are best for their own segment over those projects that benefit the firm as a whole.

Second, other works connect diversification with inefficient investment and reduced productivity. Less focused firms have lower productivity, including research productivity (Argente et al., 2020; Dittmar & Shivdasani, 2003; John & Ofek, 1995; Ozbas & Scharfstein, 2009; Seru, 2014; Teece, 1980). Rent-seeking

behaviors by division managers can lead to the subsidization of underperforming segments and increased wages due to cross-division spillovers (Duchin et al., 2017; Lamont, 1997; Rajan et al., 2000). When firms re-focus with either divestitures or spin-offs, there is generally an improvement in investment efficiency measures (Ahn & Denis, 2004; Burch & Nanda, 2003). Further, Comment and Jarrell (1995) show that firms do not rely on external capital markets any less.

For both potential sources, findings may be a result of measurement error and endogeneity in the choice to diversify or re-focus (Çolak & Whited, 2007). Using plant-level observation, Schoar (2002) finds that diversified firms' plants are more productive than those of stand-alone firms. Chevalier (2000) argues that patterns of investment often attributed to inefficient investment through cross-subsidization in diversified firms are present in the acquiring and target firms prior to the merger. Additionally, N. Khanna and Tice (2001) find no evidence of subsidizing losing departments.

Given the alleged value destruction associated with diversification, the presence of diversified firms in the market implies there must be some expected benefit to diversification. Matsusaka (2001) considers diversification as an ongoing search process through which a firm can find other industries in which its organizational capabilities are profitable. Perold (2005) models diversification among financial intermediaries and argues that diversification reduces the dead-weight costs of capital (e.g., taxes, monitoring, and moral hazard costs), allowing divisions to operate on a larger scale than if they stand-alone firms. Diversified firms may benefit from the correlations across various operating segments. Lewellen (1971) models how the imperfect correlations of cash flows smooth earnings, which leads to increased debt-carrying capacity. Imperfect correlations between division cash flows and investment opportunities allow firms to hold less cash (Duchin, 2010). Diversified firms tend to have less uncertainty about future cash flows and lower analyst forecast dispersion (Hund et al., 2010; Thomas, 2002). Moreover, the adverse-selection problem is smaller among diversified firms. Hadlock et al. (2001) find that equity issues of diversified firms are viewed less negatively than those of focused firms, which supports their hypothesis that diversification reduces infor-

mation asymmetries. When severe information asymmetries limit a firm's ability to raise capital, a merger allows the firm to fund marginally profitable projects that would not be possible otherwise (Fluck & Lynch, 1999).

## CHAPTER III: DATA & MEASURES

### III.I DATA SOURCES

The data and measurement of market competition, product diversification, and firm performance during crisis periods is novel and uses data at the product- and firm-levels. I rely on the NielsenIQ retail scanner database for product data. The scanner data report weekly prices and units sold for products from 2006 through 2020. The data cover roughly 50% of US food and drug sales, and 30% of mass merchandise sales.<sup>8</sup> Products are identified by Universal Product Codes (UPCs), which are unique identifiers assigned to individual products. New UPCs are generated for product variants such as alternative sizes, changes to branding, updated nutrition labelling, new flavors, or seasonal editions. For example, an 8 oz cola, a 12 oz cola, and an 8 oz cherry cola would each have a separate UPC.

Products are categorized in a hierarchy of three increasingly granular tiers: departments, groups, and modules. The ten departments encompass broad categories such as alcoholic beverages, dairy, and health and beauty. I think of each department as a section of a store. Within each department, products are organized into “groups” and “modules,” akin to aisles and shelves within a store. There are 122 product groups and 1,275 modules. For clarity, I refer to product groups as aisles and modules as shelves. Aisles include categories such as carbonated beverages, cereal, and snack foods. Each aisle contains one or more shelves. For example, snack aisle shelves include health bars, popped popcorn, potato chips, corn chips, tortilla chips, and variety packs. I use aisles to identify differentiated product types because I assume substitution across shelves (tortilla chips versus corn chips or tortilla chips versus potato chips) is more frequent than substitution across aisles (snacks versus candy or snacks versus cereal).

Within the NielsenIQ scanner data, products are associated with a brand but not a firm name. To connect products with their respective firms, I use the GS1 database. GS1 is a non-profit organization that maintains

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<sup>8</sup>Data coverage estimates from the 2018 NielsenIQ retail scanner data manual.

barcode standards and a record of UPC ownership. For each product, GS1 provides a company name and address, as reported by the firm that registered the UPC.<sup>9</sup> Names in GS1 are firm-reported, meaning that the name can differ from the firm's legal name and include additional detail or abbreviations (e.g., Pepsi Co North American Snacks Division).

To connect the firm names to identifiers, I search all GS1 reported firm names in the CapitalIQ (CIQ) identifier converter template, which maps the GS1 name to identifiers such as gvkey. The CIQ template matches based on similarity of the searched names to the firm names in the CIQ database. I limit the sample to firms that have at least one calendar year with more than \$1 million in NielsenIQ revenue. The revenue threshold is included to reduce noise from inaccurate matches. Smaller firms that are less likely to be in CapitalIQ are more likely to be assigned to a similarly named but different firm.

Supplementary accounting data from Compustat and stock return data from the Center for Research in Security Prices, LLC (CRSP) is integrated. Foreign exchange data from Yahoo Finance is utilized to convert financial statements to US dollars. Both NielsenIQ and accounting data are adjusted for inflation using estimates from the Bureau of Labor Statistics. As the NielsenIQ retail scanner data do not cover the entirety of firm sales, I use the ratio of NielsenIQ revenue to Compustat sales to estimate the percentage of observed firm revenue. For firms with Compustat data, I require an above-median NielsenIQ revenue-to-Compustat sales ratio. This filter reduces the number of firms with a negligible portion of sales that appear in the NielsenIQ data.<sup>10</sup>

### **III.II COMPETITION AND DIVERSIFICATION MEASURES**

To measure market competition and diversification, I develop new approaches that leverage the NielsenIQ retail scanner data's granularity.

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<sup>9</sup>GS1 has UPC ownership at the time of access. Acquisitions and other ownership changes may result in products being assigned to their eventual owner or previous owner depending on the frequency with which a firm updates its information. UPC ownership was most recently downloaded in March 2023.

<sup>10</sup>For example, some iPhone sales are observed but the revenue is less than 1% of total Apple revenue.

Measuring market competition begins at the aisle level. I refer to each aisle as a “product market” or “market” when discussing competition. A Herfindahl-Hirschman Index (HHI) is employed to quantify market concentration. The HHI reflects the sum of squared market shares for all competitors. I scale the concentration estimate to between 0 and 1 then subtract from 1 to reverse the sign, as shown below. The market share of firm  $i$  in market  $m$  at time  $t$  is denoted as  $s_{i,m,t}$ . This scaled version of HHI is referred to as adjusted market HHI.

$$\text{Adjusted Market HHI}_{m,t} = 1 - \frac{s_{1,m,t}^2 + s_{2,m,t}^2 + \dots + s_{I,m,t}^2}{100^2} \quad (1)$$

The adjusted market HHI captures how competitive a given product market or aisle is, based on how concentrated market shares are across competitors. Values approaching 1 indicate intense competition whereas lower values imply low competition. On average, product markets have an adjusted HHI of about 0.85. Select product markets are shown in Table 1. Gum sales are relatively concentrated with an adjusted HHI of 0.4, while milk is among the most competitive product markets with revenue distributed relatively evenly across firms. The adjusted market HHI is a concentration-based measure of competition and is not monotonically related to the total number of firms in a market.

Connecting competition to firm resilience requires a firm-level competition measure rather than a market-level measure. I define a firm’s product markets as the aisles in which it generates revenue. To aggregate, I construct a weighted average of the adjusted market HHIs, weighted by the share of total firm revenue generated in each aisle ( $\omega_{i,m,t}$ ).

$$\text{Market competition}_{i,t} = \sum_{m=1}^M \omega_{i,m,t} \text{Market HHI}_{m,t} \quad (2)$$

As with market-level concentration, firm-level market competition ranges between 0 and 1, with high

values signalling greater competition. Market competition, unless otherwise specified, is a firm-level estimate of the average competitiveness of a firm's product markets.

I use a similar concentration measure to quantify how revenues are dispersed across a firm's product portfolio. I calculate the share of total firm revenue generated in each product market  $m$ . The product market share of total revenue is denoted by  $s_{m,t}$ . As shown below, I add the squared market shares, scale between 0 and 1, and reverse the sign. Product diversification for firm  $i$  at time  $t$  is bounded between 0 and 1 such that 0 reflects specialization in a singular product type and higher values signify greater diversification. Because the NielsenIQ retail scanner data primarily cover consumer goods, competition and diversification estimates do not necessarily reflect the entire firm.

$$\text{Product diversification}_{i,t} = 1 - \frac{s_{1,t}^2 + s_{2,t}^2 + \dots + s_{M,t}^2}{100^2} \quad (3)$$

As a sanity check, I compare these measures to alternative competition and diversification metrics: number of rivals and number of products. Number of rivals is the average number of competitors a firm faces in its product markets, weighted by aisle revenue. The number of products is the count of unique products sold by a firm. Figure 1 presents the density of competition and diversification measures, based on the first quarter of 2007. The density plots for concentration-based competition and number of rivals show that private firms tend to operate in more competitive markets than their public counterparts. As shown in the plots for diversification and number of products, private firms are typically less diversified.<sup>11</sup>

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<sup>11</sup>The distribution for number of products is shown up to the 95<sup>th</sup> percentile due to large outliers.

### III.III ADJUSTED REVENUE

According to the 2018 retail scanner data manual, the retail scanner data cover about 50% of US food and drug store sales and 30% of mass merchandiser sales.<sup>12</sup> This presents a challenge when measuring market competition and firm diversification. Firm-level market competition relies on average estimated concentrations, weighted by aisle revenue. Differences in coverage across product types may mechanically skew aisle revenues and provide noisier estimates. Compared to the true product portfolio, competition and diversification estimates will reflect lower mass merchandise and greater food and drug sales.

To reduce noise from inaccurate aisle weights, I adjust revenue as shown in equation 4. “Observed revenue” refers to revenue within the NielsenIQ scanner data and “multiplier” is estimated coverage of total US sales, according to the 2018 retail scanner data manual. The resulting “adjusted revenue” approximates what total US revenues would be, assuming the scanner data is a representative sample. The terms “revenue” and “NielsenIQ revenue” exclusively refer to the adjusted revenue, which is used throughout my analysis.

$$\begin{aligned} \text{Observed revenue} &= \text{Multiplier} \times \text{Total revenue} \\ \text{Adjusted revenue} &= \frac{\text{Observed revenue}}{\text{Multiplier}} \end{aligned} \tag{4}$$

### III.IV DEFINING RESILIENCE

The existing resilience literature typically examines investment decisions or stock returns.<sup>13</sup> I study firm resilience using performance metrics I categorize as “internal” or “external.”

Internal measures encompass firm-controlled outcomes such as product portfolio changes and product prices. Changes to the product portfolio include product introductions and discontinuations. Product

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<sup>12</sup>The data also include approximately 1% of liquor store sales. I do not include alcohol sales in the adjustment because I am hesitant to assume 1% of total sales is representative.

<sup>13</sup>See Acharya and Steffen (2020), Almeida et al. (2009), Ding et al. (2021), Erkens et al. (2012), and Lins et al. (2013), among others.

introductions and discontinuations are measured as percentages of the existing product base. Product introductions for a firm are defined as the number of UPCs appearing in the data for the first time at time  $t$  divided by the number of existing products at time  $t - 1$ . Product discontinuations for time  $t$  instead count the number of UPCs that existed at time  $t - 1$  but are not present at time  $t$  divided by total number of products at time  $t - 1$ . The changes to the product base are similar to higher-level investment measures but differ in timing. While capital expenditures or research and development may capture a large set of projects at various life stages, product introductions and discontinuations focus on products that are already developed and ready (or soon to be ready) for distribution.

I approach product pricing decisions through estimated profit margins (\$) and markups (%). In most aisles, a store brand or generic version is sold alongside branded products.<sup>14</sup> I use the average price for a generic product, weighted by units sold, to proxy for the cost of producing a branded product in the same aisle. Within each of a firm's product markets, I subtract the average generic product price from the firm's weighted average product price to estimate the aisle profit margin. Next, the profit margin is divided by the aisle's average generic product price to estimate markups within each aisle. The profit margin and markup per aisle are then aggregated to the firm level, weighted by aisle revenue. There are three underlying assumptions for this approach to be valid. First, the generic version of a product must be comparable to a branded product in the same aisle.<sup>15</sup> Second, the cost of producing a generic product must not differ significantly from that of producing a branded version. Finally, I assume the price of a generic product is equal to or greater than its production costs.<sup>16</sup>

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<sup>14</sup>A subset of aisles do not have store brand or generic product sales during one or more quarters. These aisles include "books and magazines" and "yeast."

<sup>15</sup>Within each aisle, it is possible that certain goods (e.g., an organic, locally sourced snack variety) may not have a generic alternative that meets the same attributes a consumer wants. Most aisles do have generic versions, though the number of available generic options varies. Further, individual store locations may not carry a generic option. While the possible lack of an exact generic alternative is worrying, I am unaware of a preferable approach. Suggestions are appreciated.

<sup>16</sup>Because store brand or generic products are used to proxy for the production costs, estimated markups may appear negative, though this is infrequent. Though store brand products are likely sold for a profit to the manufacturer and retailer, generic products are typically priced roughly 40% lower than branded versions as shown in articles from CNET.com and The Penny Hoarder. The reduced price point is attributed to lower advertising and R&D expenses. Store brand products priced above production cost will still, on average, represent the lowest sale price for a similar product.

External measures of performance are not wholly controlled by the firm. Using NielsenIQ retail scanner data, I consider revenue growth and revenue growth volatility. Revenue growth is the cumulative percent change in revenue from quarter  $t - 1$  to time  $t$ . Revenue growth volatility is the standard deviation of weekly revenue growth over a quarter. For public firms, I include realized returns and return volatility from CRSP.

Studying the relation between market competition, product diversification, and firm resilience is a challenging identification problem. Market choice and product portfolios are not randomly selected. I treat firms as given and leverage the 2008 financial crisis and COVID-19 pandemic as exogenous shocks to test firm resilience. I use portfolio sorts to observe cross-sectional differences and regression-based analysis to test for statistically significant differences in the connection between firm performance, competition, and diversification during crisis periods.

### III.V SUMMARY STATISTICS

The retail scanner data sample runs from 2006 through 2020. Table 2 presents summary statistics of key variables. To ensure the inclusion of a complete calendar year for measuring annual NielsenIQ revenue, the summarized data is from the first quarter of 2007. The table is divided into two panels: Panel A for private firms and Panel B for public firms. Each firm characteristic includes the the mean, standard deviation, 25<sup>th</sup> percentile, median, and 75<sup>th</sup> percentile. This section explores the sample characteristics, including illustrative examples to highlight the granularity of the data.

Annual NielsenIQ revenue is the adjusted firm revenue derived from all its product markets, reported in millions. Note that this revenue is estimated from sales captured in the retail scanner data. This will not include sales at non-participating retail locations, product types not tracked in the retail scanner data (e.g. cars, event tickets, prescription medication), or international and e-commerce revenue.<sup>17</sup> Data are

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<sup>17</sup>COVID-19 presents a (hopefully) unique situation during which consumer reliance on online grocery ordering and delivery services increased. While sales online and directly sent from the online retailer will not appear in the sample, I suspect delivery services such as Instacart are included. While the online platform manages orders, the orders are collected by shoppers and drivers which physically pick up groceries from store locations. Assuming that these items still pass through the standard checkout, these types of online sales are observed as a component of total revenue.

skewed by large observations, causing mean annual revenue and number of products to surpass the 75<sup>th</sup> percentile. For instance, S.C. Johnson & Son, a private firm, generated approximately 3.1 billion in revenue. Among the public firms, Procter & Gamble garnered sales revenue of about 25 billion. On the lower end of the spectrum, Table Bluff Brewing Inc., a private brewery located in Eureka, California, earned roughly 1.4 million while Willamette Valley Vineyards, a public winery in Oregon, generated about 3.7 million.<sup>18</sup> Notably, there is a substantial difference in public and private firm revenue with public firms tending to generating about 15 times the revenue of their private counterparts. Figure 2 plots median log NielsenIQ revenue of public and private firms and marks the 25<sup>th</sup> and 75<sup>th</sup> percentiles with dotted lines. The 2008 financial crisis and COVID-19 crisis are highlighted in grey.

The retail scanner data has a data anomaly in 2017, highlighted in yellow.<sup>19</sup> Additional retail locations were added to the retail scanner data in 2018. When coupled with reduced 2017 revenue, the first quarter of 2018 shows a misleading increase in product introductions and revenue. Affected observations are excluded from the analysis. Due to the substantial difference in revenue levels and unobservable firm characteristics, I analyze public and private firms separately. A later analysis on a matched sample of public and private firms is presented in section VII.

Median quarterly revenue growth is comparable for public and private firms. However, the distribution of revenue growth is wider for private firms than public firms. Private firms exhibit an interquartile range from -8.85% to 17.34%, whereas public firms show a narrower range between -6.56% to 10.42%. Private firms, on average, experienced higher revenue growth volatility. Average product prices, estimated profit margins, and estimated markups are greater for private firms than their public counterparts. Some of the highest estimated markups were observed for firms selling kitchen gadgets, baby needs, and photographic supplies, while some of the lowest estimated markups belonged to firms specializing in milk and paper

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<sup>18</sup>The sample is restricted to firms with at least one year with revenue greater than 1 million. Example firms reflect only those within the sample, not the entire NielsenIQ universe.

<sup>19</sup>Differences in data collection across calendar years resulted in changes to sample coverage. Updated scanner data was released and implemented to improve coverage but revenues remain inconsistent with prior years.

products.

In general, private firms are more focused than public. This is evident through the product diversification measure, ranging between 0 and 1 with higher values indicating more diversification, and further reflected in products and aisles. The median private firm offers 48 distinct products across 3 aisles. Meanwhile, the median public firm has a more extensive product portfolio consisting of 409 unique products spanning 7 aisles. Conair Corporation, a subsidiary of a private equity firm, has over 4,400 products in health and beauty markets, including curling irons, facial saunas, and dental floss, among others. Procter & Gamble sold over 7,000 unique products in the first quarter of 2007. In contrast, a single product was observed for Fairbank Reconstruction Corporation, a now defunct private processor and packager of meat: ground beef. Oil-Dri Corporation, a public firm selling oil sorbents, offered 35 unique products. Regarding product portfolio dynamics, public firms both introduce and discontinue a greater number of products relative to their existing product base. Private firms typically face more competition, both in terms of the concentration-based measure and number of rivals faced.

Additional summary statistics are provided for the subset of public firms using accounting and stock returns data. In the sample, the median public firm has assets totalling roughly 1.78 billion and a debt-to-assets ratio of 0.24. Quarterly realized stock returns have a median of approximately 0.72%.

Figure 3 presents correlations between explanatory and outcome variables to assess whether competition and diversification measures suffer from multicollinearity. Within private firms, the greatest correlation is 0.36 between the percentage of non-grocery revenue and estimated profit margins, implying that non-food products typically have higher estimated profit margins. For public firms, I observe a correlation of 0.54 between annual NielsenIQ revenue and total Compustat assets and a negative 0.51 correlation between total assets and realized return volatility. Market competition and product diversification have a 0.01 correlation for private firms and -0.14 for public firms.

## CHAPTER IV: DOUBLE-SORTED PORTFOLIOS

### IV.I RESEARCH DESIGN

Heightened uncertainty and external shocks are likely to highlight differences between resilient and non-resilient firms. Both the Great Recession and the COVID-19 pandemic created widespread economic distress. The 2008 financial crisis was marked by a credit crunch, reduced consumer and investor confidence, and relatively weaker government response.<sup>20</sup> COVID unfolded abruptly through lockdowns, supply chain disruptions, and supply and demand shocks.<sup>21</sup> The pandemic also impacted some industries (such as hospitality, travel, and entertainment) more dramatically than others (e-commerce, pharmaceuticals)<sup>22</sup> and saw relatively swift and robust government interventions to protect small businesses and unemployed households.<sup>23</sup> By examining both crises, I aim to differentiate between persistent and crisis-specific determinants of resilience.

To investigate how market competition and product diversification relate to firm performance, I first adopt a portfolio-sorting approach. Firms are classified into “High” or “Low” categories based on whether their market competition and product diversification measures are above or below median. These portfolios are represented as combinations of “H” and “L” for “High” and “Low,” and “C” and “D” for “Competition” or “Diversification.” For instance, a low-competition low-diversification portfolio is denoted as “LC-LD.” Within each portfolio, I investigate how performance differs between pre-crisis and crisis years (2007 versus 2008 and 2019 versus 2020).<sup>24</sup>

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<sup>20</sup>Brunnermeier (2009), Irwin (2021), and Rooney (2008)

<sup>21</sup>Brinca et al. (2020), Shih (2020), and J. Wu et al. (2020)

<sup>22</sup>Cashen (2021) and Franck (2020)

<sup>23</sup>N. Wu and Zarracina (2021)

<sup>24</sup>I use calendar years to minimize noise from mis-matched sample periods. The available retail scanner data at the time of analysis ended after 2020, limiting the sample for the COVID-19 pandemic. According to NBER business cycle expansion and contraction dates, the 2008 financial crisis began in December of 2007 and extends through June of 2009. Because two of three months in 2007 quarter 4 are pre-crisis, I consider 2007 quarter 4 a non-crisis quarter. To exactly match the time period of the remaining quarters (2008Q1 through 2009Q2) is challenging. Using a chronological 6 quarters prior introduces potential bias due to seasonality in retail sales. While analyzing the year prior and the first year of the crisis prevents a longer-term view of how competition and diversification affect firm resilience, it allows the sorted-portfolio analysis to remain relatively simple to interpret.

A similar sorted portfolio methodology was previously used by Bustamante and Donangelo (2017) and Hou and Robinson (2006). Once sorted on various measures of competition, cross-sectional variations in performance (typically stock returns) are analyzed to develop insight about competition's relation to performance. I build on their work in three ways. First, I consider both the diversification of product offerings as well as competition levels when sorting firms into portfolios. As firms choose products and services to sell, they are simultaneously selecting the markets in which to compete. Second, pre-crisis and crisis year performance within portfolios is contrasted to highlight the potential influence of competition and diversification on firm resilience. Third, both private and public firm performance are considered, though analyzed separately.

For both public and private firms, the double-sorted portfolio analysis focuses on five performance measures: product introduction rate, average product price, estimated markup, revenue growth, and revenue growth volatility. For the subsample of public firms, the double-sorted portfolio approach extends to include other measures of performance. Capital expenditures (CAPX / Total Assets) as a proxy for investment, a Compustat-based estimate of profit margin ( $\frac{\text{Sales} - \text{Cost of Goods Sold}}{\text{Sales}} \times 100$ ), realized quarterly returns, and return volatility are considered. Performance metrics are averaged within each portfolio annually, then the difference between crisis and non-crisis years is estimated with accompanying t-statistics to assess the significance of changes across years. Cross-sectional variation across portfolios and listing status is also observed.

## **IV.II EMPIRICAL EVIDENCE**

First, I investigate portfolio performance through the lens of internal (firm-controlled) performance measures. Specifically, I focus on product entry as a percent of the total existing product base, average product price, and estimated markups. Table 3 presents the portfolio average for each performance measure in the year prior to a crisis and during the first year of a crisis. The difference in performance between pre-crisis and

crisis years are presented with accompanying t-statistics. Statistically significant t-statistics are highlighted in red and green for negative and positive differences respectively.

Table 3 panel A shows a marked reduction in product introductions during market crises. Product introduction rates are significantly reduced across all portfolios of private firms during both market crises. Among public firms, high diversification portfolios suffered significant declines to product introduction rates during the 2008 financial crisis while low diversification portfolios do not have a statistically significant change in product introduction rates from pre-crisis levels. During COVID-19, public firms experience a significant reduction in product introduction rates across all portfolios. In general, portfolios of private firms tend to have greater declines in product entry rates compared to the corresponding portfolios of public firms. Reductions to product introduction rates were milder during the 2008 financial crisis than the COVID-19 pandemic.

Panel B of Table 3 showcases change in average product prices from pre-crisis years to crisis years across portfolios sorted on competition and diversification. In general, there is a statistically significant increase in product prices during the first year of the 2008 financial crisis. This holds true for public and private firms across all portfolios and both crises, with two exceptions. During the Great Recession, the HC-HD portfolio of private firms and the HC-LD portfolio of public firms experience statistically insignificant increases to product prices. During the COVID-19 pandemic, all portfolios of private firms increase average product price between 12 to 24 cents, which is considered statistically significant. In contrast, only the LC-LD portfolio of public firms experiences a significant increase in average product price.

Estimated product markups across sorted portfolios are reported in Panel C of Table 3. These consider the percentage difference in average product price between a firm's products and the average price of comparable generic goods. Though Panel B shows product prices tend to increase during the first year of a crisis, only three portfolios exhibit a significant change in markup percentage from pre-crisis to crisis period. First, the markup percentage of HC-LD portfolio of private firms is, on average, 2.4% less during 2008 than 2007.

During the COVID-19 pandemic, the HC-HD portfolio of private firms experienced a roughly 1.8% increase in estimated markups while the LC-LD portfolio of public firms had a 4.8% increase in markups. The remaining portfolios of public and private firms show crisis markups do not significantly vary from pre-crisis markups.

Comparing high and low competition portfolios (HC-LD to LC-LD and HC-HD to LC-HD) produces a somewhat counterintuitive result: firms operating in more competitive environments tend to have higher markup percentages. This finding is echoed in the average product prices as well, with generally higher product prices for high competition portfolios. This may signal that firms in competitive markets may opt to compete through product quality or differentiation, rather than price. I explore further in the regression analysis and find this result does not persist after controlling for other potential contributing factors.

Next, I examine variation in revenue growth and revenue growth volatility across sorted portfolios. Unlike product introductions and estimated markups, firms are unlikely to directly control all aspects of their revenue streams. Findings are presented in Table 4.

Table 4 Panel A documents how revenue growth changes during market crises. Prior to discussing the resilience of revenue growth in crises, there are a few cross-sectional variations of interest across portfolios and listing status. Portfolios of private firms that are considered high diversification have greater revenue growth than the corresponding portfolios of public firms. For public firms, revenue growth seems more sensitive to diversification levels than competition levels and portfolios of highly diversified firms have reduced revenue growth. However, diversification has a less pronounced, though still negative, association with average revenue growth for the portfolios of private firms.

I attribute this to the role of firm size, as proxied for with revenue. As shown in Figure 3, product diversification has a 0.4 correlation with annual retail scanner revenue for public firms. For private firms, the correlation between annual revenue and product diversification is 0.09. Because private firm diversification is less correlated with retail scanner revenue, highly diversified private firms are less susceptible to the

mechanical decline in revenue growth caused by a potential corresponding increase in revenue levels.

During the Great Recession, private firms that face high competition experienced reduced revenue growth. Among private firms, average quarterly revenue growth declined by 3.1% for the HC-LD portfolio and 2.5% for the HC-HD portfolio. For public firms, statistically significant reductions in revenue growth during the 2008 financial crisis are observed in high diversification portfolios. Revenue growth declined by 2.9% from 2007 to 2008 for public firms in the LC-HD portfolio and 6.4% for public firms in the HC-HD portfolio.

In regards to the pandemic, private firms' revenue growth decreased across all portfolios. For three portfolios (LC-LD, LC-HD, and HC-LD), the decline was statistically significant. The low diversification portfolios of private firms had the most dramatic reductions, with a decline of 8.4% and 8.6% for the LC-LD and HC-LD portfolios respectively. While high competition portfolios of public firms tend to experience reduced revenue growth during the pandemic, the decline is not statistically significant.

Table 4 Panel B showcases revenue growth volatility. In regards to cross-sectional variation, portfolios of private firms generally have greater revenue growth volatility than the corresponding portfolios of public firms. Unsurprisingly, portfolios of highly diversified firms tend to have reduced revenue growth volatility. During the Great Recession, there is no statistically significant change to revenue growth volatility across all portfolios of private firms. Three of the four portfolios of public firms similarly lack a meaningful change. The exception, the LC-HD portfolio of public firms, has a significant reduction (about 0.8%) in revenue growth volatility during the 2008 crisis.

When examining the pandemic, a peculiar trend emerges across different diversification levels. For three of the four high diversification portfolios, revenue growth volatility increases significantly in high diversification portfolios, with the exception of the HC-HD portfolio of public firms. The increases in revenue growth volatility range between 1.0% to 2.1%. For low diversification portfolios, changes to revenue growth volatility are not significantly different from zero. While it is to be expected that volatility increases

somewhat during market crises, diversification is typically associated with reduced risk so it is counterintuitive that portfolios of more diversified firms should experience increases in revenue growth volatility while revenue growth volatility remains relatively unchanged for portfolios of less diversified firms.

Determining the exact channel for this result is beyond the scope of this paper. However, I hypothesize that the increased volatility of more diversified firms can be attributed to the more complex supply networks of diversified firms. Note that the heightened volatility is evident during the pandemic but not the Great Recession. I theorize this finding may be driven by a crisis-specific force which disproportionately affected more diversified firms. As discussed in section IV.I, the pandemic created widespread supply chain disruptions through lockdowns and travel restrictions while the 2008 financial crisis did not. I assume diversified firms have more complex supply networks as there is likely a greater variety of production needs and inputs. Mitigating the impact of COVID-19 on supply chains would likely be more challenging for more diversified firms. Further investigation is required to validate (or invalidate) this channel.

The third set of sorted portfolios is focused on the subset of public firms. Using the available accounting and return data, I extend the performance measures beyond the scope of the retail scanner data. Investment and a Compustat-based estimate of profit margin are used as firm-controlled performance variables while realized returns and return volatility are considered external measures.

Table 5 Panel A presents pre-crisis and crisis period investment levels. Portfolios of more diversified firms tend to have a lower ratio of capital expenditures to assets. This pattern is likely partially driven by the correlation between product diversification and firm assets. Diversification and assets have a correlation of 0.28 (figure 3) so the reduced investment levels observed in the low diversification portfolios may reflect a tendency towards greater assets rather than a clear indication of lower investment. In general, the investment level declines slightly during crisis periods but the change is not statistically significant.

Panel B shows changes in Compustat-based profit margins. Comparing across competition levels (LC-LD to HC-LD and LC-HD to HC-HD), Portfolios of firms in high competition environments tend to have

lower Compustat profit margins. During the 2008 financial crisis, the LC-LD portfolio experiences a 3.3% reduction in Compustat profit margins and the LC-HD portfolio has a 1.2% reduction. While there are fluctuations in Compustat profit margins for the high competition portfolios, these changes are not statistically significant. During the pandemic, there is minimal change to estimated Compustat profit margins. All portfolios maintain Compustat profit margins within 1 percentage point of the prior year.

Realized stock returns are shown in Panel C of Table 5. The realized return refers to the average quarterly cumulative return for firms within a given portfolio. From 2007 to 2008, the LC-LD, HC-LD, and HC-HD portfolios experience a significant decline in average returns. The LC-HD portfolio also experiences reduced return but the change is not statistically significant. Compared to 2019, the HC-HD portfolio of firms have a reduction in average quarterly realized returns of 5.3% during the first year of the pandemic. The other three portfolios (LC-LD, LC-HD, and HC-LD) do not exhibit statistically significant changes between 2019 and 2020.

Table 5 Panel D presents changes to return volatility during crisis years. Return volatility is measured as the quarterly standard deviation of daily returns. As one might expect, return volatility increases during market crises. This increase is seen for all portfolios during both crises. There is relatively little variation across portfolios both in terms of pre-crisis return volatility and the magnitude to which volatility increases during crisis periods. The absence of clear cross-sectional patterns may be due to the lack of controls or the setting.

When considering the implications of the sorted portfolio analysis, it is important to remember the sample used focuses on firms within the retail scanner data because a granular view of competition and diversification is possible. However, the retail scanner data mainly covers consumer goods firms. A wider investigation across more industries may produce additional insight. Section V continues the analysis using a regression-based approach which controls for other potential contributing factors such as size and capital structure.

## CHAPTER V: REGRESSION ANALYSIS

### VI RESEARCH DESIGN

The regression model estimates the connection of market competition (MC) and product diversification (PD) to firm performance during crisis and non-crisis periods, as shown in equation 5. To capitalize on the increased statistical power in crisis periods, I estimate coefficients for interaction terms between determinants of resilience and two crises: the 2008 financial crisis ( $GR_t$ ) and COVID-19 pandemic ( $COVID_t$ ).<sup>25</sup>  $\beta_1$  and  $\beta_4$  estimate the non-crisis effect of competition and diversification respectively on firm performance.  $I$  indexes firm and  $t$  indexes time. Observations are quarterly.

$$\begin{aligned} y_{i,t} = & \beta_1 MC_{i,t-1} + \beta_2 MC_{i,t-1} \times GR_t + \beta_3 MC_{i,t-1} \times COVID_t \\ & + \beta_4 PD_{i,t-1} + \beta_5 PD_{i,t-1} \times GR_t + \beta_6 PD_{i,t-1} \times COVID_t \\ & + X_{i,t-1} + \text{Firm FE}_i + \text{Year-quarter FE}_t + \varepsilon \end{aligned} \quad (5)$$

In addition to the main variables of interest, I include a vector of controls ( $X_{i,t-1}$ ). For all firms, I use annual log NielsenIQ revenue as a proxy for firm size and log age using year-founded from CapitalIQ.<sup>26</sup> Additional controls are included when relevant, such as log number of products when considering product introductions. As a control for the types of products sold, I use the percentage of non-food revenue (e.g., health and beauty products, office supplies). Because food sales may respond differently from non-food goods to crisis periods, I include crisis interaction terms for the percentage of non-food revenue as well. Within the subsample of public firms, I control for log assets and debt-to-assets ratio. I include firm fixed effects to account for the time-invariant firm-specific component of performance and year-quarter fixed

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<sup>25</sup>The Great Recession dates are defined based on the US Business Cycle Expansions and Contractions data from The National Bureau of Economic Research (NBER). COVID is defined as the second, third, and fourth quarters of 2020.

<sup>26</sup>For firms that lack a CapitalIQ year-founded value, I consider the first year the firm is observed in the retail scanner data as its first year of existence.

effects to control for any unobserved time-specific factors or trends. Standard errors are clustered at the firm level.

In some instances, the individual coefficient estimates for market competition ( $\beta_1$ ) and the interaction term between market competition and crisis dummy variables ( $\beta_2$  and  $\beta_3$ ) are insignificant but have the same sign. For each crisis, I test whether the linear combination of non-crisis ( $\beta_1$ ) and crisis period ( $\beta_c$  where  $c = 2$  or  $3$ ) coefficients significantly differ from 0. I estimate the unrestricted and restricted models and attempt to reject the null hypothesis (shown in equation 6) that the combined coefficients are not significantly related to the performance measure using an F-test. I conduct equivalent F-tests to assess the significance of the combined crisis and non-crisis period coefficients of product diversification.

$$H_0 : \beta_1 + \beta_c = 0 \tag{6}$$

$$H_1 : \beta_1 + \beta_c \neq 0$$

The regression analysis is performed using first internal then external performance measures. The internal performance measures capture firm behavior, such as product portfolio changes and product pricing, while external performance measures include revenue growth and stock returns. Interaction terms are included to further isolate the connection between competition, diversification, and crisis-period performance. The estimated coefficients reflect the existing relation, if any, for illustrative purposes. The crises are plausibly exogenous shocks but causality should be inferred with caution given the selection bias of market choice and product portfolios.

## V.II EMPIRICAL EVIDENCE

Table 6 reports regression estimates for product introduction and discontinuation rates. The association between market competition and product introduction rates is statistically insignificant during both crisis

and non-crisis periods. For private firms, the coefficients representing the correlation between market competition and product introduction rates during non-crisis periods and the pandemic are both positive, though insignificant. I use an F-test to assess whether the combined coefficient is statistically significant and can reject the null hypothesis at the 5% level, implying that private firms in more competitive markets tend to introduce products at a higher rate during the pandemic than their peers in less competitive markets. A one standard deviation increase in market competition correlates with a 0.2 percentage point increase in product introduction rates for private firms during the pandemic. For public firms, the additional impact of market competition on product introduction rates during market crises is negative but statistically insignificant. During non-crisis periods, more diversified firms launch more products relative to their existing product base. Specifically, a one standard deviation increase in product diversification correlates with an increase in product entry rates of roughly 0.2 percentage points for private firms and 0.53 percentage points for public firms. For private firms, this effect strengthens during the Great Recession and weakens during COVID-19. The coefficients showing any additional crisis-period effect of diversification on product introduction rates during market crises for public firms share the same signs as those of private firms but are not statistically significant.

The analysis of product discontinuations is restricted to the Great Recession. I require a product's absence for at least one calendar year to mitigate noise from seasonal variations. Due to the longer window of observation necessary, the sample period ends in 2019 and does not include the pandemic. During non-crisis periods, market competition does not have a significant relation with product exit rates. During the Great Recession, private firms facing more intense competition discontinue a smaller fraction of their existing products while public firms show no additional relation between market competition and product exit rates. In non-crisis periods, greater diversification in private firms is associated with reduced product discontinuation rates. A one standard deviation increase in product diversification of private firms correlates with about a 0.3 percentage point reduction to product discontinuation rates. For private firms, this effect does

not significantly differ during the 2008 financial crisis. For public firms, diversification is positively but not significantly correlated with product discontinuations during both crisis and non-crisis periods.

Table 7 investigates how product pricing behavior relates to competition and diversification during crisis and non-crisis periods. Columns 1 and 2 detail the connection between estimated markups and firm characteristics. Increased market competition is associated with reduced markups for both public and private firms during non-crisis periods. A one standard deviation increase in competition correlates with roughly a 5.4 percentage point decrease in estimated markups for private firms and a 7.8 percentage point decrease for public, significant at the 10% level, for public firms. For private firms, this effect is weakened during the 2008 financial crisis and, to a greater extent, COVID-19 pandemic. Each standard deviation increase in market competition is associated with a 3.1 percentage point reduction in markups for private firms during the 2008 financial crisis and a 0.9 percentage point reduction during the pandemic. Product diversification does not show a significant relation to estimated markups during non-crisis periods. Additional crisis-period effects are not statistically significant for private firms. An additional effect is observed for public firms during 2008 financial crisis, suggesting that more diversified public firms tend to have greater markups during the Great Recession. The additional pandemic effect of diversification on estimated markups for public firms is positive but not statistically significant.

Table 7 columns 3 and 4 report estimated profit margins. In non-crisis periods, greater market competition is associated with reduced estimated profit margins. A one standard deviation increase in market competition correlates with a decline of roughly 21 cents in estimated profit margins of private firms and 34 cents for public firms. During the 2008 financial crisis, this relation lessens. A one standard deviation increase in market competition is associated with a 9 cent reduction in estimated profit margins of private firms during the 2008 financial crisis and a 12 cent reduction for public firms. During the pandemic, the estimated profit margins of private firms decline by 3 cents per standard deviation increase in market competition. The relation between market competition and public firm estimated profit margins does not differ

significantly during the COVID-19 pandemic.

For private firms, product diversification correlates with reduced estimated profit margins during non-crisis periods. For each standard deviation increase in product diversification, there is a 15 cent reduction in estimated profit margins of private firms. During the 2008 financial crisis, each standard deviation increase in product diversification correlates with about a 20 cent decline in estimated profit margins of private firms. Any additional impact of diversification on estimated profit margins during the pandemic is not statistically significant. Public firms, however, do not show a significant correlation between product profit margins and diversification during non-crisis periods or during the pandemic. During the 2008 financial crisis, public firms tend to have a 26 cent decline in estimated profit margins per standard deviation increase in product diversification.

Three key takeaways emerge from analyzing internal performance measures. First, more diversified firms tend to introduce more products. This holds true for both public and private firms and is generally the case when examining the combined crisis and non-crisis period coefficients. Second, market competition is associated with reduced markups and estimated profit margins, consistent with Bertrand competition. This finding contrasts with Table 3, which shows high competition portfolios tend to have greater markups and estimated profit margins. However, the sorted portfolios do not control for other contributing factors such as firm size or firm age. The pricing behavior of private firms appears more sensitive to market competition during market crises than the pricing of public firms. Last, product diversification affects the pricing behavior of public and private firms in different ways, especially during the Great Recession. Greater product diversification is associated with higher markups and estimated profit margins for public firms during the 2008 financial crisis. For private firms, diversification shows a negative relation to estimated markups (when combined with the non-crisis period coefficient) during the 2008 financial crisis and a negative correlation with estimated profit margins. I now turn to externally driven performance measures, which include revenue growth, revenue growth volatility, and realized returns.

Table 8 columns 1 and 2 show the relation between competition, diversification, and cumulative revenue growth. Market competition has a negative but statistically insignificant relation with revenue growth during non-crisis periods. For private firms, the non-crisis and 2008 financial crisis coefficients are individually insignificant and negative but in combination are significant at the 1% level. During the 2008 financial crisis, each standard deviation increase in market competition corresponds with a 7.8 percentage point reduction in revenue growth for private firms. During the COVID-19 pandemic, there is an additional, though statistically insignificant, positive association between competition and revenue growth of private firms. For public firms, market competition is negatively correlated with revenue growth during both crises, with significance at the 10% level. A one standard deviation increase in market competition is associated with a roughly 6.0 percentage point reduction in revenue growth for public firms during the 2008 financial crisis and a 5.0 percentage point reduction during the pandemic. This finding echoes the negative relation between competition and returns identified by Bustamante and Donangelo (2017).

Product diversification exhibits a positive, though insignificant, correlation with cumulative revenue growth for public and private firms during non-crisis periods. An F-test shows that the combined coefficients of product diversification and cumulative revenue growth during non-crisis periods and the Great Recession is significant at the 5% level for both private and public firms. During the 2008 financial crisis, private firms tend to have 2.3 percentage points greater cumulative revenue growth per standard deviation increase in product diversification, while public firms have about a 6.2 percentage point increase in revenue growth per standard deviation increase in diversification. With respect to the pandemic, the additional impact of product diversification on cumulative revenue growth is significant for private firms at the 5% level and, for public firms, an F-test shows the combination of non-crisis and pandemic coefficients is significant at the 5% level. For each standard deviation increase in product diversification, revenue growth is 3.3 percentage points greater for private firms and 6.0 percentage points greater for public firms during the pandemic.

Columns 3 and 4 of table 8 present estimated coefficients for revenue growth volatility, measured as

the standard deviation of weekly revenue growth. During non-crisis periods, market competition shows a negative relation with revenue growth volatility but lacks statistical significance. The crisis-period coefficients on market competition for private firms are also negative but statistically insignificant. For private firms, an F-test reveals that the combined coefficients of market competition during crisis and non-crisis periods are statistically significant at the 1% level. A one standard deviation increase in market competition of private firms corresponds with a 0.8 percentage point reduction in revenue growth volatility during the 2008 financial crisis and 1.1 percentage point reduction in revenue growth volatility during the pandemic.

For public firms, there is an additional negative correlation between competition and revenue growth volatility during market crises, with significance at the 10% level during the 2008 financial crisis and significance at the 5% level during the pandemic. A one standard deviation increase in market competition correlates with roughly a 1.1 percentage point decrease in revenue growth volatility during the Great Recession. During the COVID-19 pandemic, each standard deviation increase in market competition correlates with about a 0.9 percentage point reduction in revenue growth volatility.

During non-crisis periods, each standard deviation increase in product diversification correlates with a 0.7 percentage point reduction in revenue growth volatility for private firms and a 2.3 percentage point reduction for public firms. This is consistent with the firm-specific risk reduction aspect of diversification. For both public and private firms, the coefficient on the interaction term of product diversification and the 2008 financial crisis shows that diversification does not have a significant additional effect during the Great Recession. During the pandemic, the risk reduction associated with diversification diminishes in magnitude. A one standard deviation increase in product diversification corresponds to a 0.2 percentage point reduction in revenue growth volatility of private firms during the pandemic and a 1.6 percentage point reduction for public firms. While the estimated risk reduction of product diversification remains unchanged during the 2008 financial crisis, it significantly weakens during COVID-19. I theorize this outcome may be attributed

to supply chain disruptions, which may have disproportionately affected less-focused firms.<sup>27</sup>

Table 9 documents how realized stock returns and return volatility are connected to competition and diversification. The connection of market competition and product diversification to stock returns is interesting for two reasons. First, Ali et al. (2008), Bustamante and Donangelo (2017), and Hou and Robinson (2006) have investigated the connection between competition and stock returns and presented conflicting evidence each time. This study builds on their work through constructing a new measure of competition and distinguishing between non-crisis and crisis periods. Second, until now, the performance measures I analyze (product portfolio changes, estimated profit margins, revenue growth) were based on the retail scanner data because the setting allows for the comparison of private and public firms. The estimated relation to stock returns is unique in that observed performance is beyond the scope of the NielsenIQ data. As my measures of competition and diversification are limited to the retail scanner data, which represents a fraction of total firm revenue,<sup>28</sup> a significant relation between market competition, product diversification, and stock returns would suggest that these measures may have explanatory power beyond the scope of the NielsenIQ retail scanner data.

Table 9 column 1 shows that market competition is not significantly related to realized returns during non-crisis periods. The market competition coefficients during non-crisis periods and the 2008 financial crisis are positive and insignificant. Further, an F-test confirms that the combination of non-crisis and Great Recession coefficients is insignificant. During COVID-19, market competition displays a negative relation with returns, significant at the 10% level. A one standard deviation increase in market competition is associated with a 1.6 percentage point reduction in realized returns during the pandemic. Product diversification is associated with reduced returns during non-crisis periods, with roughly a 3.1 percentage point reduction in quarterly realized returns per standard deviation increase in product diversification. Product diversification

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<sup>27</sup>Ahn and Denis (2004) and Burch and Nanda (2003)

<sup>28</sup>The scanner data covers only participating retail locations in the United States. The estimates will not include any international or e-commerce revenue. Certain product types will also not be represented such as cars, event tickets, and prescription medication.

has a negative but insignificant additional effect on quarterly returns during crisis periods. In Table 9 column 2, return volatility shows a negative but statistically insignificant correlation with market competition and product diversification during non-crisis periods. However, both competition and diversification show a significant additional effect during the 2008 financial crisis. During the Great Recession, firms experience approximately a 0.2 percentage point increase in return volatility per standard deviation increase in market competition and a 0.4 percentage point reduction in return volatility per standard deviation increase in product diversification. Neither market competition nor product diversification display an additional significant relation to return volatility during the pandemic, which is confirmed by insignificant F-statistics.

In summary, external measures of firm performance show that public and private firms are similarly impacted by competition and diversification during crisis and non-crisis periods. Competition has a greater impact on firm performance during crisis periods. Diversification reduces revenue growth volatility but the effect is significantly weaker during the COVID-19 pandemic. During the 2008 financial crisis, realized return volatility is positively related to competition and negatively related to product diversification. Because measures of competition and diversification are estimated based on the NielsenIQ scanner data, finding a significant connection with stock return volatility lends credibility to the explanatory power of these measures beyond the scope of the retail scanner data.

I find mixed support for the negative relation between competition and performance observed by Bustamante and Donangelo (2017). While there is a significant negative correlation between competition and revenue growth during market crises, I do not observe a strong negative relation when examining returns. There is an important distinction in methodology between my empirical strategy and that of Bustamante and Donangelo (2017). While their study focuses on proxies for expected returns, I consider realized returns and revenue growth without adjustment for expectations.

## CHAPTER VI: ALTERNATIVE MEASURES

### VII MEASURES AND METHODS

Concentration measures, specifically the Herfindahl-Hirschman Index, are commonly used by policy-makers to test market competitiveness (United States Department of Justice & Federal Trade Commission, 2010). However, to assess the persistence of my findings (or lack thereof), two alternative approaches of measuring both competition and diversification are included. The first is log number of rivals, which is a count of how many competitors a firm faces on average in its product markets, weighted by the percentage of total firm revenue from a given market. The log transformation is used because the marginal increase in competitiveness caused by a new competitor is likely decreasing. The average number of rivals faced is about 111 for private firms and 93 for public firms. Next, I use average firm market share. This is the average of a firm's market share in each aisle, weighted by aisle revenue. It can be thought of as a measure of a firm's average position within a product market. The key difference here is that it is a metric of a firm's competitiveness rather than the competitiveness of the markets in which it operates. Variable creation is depicted in equation 7, with  $m$  indexing markets. For each firm  $i$  at time  $t$ , the number of rivals in the market (minus one for the firm itself) is weighted by the share of total firm revenue from market  $m$  at time  $t$  ( $\omega_{m,t}$ ). Market share ( $s_{i,m,t}$ ) is the proportion of total revenue in market  $m$  at time  $t$  generated by firm  $i$ .

$$\begin{aligned} \text{Avg. rivals}_{i,t} &= \sum_{m=1}^M \omega_{m,t} (\# \text{ Rivals}_{m,t} - 1) \\ \text{Firm market share}_{i,t} &= \sum_{m=1}^M \omega_{m,t} s_{i,m,t} \end{aligned} \tag{7}$$

For diversification, I use the number of aisles in which a firm generates revenue and similarity of aisle descriptions as a measure of product portfolio homogeneity. A high similarity metric implies that the firm, regardless of how many aisles, primarily generates revenue from aisles with similar descriptions. For each

pairing of aisles, I find the proportion of shared descriptive words from the aisle and department labels. To aggregate to the firm level, I use a weighted average. The similarity of each aisle pairing is weighted by the sum of both aisles' revenues divided by the sum of revenues from all possible aisle pairings.

$$\text{Aisle-pairing similarity}_{m,-m} = \frac{\text{Words in both aisle } m \text{ and } -m}{\text{Total descriptive words in aisles } m \text{ and } -m} \quad (8)$$

It is important to note how the alternative measures differ from the concentration-based measures. The number of rivals faced does not necessarily linearly correlate with the number of credible competitors that pose a threat to firm survival. Firm average market share provides insight into the position of a firm within its markets but does not directly address competitors. Aisles, similarly to rivals, are a relevant metric when revenues are split evenly. A firm that generates 99% of its revenue in one aisle is still focused, regardless of how many other aisles comprise the remaining 1% of revenue. The product similarity measure attempts to quantify how differentiated products are within a product portfolio. Unfortunately, variation in the specificity of aisle description may introduce noise and possible bias to estimated product similarity.

## **VI.II EMPIRICAL EVIDENCE**

For each performance measure, I compare the findings from the main analysis to the results using alternative measures of competition and diversification.

First, I revisit how competition and diversification influence product introduction rates. Using concentration-based metrics, as shown in Table 6, the relation between competition and product entry does not significantly differ from zero for either public or private firms. This does not change during market crises. Table 10 reports estimated coefficients using alternative measures of competition. Columns 1 and 2 show estimated coefficients using the log number of rivals faced as a proxy for the degree of competition. There is a positive, though not statistically significant relation between the number of rivals faced and product introductions during non-crisis periods for private firms. The additional effect of rivals on product introduction rates of

private firms during market crises is negative but insignificant during the Great Recession and negative with statistical significance at the 10% level during COVID-19. For public firms, there is a negative but statistically insignificant impact of the number of rivals faced on product entry rates during non-crisis periods. Additional crisis-specific effects for public firms similarly lack statistical significance. Columns 3 and 4 utilize the average market share a firm has in its aisles as a measure of the firm's competitive position. For both private and public firms, maintaining a greater market share in aisles is negatively, though insignificantly, related to product entry rates. During the Great Recession, having greater market share for private firms produces an additional positive effect on product introduction rates, again attenuating the overall impact. With respect to public firms, the relation does not significantly differ during market crises.

Private and public firms with greater concentration-based measures of product diversification tend to introduce products at a higher rate. For private firms, this effect strengthens during the Great Recession and weakens during COVID-19. Public firms do not experience a statistically significant additional effect of product diversification during market crises. Table 11 shows estimated coefficients using the log number of aisles and average product similarity. During non-crisis periods, number of aisles has a positive, though insignificant, relation to product entry rates. For private firms, operating in more aisles has an additional positive effect during the Great Recession and an additional negative effect during the pandemic. Public firms operating in more aisles tend to introduce fewer products during COVID-19, with significance at the 10% level. The correlation between product similarity and product entry rates does not appear statistically significant for either public or private firms during either crisis or non-crisis periods.

Analysis of the relation between estimated markups and concentration-based competition and diversification measures are reported in Table 7. Private and public firms facing greater concentration-based competition had, on average, reduced estimated markups. The effect of competition on markups became less negative during the 2008 financial crisis and COVID-19 for private firms. The relation did not change significantly for public firms during market crises. Table 12 repeats the regression estimation with alternative

measures of competition. The number of rivals a firm faces did not significantly relate to estimated markups during non-crisis or crisis periods. Greater market share per aisle is negatively, but not significantly, associated with estimated markups. For public firms, there is an additional negative impact on estimated markups associated with increased market share during the Great Recession, with significance at the 5% level. The relation between market share and estimated markups did not significantly differ for private firms during market crises.

Product diversification, when measured with a concentration-based measure, does not appear significantly related to estimated markups during non-crisis periods. For public firms, high diversification levels are associated with an additional positive impact on markups during the 2008 financial crisis. Findings with alternative measures are presented in Table 13. The coefficients estimating the relation between number of aisles and markups exhibit a similar pattern, such that the majority of coefficients are not statistically significant. During the Great Recession, however, each standard deviation increase in number of aisles is associated with about a 7.5 percentage point increase in estimated markup for public firms, with significance at the 10% level. For private firms, product similarity has a negative relation to markups during non-crisis periods that is not statistically significant. During the Great Recession, the combined crisis and non-crisis period coefficients show an overall positive effect of product similarity on markups, with significance at the 10% level. For public firms, a one standard deviation increase in product similarity is associated with a roughly 6.8 percentage point reduction in markups during non-crisis periods. During the Great Recession, however, the overall effect reverses such that a one standard deviation increase in product similarity is associated with an increase of 4.9 percentage points in markups.

Table 8 columns 1 and 2 show how revenue growth is related to market competition and product diversification using concentration-based estimates. In the main analysis, the non-crisis period relation of market competition with revenue growth is negative but lacks statistical significance. For private firms, the combined non-crisis and Great Recession coefficients show each standard deviation increase in market

competition correlates with a 7.8 percentage point reduction in revenue growth that is significant at the 1% level. For public firms, the coefficients on interaction terms for the additional impact of competition on revenue growth during market crises are each significant at the 10% level. Each standard deviation increase in competition correlates with a 6 percentage point reduction in revenue growth during the Great Recession and a 5 percentage point reduction during the pandemic.

Table 14 repeats the analysis with alternative measures of competition. For private firms, the number of rivals faced is negatively, though not significantly, associated with revenue growth. During the Great Recession, there is an additional negative effect that is significant at the 1% level. The combined non-crisis and Great Recession coefficients indicate that each standard deviation increase in the log number of rivals is associated with a decrease of roughly 2.7 percentage points in revenue growth for private firms. For public firms, the negative association between number of rivals and revenue growth during non-crisis periods is significant at the 10% level. Each standard deviation increase in log number of rivals corresponds with a 11.8 percentage point reduction in revenue growth. During the Great Recession, the effect strengthens with each standard deviation increase in number of rivals associated with a reduction of 17.2 percentage points in revenue growth. Columns 3 and 4 use average market share as a measure of competition. During non-crisis periods, having high market share is associated with reduced revenue growth for both private and public firms. During the Great Recession, this effect weakens slightly.

The main analysis findings show a positive, but statistically insignificant relation between product diversification and revenue growth. During the pandemic, there is an additional positive impact on revenue growth of private firms, with significance at the 5% level. The relation between product diversification and revenue growth of public firms does not significantly differ during market crises. As shown in Table 15, private firms operating in a higher number of aisles tend to experience reduced revenue growth during non-crisis periods. This remains relatively unchanged during the 2008 financial crisis, but somewhat reverses during the pandemic. For public firms, there is a positive marginally significant relation between the number

of aisles and revenue growth during non-crisis periods. This association does not substantially change during market crises. Average product similarity has a positive, though insignificant, association with increased revenue growth during non-crisis periods. For private firms, having a relatively uniform product base during the 2008 financial crisis contributed to increased revenue growth. For public firms, the relation between product similarity and revenue growth reverses during COVID-19, such that the overall effect implies public firms with high product similarity experienced reduced revenue growth during the pandemic relative to peers.

The third and fourth columns in Table 8 showcase the relation between competition, diversification, and revenue growth volatility. For both private and public firms, there is a negative but not statistically significant correlation between competition and revenue growth volatility during non-crisis periods. Additional negative crisis-period effects are observed but are only statistically significant for the subset of public firms. Table 16 presents findings using alternative measures of competition. The number of rivals faced is negatively associated with revenue growth volatility for private firms with significance at the 10% level. This relation weakens during the Great Recession, also with significance at the 10% level. With respect to public firms, the relation between number of rivals and revenue growth volatility is negative, though statistically insignificant during non-crisis periods. The additional crisis period effects for public firms also lack statistical significance. Using average market share as a proxy for a firm's competitive positioning, private firms experience a negative but statistically insignificant correlation between competitiveness and revenue growth volatility. Public firms show a positive but statistically insignificant association between average market share and revenue growth volatility during non-crisis periods. Additional crisis period effects of competition on revenue growth volatility lack statistical significance for both private and public firms.

For private and public firms alike, a concentration-based perspective of product diversification has a significant, negative association with revenue growth volatility during non-crisis periods that weakens during COVID-19. Table 17 reports estimated coefficients using alternative measures of product diversification.

For private firms, this finding is supported when considering number of aisles as a measure of diversification. A one standard deviation increase in log number of aisles correlates with about a 0.6 percentage point reduction in revenue growth volatility for private firms. This does not significantly differ during the Great Recession or COVID-19 pandemic. For public firms, there is a negative but statistically insignificant correlation between number of aisles and revenue growth volatility. This relation remains relatively unchanged during the Great Recession. During the pandemic, the combined non-crisis and pandemic coefficients indicate a small positive correlation between number of aisles and revenue growth volatility. Each standard deviation increase in the log number of aisles is associated with a 0.2 percentage point increase in revenue growth volatility. With respect to product similarity, a relatively uniform product base (low diversification) has a positive but insignificant association with revenue growth volatility. During COVID-19, there is a statistically significant reversal in the overall effect sign for both private and public firms. A one standard deviation increase in product similarity correlates with roughly a 0.4 percentage point increase in revenue growth volatility for private firms and a 1.0 percentage point increase in volatility for public firms.

Table 9 shows the connection between competition, diversification, and realized returns. Market competition is positively, though insignificantly, related to realized returns. During COVID-19, there is a negative additional impact of competition that is significant at the 10% level. The combined coefficients suggest an overall negative correlation between competition and realized returns during the pandemic. Table 18 presents the estimated coefficients using alternative measures of competition and diversification. The average number of rivals faced by a firm has a negative but insignificant correlation with realized returns during non-crisis periods, which does not meaningfully differ during market crises. Market share also has a negative but insignificant relation with realized returns during non-crisis periods. During the Great Recession, there is an additional negative effect of market share on realized returns that is significant at the 10% level.

The main analysis shows a marginally significant negative association between product diversification and realized returns during non-crisis periods. Any additional crisis period effects are not statistically sig-

nificant. The effect of number of aisles on realized returns does not significantly differ from zero during non-crisis periods and does not substantially change during either crisis. While product similarity has a negative but insignificant correlation with realized returns during non-crisis periods, the additional impact of product similarity during COVID-19 reverses the sign such that firms with a more uniform product base during the pandemic tend to have higher realized returns.

Columns 3 and 4 of Table 9 focus on the relation of competition and diversification with realized return volatility. During non-crisis periods, market competition has an insignificant negative correlation with return volatility. During the Great Recession, there is a strong positive impact of competition on return volatility such that the combined coefficients of non-crisis period and Great Recession are positive overall. The additional effect during COVID-19 is not statistically significant. Table 19 reports estimated coefficients using alternative measures of competition and diversification. The number of rivals faced shows a positive but insignificant association with return volatility that does not significantly differ during market crises. During non-crisis periods, market share has a negative but insignificant connection to return volatility. With significance at the 1% level, the combined coefficients show each standard deviation increase in average market share correlates with a 0.3 percentage point increase in return volatility.

With respect to product diversification, the non-crisis period relation with return volatility does not significantly differ from zero. During the Great Recession, there was an additional negative effect with significance at the 5% level. During COVID-19, there is not a statistically significant additional impact of product diversification on return volatility. For the alternative measures, the number of aisles in which a firm operates shows an insignificant negative correlation with return volatility during non-crisis periods. During the Great Recession, there is an additional marginally significant negative impact of the number of aisles on return volatility. For product similarity, firms with a relatively uniform product base tend to have reduced return volatility during non-crisis periods. While this remains relatively unchanged during the 2008 financial crisis, this effect attenuates almost entirely during the pandemic due to the additional positive crisis-period

effect, with significance at the 5% level.

Overall, the results with alternative measures of competition and diversification provide weak support for the findings with concentration-based metrics. This is a possible cause for concern given that it may indicate the results found in the main analysis are not robust to different measurement approaches. While this is a valid concern, it is important to note that the concentration-based metrics are capturing a unique perspective of competition and diversification levels of the firm. A count of the number of rivals faced does not indicate the threat level posed by each. A market with many rivals could still be dominated by a few main competitors. Average market share indicates a firm's position in the market relative to peers but does not account for the relative strength and number of competitors. A concentration-based approach to competition is standard to the literature, in part, due to how it captures the overarching balance of competitors. For diversification, a count of the aisles in which a firm operates does not necessarily mean revenues are generated evenly across all aisles. Product similarity is dependent on the product classification data available. A secondary consideration is the complexity of the main results. There is no clear answer about what makes a firm resilient and, while this paper contributes to the discussion, the findings of the main analysis highlight the nuances associated with resilience with varying degrees of statistical significance across market crises and perspectives of what "resilience" is.

## CHAPTER VII: MATCHED SAMPLE ANALYSIS

### VII.I MATCHING AND METHODS

In addition to the size disparity across private and public firms, both theoretical and empirical work explore a variety of potential differences between public and private firms. Public firms separate ownership and control. As described by Jensen (1986) and Jensen and Meckling (1976), agents may not act in the best interest of owners because they do not bear the full cost. Private firms are, on average, more insulated from these agency costs. Asker et al. (2015) claim that lower agency costs allow private firms to be more responsive to changes in investment opportunities, as measured by sales growth and Tobin's  $q$ . From a cost of capital perspective, Brav (2009) asserts that the higher relative cost of equity for private firms leads to a greater reliance on debt financing. Public firms benefit from lower loan rates (Pagano et al., 1998; Saunders & Steffen, 2011). More severe cuts to investment during crisis periods were observed for firms with high leverage (Almeida et al., 2009), a relatively larger cost of raising capital (Duchin et al., 2010), and greater financial constraints (Campello et al., 2010).

The endogeneity of listing status presents a challenge when identifying differences in performance and resilience across public and private firms. To reduce variation driven by observable firm characteristics, I use propensity score matching, using Mahalanobis distance. Public firms are considered as "treated." Matching is based on first quarter of 2007 to ensure a full year of retail scanner data. Due to a lack of financial information about private firms, there is a relatively small set of possible matching variables. For each firm, the probability of being publicly listed is estimated based on log annual retail scanner revenue, log number of products, and log firm age. Number of products is a secondary perspective of firm size and a measure of product diversification without directly matching based on the concentration-based metric. Firms outside of the region of common support are excluded from the sample. Each firm is matched with its nearest neighbor,

within a 0.2 caliper.<sup>29</sup> The resulting sample includes 61 matched pairs.

The sample balance pre- and post-matching is shown in Figure 4. The first row shows the distribution of log firm revenue before and after matching to confirm that the matching process selected public and private firms within the same approximate size range. The second and third rows show concentration-based measures of competition and diversification, which were not directly used as matching variables. Competition and diversification levels are comparable across public and private firms in the matched sample.

The regression analysis is repeated with a dummy variable equal to one for public firms and interaction terms to capture any additional effect of listing status during market crises. It is reasonable<sup>30</sup> to assume that the time invariant component of firm performance is correlated in some way with the decision to IPO. This presents a question of whether or not firm fixed effects are appropriate when analyzing the role of listing status. Firm fixed effects may absorb more variation than is desirable. I consider each regression with and without firm fixed effects to lessen this concern. Caution is advised when interpreting the coefficient describing the effect of listing status on performance because it is estimated without firm fixed effects and is likely endogenous.

$$y_{i,t} = \beta_1 \text{Public}_i + \beta_2 \text{Public}_i \times \text{GR}_t + \beta_3 \text{Public}_i \times \text{COVID}_t + \beta_4 \text{MC}_{i,t-1} + \beta_5 \text{PD}_{i,t-1} + X_{i,t-1} + \text{FE}_t + \varepsilon \quad (9)$$

The regression estimation within the matched sample is shown in equation 9. The effect of being publicly listed ( $\text{Public}_i$ )<sup>31</sup> on each performance variable ( $y_{i,t}$ ) is estimated, along with interaction terms to isolate any additional effect of listing status during market crises. Controls are included for market competition ( $\text{MC}_{i,t-1}$ ) and product diversification ( $\text{PD}_{i,t-1}$ ). Interaction terms are not included for competition and diver-

<sup>29</sup> Alternative calipers have been explored and do not cause significant variation in results.

<sup>30</sup> In my opinion.

<sup>31</sup> The indicator variable  $\text{Public}_i$  does not vary over time. This is because there are no firms that transition from public to private or vice versa within the matched sample, though some IPOs and private equity buyouts do occur in the overall sample.

sification. Given the limited information available about private firms and a relatively small matched sample, interaction terms for market competition and product diversification with crisis indicators are excluded to reduce possible overfitting.<sup>32</sup>  $X_{i,t-1}$  is a vector of controls, identical to those used in the main analysis.

## VII.II EMPIRICAL EVIDENCE

The matched sample analysis begins by examining how listing status influences firm investment, as proxied for by product introduction and discontinuation rates. Results are presented in Table 20. Columns 1 and 3 do not include firm fixed effects. The coefficient on  $Public_i$  is positive and significant for both product entry and product exit rates, implying that public firms typically both introduce and discontinue a greater proportion of their existing product base. For product entry rates, listing status does not have a significant additional crisis-period effect on product entry rates. With marginal significance, the increased product discontinuation rates of public firms during non-crisis periods attenuate during the Great Recession. Columns 2 and 4 include firm fixed effects. Column 2 shows that publicly listed firms tend to introduce a lower percentage of products relative to their existing product base during COVID-19, with significance at the 10% level. Public firms discontinued a smaller percentage of their product base during the Great Recession than comparable private firms.

Table 21 reports how estimated product markups are influenced by listing status. Firm fixed effects are included in column 2. The non-crisis period effect of listing status on product markups is positive but not statistically significant. Both with and without firm fixed effects, there is no additional crisis-period effect of listing status on estimated product markups.

Estimated coefficients showing the impact of listing status on revenue growth and revenue growth volatility during market crises are reported in Table 22. Listing status does not appear significantly correlated with revenue growth during non-crisis periods. The additional effect of being public on revenue growth during

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<sup>32</sup>Alternative specifications which allow for interaction terms of market competition and product diversification with market crises were explored. Their inclusion did not substantially change estimated coefficients on  $Public_i$ .

the Great Recession appears positive but insignificant. During COVID-19, the additional effect is negative but similarly insignificant. Revenue growth volatility also does not appear significantly affected by listing status during non-crisis periods. When firm fixed effects are included, there is a marginally significant negative effect of being publicly listed on revenue growth volatility.

So often, listing status is cited as reflecting some underlying difference in unobservable firm characteristics. Further, publicly listed firms are assumed to have easier access to capital markets, reduced cost of capital, and greater exposure to agency costs. I anticipated listing status would have at least some impact on firm resilience. However, this study is largely unable to find significant differences in resilience across public and private firms. Perhaps this merely reflects a lack of sufficient controls for firm characteristics such as debt levels or the inability to observe non-retail scanner revenue. The sample is also restricted to consumer goods which may differ from other product markets. Additional investigation is needed in order to draw convincing conclusions.

## CHAPTER VIII: CONCLUSIONS

This study uses micro-level retail scanner data to investigate how market competition and diversification affect firm resilience. I aim to establish a base understanding of resilience in the product market space and introduce new approaches to measuring competition and diversification. Using product-level estimates, I find that private firms typically operate in more competitive environments and are less diversified. Further, private firms tend to have higher estimated profit margins.

Examining cross-sectional variation in portfolios sorted on competition and diversification reveals that private firms tend to have greater revenue growth. This trend is particularly pronounced in high diversification portfolios. Compared to their public counterparts, private firms have significantly more volatile revenue growth. This holds true in three of four portfolios, with the exception of the high competition - low diversification portfolio. Comparing crisis year to pre-crisis performance, I find that product introduction rates declined more dramatically during the COVID-19 pandemic than 2008 financial crisis. While average product prices tended to increase during market crises, markups remained largely statistically unchanged. There is not a clear pattern on which portfolios were most susceptible to declines in revenue growth during market crises. Examining revenue growth volatility, three of four high diversification portfolios experience an increase in revenue growth volatility during COVID-19. Among public firms, the low competition - high diversification portfolio experienced the smallest decline in realized returns and smallest increase in return volatility during the 2008 financial crisis and COVID-19 pandemic.

In the regression analysis, I observe lower product markups and estimated profit margins for both public and private firms in more competitive markets. For private firms, this connection becomes less negative during both crises. When examining the combined crisis and non-crisis period coefficients, I find evidence that market competition is associated with reduced revenue growth for private and public firms during the 2008 financial crisis and COVID-19 pandemic. More diversified firms have less volatile revenue growth during

non-crisis periods but this effect weakens during the COVID-19 pandemic for both public and private firms. This may reflect COVID-19's impact on global supply chains. As more diversified firms are likely to have more complex supply networks, I suspect the disruptions may lessen the risk reduction value of diversification. Realized returns tend to be lower for more diversified firms, with marginal significance. During the 2008 financial crisis, return volatility is positively correlated with market competition and negatively correlated with product diversification.

Using alternative measures of competition and diversification adds insight to the importance of caution when attempting to quantify competition and diversification. Results are sensitive to changes in definitions. Though I feel confident that a concentration-based approach is most appropriate, there is room for improvement.

When considering the role of listing status, I construct a matched sample of public and private firms. Despite my expectations that public and private firms would have different resilience levels, I was unable to find supporting evidence. This may indicate that, when matched on observable characteristics and directly comparing performance, private and public firms are more alike than initially suspected. It seems more likely, however, that the limited financial information available on the set of private firms limits this analysis. I maintain that it is interesting to investigate how listing status affects crisis period resilience and expect further study is necessary.

While selection bias makes identification challenging, I hope to document product market outcomes and contribute to the general understanding of competition and diversification. There is ample room for future study. My findings are limited to the consumer goods industry and two global economic shocks. Other industries may have a vastly different association between competition, diversification, and resilience. Similarly, studying alternative market crises or more localized shocks could provide additional insight. Given the weakened association between product diversification and revenue growth volatility during the COVID-19 pandemic, it may be useful to examine the relation of vertical integration or geographic diversification of

supply networks to firm resilience during supply shocks.

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Figure 1: Market competition and product diversification

Market competition and product diversification measures range between 0 and 1 with higher values indicating intense competition or a very diversified product base. Construction is described in the data and measures section. # Rivals is the average number of competitors observed for a firm in its product markets. # Products is the average number of products a firm sells. The product density plot is capped at the 95<sup>th</sup> percentile due to large outliers (e.g., Procter and Gamble sold over 7,000 unique products in 2007 quarter 1).

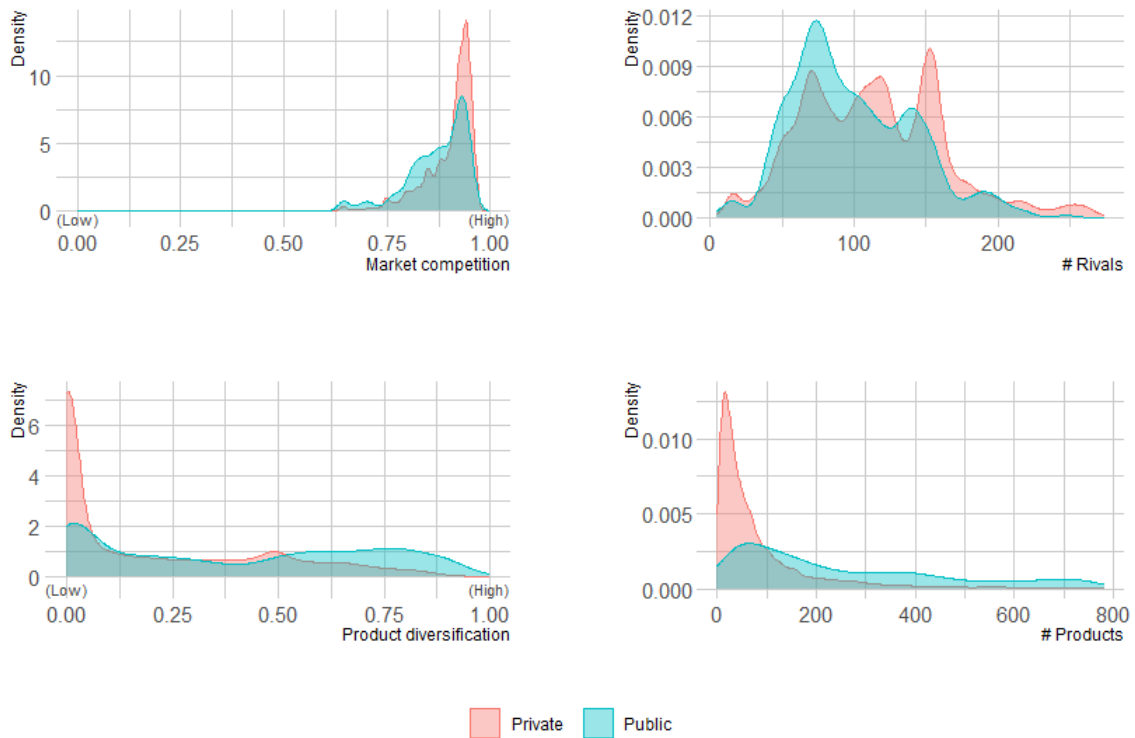


Figure 2: NielsenIQ revenue of public and private firms

The sample period begins 2006 quarter 1 and ends 2020 quarter 4. Dotted lines report the 25<sup>th</sup> and 75<sup>th</sup> percentiles and solid lines report median log NielsenIQ revenue. Grey-shaded periods indicate the 2008 financial crisis and COVID-19 pandemic. The beginning and end of the 2008 financial crisis are defined using US Business Cycle Expansions and Contractions data from The National Bureau of Economic Research (NBER) and I define COVID-19 as the year 2020. The yellow highlighted region reflects a data anomaly during the calendar year 2017. Data points affected by this period are removed from later analysis.

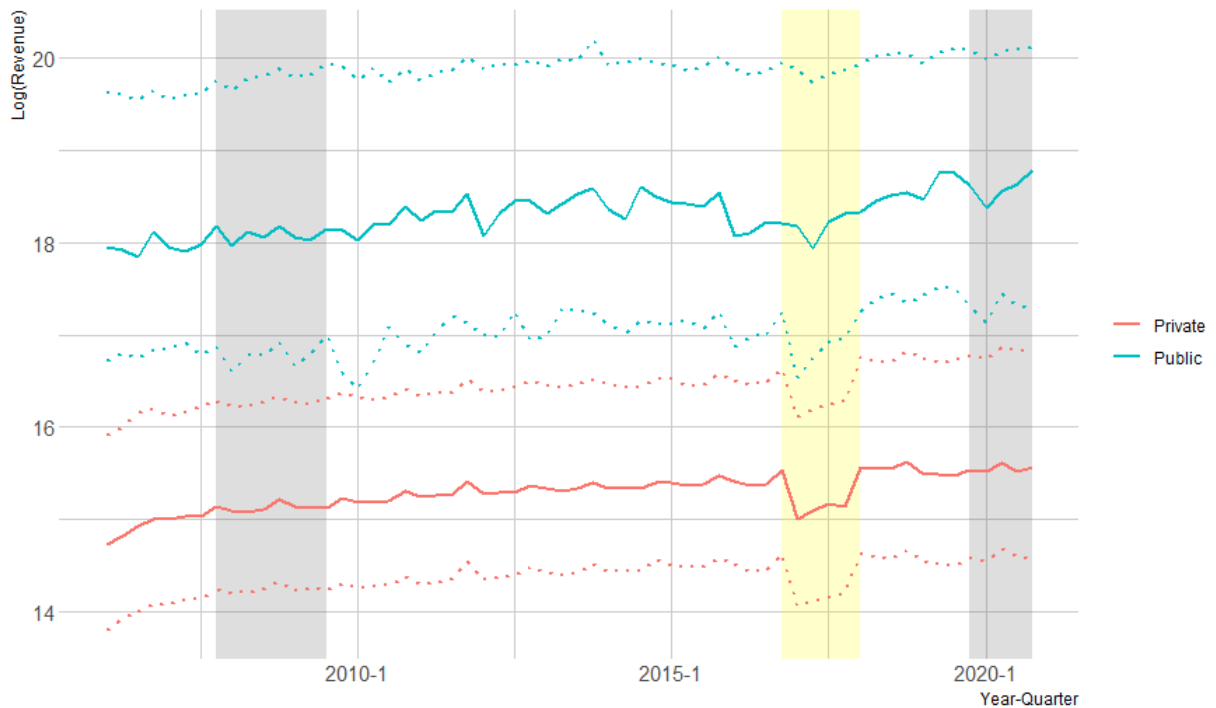


Figure 3: Variable correlations for private and public firms

Firm age is from CapitalIQ or inferred from length of time in the sample. Assets and debt data is from Compustat. Annual revenue is adjusted annual retail scanner revenue. Estimated markups are the percentage difference between a firm's average product price and the average price of equivalent generic products. Market competition ranges between 0 and 1 with higher values indicating more intense competition. Non-grocery revenue indicates the percentage of non-food revenue a firm generates (e.g., mass merchandise, health and beauty products). Product diversification is between 0 and 1 with higher values implying greater firm diversification. Realized stock returns are quarterly and return volatility is the quarterly standard deviation of daily realized returns from CRSP. Revenue growth is the percentage change in revenue from the prior quarter and revenue growth volatility is the quarterly standard deviation of weekly revenue growth. Estimated correlations are based on 2007 quarter 1.

**Variable correlations**

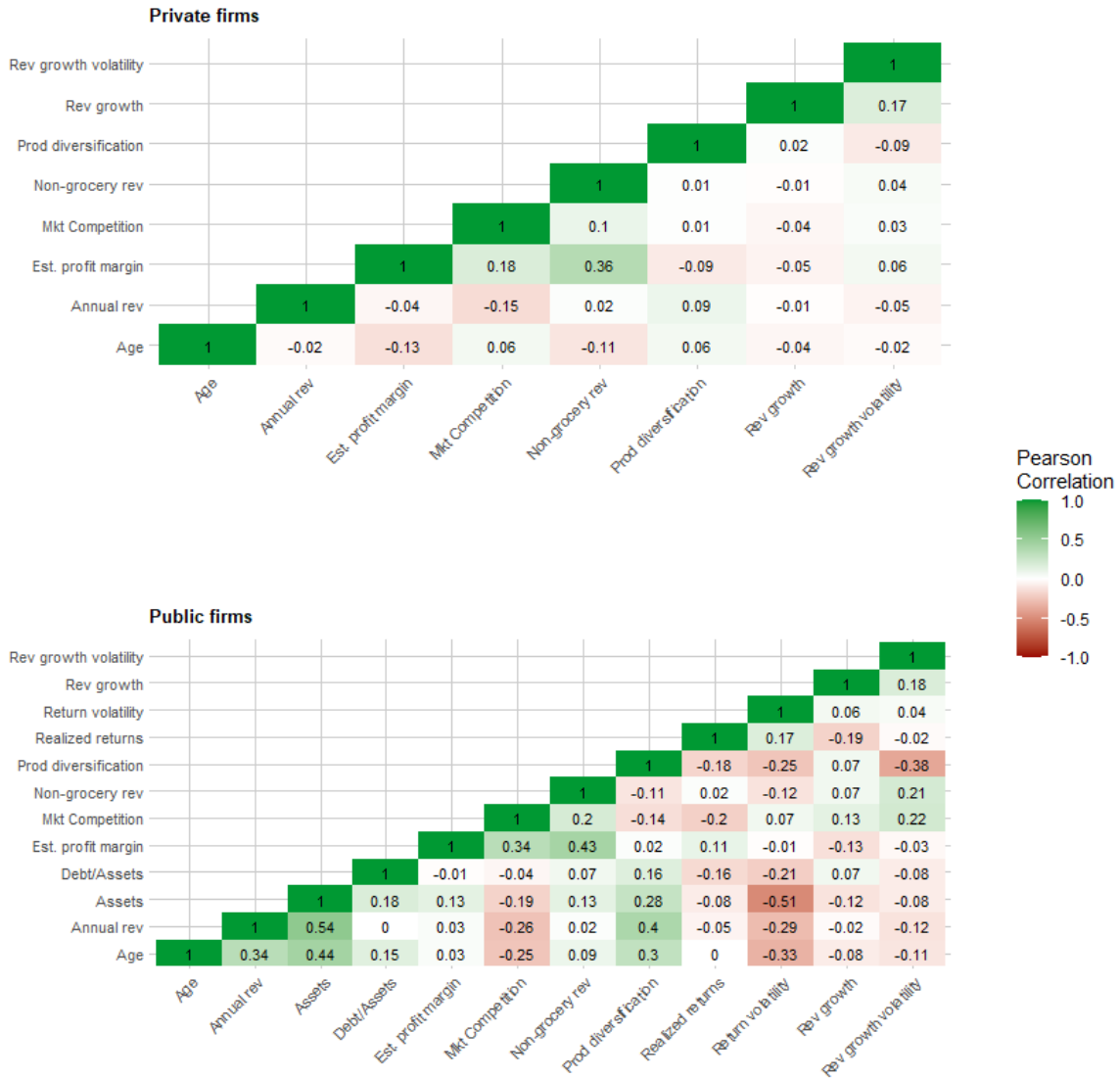


Figure 4: Pre- and post- matching distributions

Density plots in the left column display the distribution of the full sample of public and private firms prior to matching. Density plots on the right show after matching private and public firms on retail scanner revenue, number of products, and firm age.

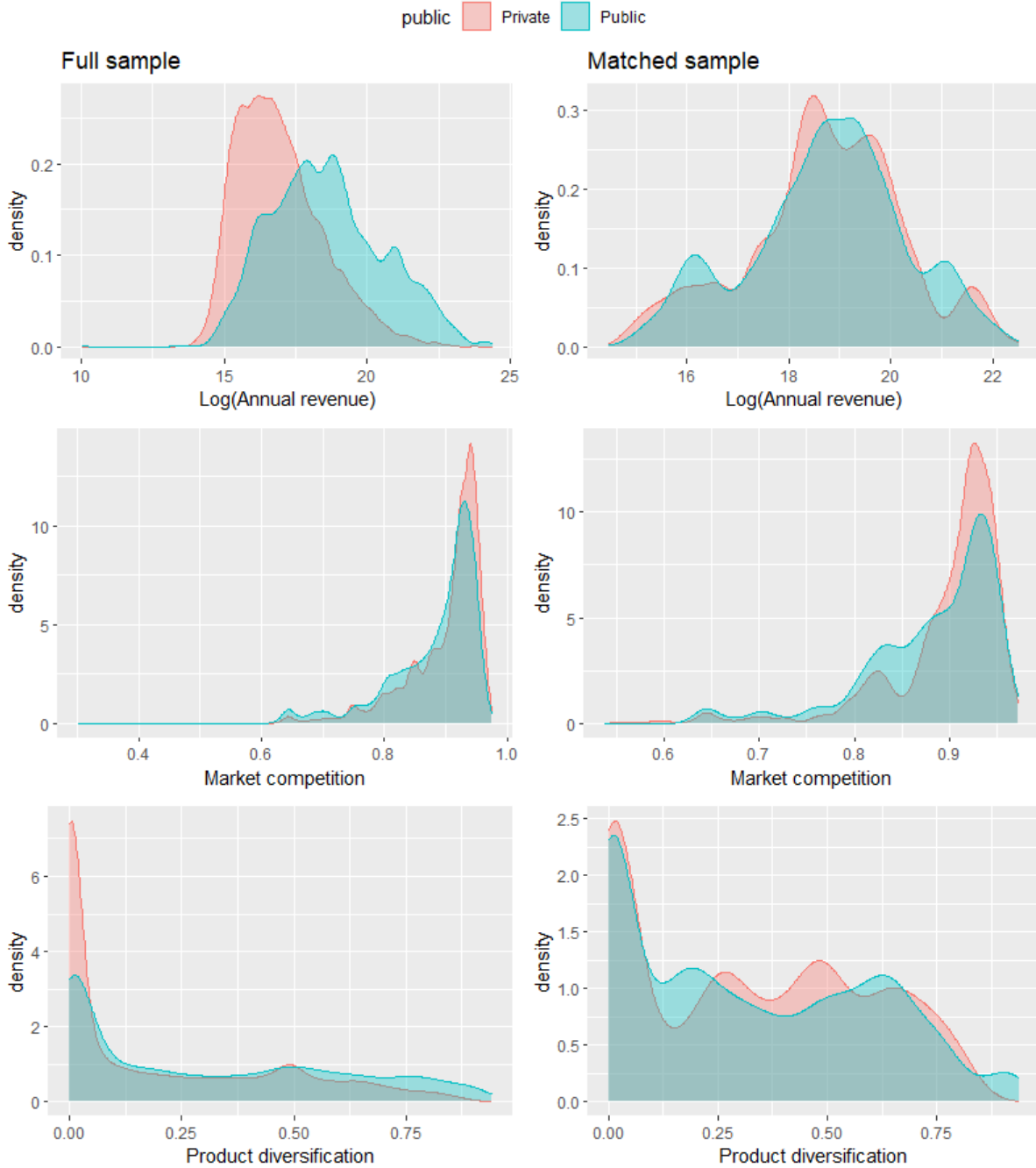


Table 1: Example market competition

Aisle descriptions are the NielsenIQ data description of a product group. Adjusted market HHI reflects the concentration of a market, scaled between 0 and 1. Higher values indicate more competitive markets. Revenue reported in millions reflects the rebalanced aisle revenue during 2007 quarter 1 and # UPCs is the count of all unique products sold in that aisle during 2007 quarter 1. The number of firms indicates the total number of firms selling at least one product in the aisle. In sample is the number of firms that met filtering requirements (at least 1 year with above 1 million in observed NielsenIQ revenue and above-median NielsenIQ revenue-to-Compustat sales ratio for public firms). Store brand is the number of retailers offering a generic version of a product. Retailers are identified anonymously so this is based on the number of retail chains selling a generic product. Product price for branded goods is the average product price for any non-generic product and store brand product price is the average price of a generic version.

Aisle	Adj. HHI	Revenue (mil)	# UPCs	# Firms			Product price	
				All	In sample	Store brand	Branded	Store brand
GUM	0.40	111.8	1336	180	42	51	1.61	1.10
DETERGENTS	0.59	638.7	4647	168	28	78	3.73	2.91
CEREAL	0.81	680.9	8545	228	44	73	3.58	2.10
PASTA	0.86	121.5	7143	364	73	76	2.21	0.98
COFFEE	0.86	377.9	8208	370	68	72	5.17	4.14
HOUSEHOLD CLEANERS	0.88	217.2	5204	377	80	80	3.75	1.87
SUGAR, SWEETENERS	0.88	118.0	2001	220	48	78	2.88	2.12
FLOUR	0.90	26.0	1367	227	44	75	2.51	1.43
SOFT DRINKS-NON-CARBONATED	0.95	608.2	7594	663	131	82	2.67	1.61
MILK	0.96	1001.4	8117	298	71	77	2.73	2.40

Table 2: Summary statistics

Summary statistics are based on 2007 quarter 1. NielsenIQ revenue is all observed retail scanner revenue, rebalanced to accommodate differences in product type coverage. Cumulative quarterly revenue growth is the log return of retail scanner revenue. Revenue growth volatility is the quarterly standard deviation of weekly revenue growth. Average product price is weighted by number of units sold. Average store brand product price is the average price for store brand products equivalent to those sold by a firm. Store brand price excludes any aisles that do not have a store brand version. Estimated profit margin is the difference between a firm's average product price and the average store brand price. Product diversification ranges between 0 and 1 with high values indicating less concentrated revenue. Number of products is the count of UPCs and number of aisles is the count of product groups as defined by the NielsenIQ retail scanner data. Product entry is the number of newly introduced products this quarter divided by the number of existing products in the prior quarter. Product exits is the number of products that existed in the prior quarter but no longer are observed divided by the total number of existing products in the prior quarter. Net change in number of products is the percentage change in the number of UPCs from the prior quarter. Market competition ranges between 0 and 1 with high values indicating greater competition. Average number of rivals is the weighted average number of competitors observed per aisle, weighted by share of firm revenue from each aisle. Non-food revenue percent is the share of total firm revenue from products in general merchandise, health and beauty, and non-food grocery departments. Accounting data is from Compustat. Debt-to-assets is total debt divided by total assets. Cash-to-assets is the ratio of cash and cash equivalents to total assets. Stock return data is from CRSP. Returns are realized returns.

Panel A: Private firms (N = 1,330)

Statistic	Mean	St. Dev.	Pctl(25)	Median	Pctl(75)
NielsenIQ revenue (Annual, mil)	82.42	349.31	5.09	12.53	39.24
Revenue growth (Quarter, %)	5.42	31.88	-8.85	3.69	17.34
Revenue growth volatility (Quarter, %)	15.26	13.58	7.41	11.32	17.85
Non-food revenue (%)	28.08	44.55	0.00	0.00	99.95
Avg. product price	5.68	6.85	2.34	3.51	6.20
Avg. store brand product price	3.26	2.34	1.78	2.40	3.89
Profit margin	2.03	3.42	0.06	1.01	2.56
Estimated markup (%)	69.68	91.64	5.51	45.44	106.04
Product diversification	0.21	0.25	0.00	0.06	0.40
# Products	134.20	385.45	20	48	110.8
# Aisles	4.45	5.12	1	3	5
Product entry (%)	6.25	7.83	0.00	4.30	8.91
Product exits (%)	2.58	4.13	0.00	1.21	3.89
Market competition	0.89	0.07	0.86	0.91	0.93
Avg. # Rivals	111.02	48.80	71.06	107.41	147.00

Panel B: Public firms (N = 85)

Statistic	Mean	St. Dev.	Pctl(25)	Median	Pctl(75)
NielsenIQ revenue (Annual, mil)	1,252.82	2,978.65	84.25	257.32	1,185.78
Revenue growth (Quarter, %)	4.58	29.79	-6.56	4.16	10.42
Revenue growth volatility (Quarter, %)	12.76	12.30	6.09	8.98	12.73
Non-food revenue (%)	39.22	46.90	0.00	0.74	99.83
Avg. product price	5.64	5.94	2.56	3.42	6.38
Avg. store brand product price	3.74	2.81	1.96	2.84	4.07
Profit margin	1.75	3.18	0.32	0.98	1.88
Estimated markup (%)	60.16	75.76	18.77	43.47	82.05
Product diversification	0.41	0.31	0.10	0.44	0.69
# Products	977.27	1,354.90	158	409	1,359
# Aisles	14.36	14.84	5	7	20
Product entry (%)	6.80	4.10	4.01	6.16	8.07
Product exits (%)	3.55	2.54	1.77	3.44	4.47
Market competition	0.86	0.07	0.82	0.87	0.92
Avg. # Rivals	93.00	39.16	62.30	82.01	124.23
Total Assets (Billions)	8.84	20.12	0.57	1.78	4.36
Observed adj. revenue (%)	23.63	18.93	8.42	17.06	31.95
Debt-to-Assets	0.27	0.18	0.14	0.24	0.38
Cash-to-Assets	0.09	0.12	0.02	0.05	0.10
Book-to-Market	0.34	0.28	0.16	0.31	0.42
Realized returns (%)	2.55	13.80	-6.10	0.72	7.87
Return volatility (%)	1.54	0.74	1.13	1.35	1.75

Table 3: Internal performance of sorted portfolios before and during crisis periods

Public and private firms are sorted into “high” or “low” categories based on whether they have above or below median levels of competition and diversification within listing status. Public firms are restricted to those with an above-median NielsenIQ revenue to Compustat sales ratio. T-statistics are reported below the differences. T-statistics above and below 1.96 are marked with green and red respectively. Product entry is measured at the firm-quarter level as the number of UPCs observed in the current quarter that did not appear in the prior quarter divided by last quarter total existing products. Average product price is the firm-quarter level average price per product, weighted by units sold. The estimated markup per aisle is the weighted average product price minus the weighted average price of a generic version of a comparable product, divided by the average price of the generic version. This is aggregated to the firm level as a weighted average, based on the percentage of total firm revenue from each aisle.

Competition Diversification	Private				Public				
	Low Low	Low High	High Low	High High	Low Low	Low High	High Low	High High	
<i>A. Entry rate (%)</i>									
2007	5.0%	4.7%	4.2%	4.5%	2007	5.0%	5.5%	5.9%	5.8%
2008	3.8%	3.7%	3.2%	3.4%	2008	5.6%	4.6%	4.8%	4.3%
Δ	-1.2%	-1.0%	-1.0%	-1.1%	Δ	0.5%	-0.9%	-1.1%	-1.5%
	(-4.73)	(-5.09)	(-4.33)	(-5.42)		(0.41)	(-4.81)	(-1.24)	(-2.24)
2019	4.1%	3.2%	3.7%	2.9%	2019	2.7%	3.2%	3.2%	3.3%
2020	0.5%	0.5%	0.4%	0.4%	2020	0.6%	0.8%	0.4%	0.6%
Δ	-3.6%	-2.7%	-3.3%	-2.4%	Δ	-2.1%	-2.4%	-2.7%	-2.7%
	(-8.86)	(-10.58)	(-7.71)	(-10.66)		(-7.73)	(-9.00)	(-4.67)	(-7.12)
<i>B. Product price</i>									
2007	\$ 4.86	\$ 4.22	\$ 8.09	\$ 5.68	2007	\$ 4.62	\$ 3.98	\$ 10.78	\$ 6.07
2008	\$ 5.11	\$ 4.38	\$ 8.28	\$ 5.76	2008	\$ 4.98	\$ 4.19	\$ 11.05	\$ 6.24
Δ	\$ 0.25	\$ 0.16	\$ 0.19	\$ 0.09	Δ	\$ 0.36	\$ 0.21	\$ 0.27	\$ 0.18
	(3.50)	(5.08)	(3.88)	(1.47)		(3.07)	(5.24)	(0.33)	(2.75)
2019	\$ 6.72	\$ 6.14	\$ 9.04	\$ 6.82	2019	\$ 5.10	\$ 5.24	\$ 7.44	\$ 5.49
2020	\$ 6.86	\$ 6.26	\$ 9.25	\$ 7.07	2020	\$ 5.55	\$ 5.35	\$ 7.65	\$ 5.84
Δ	\$ 0.14	\$ 0.12	\$ 0.22	\$ 0.24	Δ	\$ 0.45	\$ 0.12	\$ 0.20	\$ 0.36
	(2.94)	(2.16)	(4.42)	(4.83)		(4.95)	(1.26)	(1.90)	(1.54)
<i>C. Markup (%)</i>									
2007	51.4%	62.4%	65.2%	62.5%	2007	39.2%	61.5%	63.5%	64.7%
2008	50.6%	61.3%	62.8%	61.4%	2008	48.5%	61.3%	65.5%	65.4%
Δ	-0.8%	-1.1%	-2.4%	-1.1%	Δ	9.3%	-0.2%	2.0%	0.7%
	(-0.96)	(-1.20)	(-3.72)	(-1.41)		(1.50)	(-0.10)	(0.95)	(0.44)
2019	46.0%	60.3%	57.8%	59.1%	2019	22.1%	41.5%	66.2%	36.8%
2020	45.5%	59.1%	56.8%	60.9%	2020	26.9%	40.8%	63.4%	34.9%
Δ	-0.4%	-1.2%	-1.0%	1.8%	Δ	4.8%	-0.8%	-2.8%	-1.9%
	(-0.60)	(-1.36)	(-1.76)	(2.45)		(2.49)	(-0.58)	(-1.47)	(-0.72)

Table 4: Revenue performance of sorted portfolios before and during crisis periods

Public and private firms are sorted into “high” or “low” categories based on whether they have above or below median levels of competition and diversification within listing status. Public firms are restricted to those with an above-median NielsenIQ revenue to Compustat sales ratio. T-statistics are reported below the differences. T-statistics above and below 1.96 are marked with green and red respectively. Revenue growth is the percentage change in quarterly retail scanner sales revenue from the prior quarter. Revenue growth volatility is measured as the standard deviation of weekly revenue growth (percentage change from prior week) in a given quarter.

Competition Diversification	Private				Public				
	Low Low	Low High	High Low	High High	Low Low	Low High	High Low	High High	
<i>A. Revenue growth</i>									
2007	13.0%	10.2%	10.5%	8.8%	2007	10.0%	4.3%	16.4%	5.6%
2008	13.2%	9.8%	7.4%	6.3%	2008	21.6%	1.4%	11.8%	-0.9%
Δ	0.2%	-0.4%	-3.1%	-2.5%	Δ	11.6%	-2.9%	-4.6%	-6.4%
	(0.16)	(-0.40)	(-3.76)	(-3.91)		(1.29)	(-2.61)	(-1.74)	(-2.20)
2019	13.8%	7.3%	16.0%	7.6%	2019	4.9%	0.0%	37.4%	8.7%
2020	5.5%	4.2%	7.2%	5.1%	2020	8.9%	0.1%	13.8%	2.3%
Δ	-8.4%	-3.1%	-8.6%	-2.5%	Δ	3.9%	0.1%	-23.5%	-6.3%
	(-3.10)	(-2.07)	(-3.38)	(-1.40)		(1.00)	(0.15)	(-1.12)	(-1.63)
<i>B. Revenue growth volatility</i>									
2007	16.4%	13.5%	16.0%	14.9%	2007	16.9%	7.5%	19.1%	10.3%
2008	16.5%	13.1%	15.5%	14.7%	2008	17.7%	6.7%	20.1%	9.7%
Δ	0.2%	-0.3%	-0.4%	-0.3%	Δ	0.8%	-0.8%	1.1%	-0.6%
	(0.49)	(-1.51)	(-1.59)	(-0.84)		(0.56)	(-2.27)	(0.87)	(-1.17)
2019	17.1%	11.8%	19.9%	13.0%	2019	11.1%	6.0%	12.8%	9.0%
2020	16.1%	13.2%	18.7%	14.0%	2020	12.1%	8.1%	13.1%	9.5%
Δ	-1.0%	1.4%	-1.2%	1.0%	Δ	1.0%	2.1%	0.2%	0.5%
	(-1.25)	(3.14)	(-1.83)	(2.75)		(1.68)	(6.05)	(0.12)	(1.08)

Table 5: Compustat-based performance of sorted portfolios before and during crisis periods

Public and private firms are sorted into "high" or "low" categories based on whether they have above or below median levels of competition and diversification within listing status. Public firms are restricted to those with an above-median NielsenIQ revenue to Compustat sales ratio. T-statistics are reported below the differences. T-statistics above and below 1.96 are marked with green and red respectively. CAPX/Assets is capital expenditures divided by total assets and proxies for investment. Compustat profit margin is sales minus cost of goods sold, divided by sales. Realized returns are the quarterly cumulative raw return from CRSP. Return volatility is a quarterly standard deviation of daily stock returns.

Competition Diversification	Low Low	Low High	High Low	High High		Low Low	Low High	High Low	High High
<i>A. CAPX / Assets</i>					<i>B. Profit margin (Compustat)</i>				
2007	0.030	0.020	0.029	0.019	2007	39.7%	48.8%	29.7%	33.5%
2008	0.029	0.020	0.026	0.019	2008	36.5%	47.7%	35.7%	27.7%
Δ	-0.001 (-0.12)	0.000 (0.27)	-0.003 (-1.38)	0.000 (-0.15)	Δ	-3.3% (-3.96)	-1.2% (-2.82)	6.0% (0.84)	-5.8% (-0.73)
2019	0.023	0.013	0.022	0.022	2019	41.0%	49.8%	40.3%	35.1%
2020	0.022	0.013	0.019	0.021	2020	40.8%	50.1%	40.2%	35.6%
Δ	-0.001 (-1.04)	-0.001 (-0.61)	-0.003 (-1.58)	-0.001 (-0.87)	Δ	-0.2% (-0.25)	0.4% (1.13)	-0.1% (-0.08)	0.5% (0.73)
<i>C. Realized returns</i>					<i>D. Return volatility</i>				
2007	1.0%	-0.9%	-1.5%	1.3%	2007	2.0%	1.7%	1.7%	1.8%
2008	-12.3%	-4.6%	-9.7%	-8.4%	2008	3.2%	2.6%	3.1%	3.1%
Δ	-13.3% (-4.24)	-3.1% (-1.31)	-7.4% (-3.26)	-9.7% (-4.09)	Δ	1.2% (7.09)	1.0% (7.24)	1.4% (10.20)	1.3% (6.85)
2019	7.4%	5.0%	5.2%	6.7%	2019	1.8%	1.6%	2.0%	1.8%
2020	5.9%	5.4%	7.8%	1.4%	2020	2.8%	2.4%	3.4%	2.7%
Δ	-1.5% (-0.54)	0.4% (0.24)	2.6% (0.61)	-5.3% (-2.49)	Δ	1.0% (8.90)	0.9% (8.98)	1.3% (5.46)	0.9% (5.39)

Table 6: Product introductions and discontinuations during market crises

Product entry (%) is the number of new UPCs at time  $t$  divided by the number of existing UPCs at time  $t - 1$ . Product exits (%) is the number of UPCs discontinued (appeared at time  $t - 1$  but are not observed at time  $t$ ) divided by existing UPCs from the prior quarter. Product exits are restricted to those that do not reappear within the following four quarters so the sample does not include COVID. Market competition and product diversification range between 0 and 1 with high values indicating more competition or more dispersed revenue. GR is a dummy variable equal to 1 based on the NBER dates of the 2008 financial crisis and COVID is a dummy variable equal to 1 during the year 2020. Unreported NielsenIQ controls include log revenue, log age, percent non-food revenue, and log # existing UPCs. Non-food revenue percentage is allowed to have differing effects during crisis periods. Unreported Compustat controls are log assets and debt-to-assets. All control variables are lagged. Observations are filtered to require above median NielsenIQ revenue to Compustat sales ratio for public firms and eliminating 2017 and first quarter of 2018 due to a data concern. Year-quarter and firm fixed effects are included. Observations are quarterly. Standard errors are reported in parentheses and are clustered by firm.

	<i>Dependent variable:</i>			
	Product entry <sub><i>t</i></sub> (%)		Product exits <sub><i>t</i></sub> (%)	
	Private	Public	Private	Public
	(1)	(2)	(3)	(4)
Mkt competition <sub><i>t-1</i></sub>	0.018 (0.014)	0.011 (0.032)	-0.013 (0.013)	0.003 (0.029)
Mkt competition <sub><i>t-1</i></sub> × GR <sub><i>t</i></sub>	-0.008 (0.012)	-0.022 (0.020)	-0.024*** (0.008)	-0.012 (0.014)
Mkt competition <sub><i>t-1</i></sub> × COVID <sub><i>t</i></sub>	0.015 (0.011)	-0.044 (0.027)		
Prod. diversification <sub><i>t-1</i></sub>	0.008** (0.004)	0.017** (0.009)	-0.013*** (0.003)	0.001 (0.009)
Prod. diversification <sub><i>t-1</i></sub> × GR <sub><i>t</i></sub>	0.006** (0.002)	0.00001 (0.005)	-0.002 (0.002)	0.002 (0.003)
Prod. diversification <sub><i>t-1</i></sub> × COVID <sub><i>t</i></sub>	-0.006*** (0.002)	-0.006 (0.004)		
Fixed effects	YQ & Firm	YQ & Firm	YQ & Firm	YQ & Firm
NielsenIQ controls	Y	Y	Y	Y
Compustat controls	N	Y	N	Y
Observations	69,790	4,438	63,748	3,995
R <sup>2</sup>	0.235	0.467	0.285	0.460
Adjusted R <sup>2</sup>	0.217	0.439	0.268	0.430

Note:

\*p<0.1, \*\*p<0.05, \*\*\*p<0.01

Table 7: Product pricing during market crises

Estimated markup is the firm-level weighted average of aisle markups where aisle markups are found as average product price minus average generic product price, divided by average generic product price. Estimated profit margin is average product price minus average generic product price within an aisle, aggregated to the firm level, weighted by the percent of total firm revenue per aisle. Market competition and product diversification range between 0 and 1 with high values indicating more competition or more dispersed revenue. GR is a dummy variable equal to 1 based on the NBER dates of the 2008 financial crisis and COVID is a dummy variable equal to 1 during the year 2020. Unreported NielsenIQcontrols include log revenue, log age, and percent non-food revenue. Non-food revenue percentage is allowed to have differing effects during crisis periods. Unreported Compustat controls are log assets and debt-to-assets. All control variables are lagged. Observations are filtered to require above median NielsenIQrevenue to Compustat sales ratio for public firms and eliminating 2017 and first quarter of 2018 due to a data concern. Year-quarter and firm fixed effects are included. Observations are quarterly. Standard errors are reported in parentheses and are clustered by firm.

	<i>Dependent variable:</i>			
	Estimated markup <sub>t</sub> (%)		Estimated profit margin <sub>t</sub> (\$)	
	Private	Public	Private	Public
	(1)	(2)	(3)	(4)
Mkt competition <sub>t-1</sub>	-0.775*** (0.222)	-1.116* (0.593)	-2.987*** (0.780)	-4.870** (2.411)
Mkt competition <sub>t-1</sub> × GR <sub>t</sub>	0.337*** (0.120)	0.151 (0.280)	1.725*** (0.520)	3.095** (1.432)
Mkt competition <sub>t-1</sub> × COVID <sub>t</sub>	0.649*** (0.141)	-0.194 (0.369)	2.626*** (0.685)	1.610 (1.905)
Prod. diversification <sub>t-1</sub>	-0.034 (0.046)	0.200 (0.171)	-0.615** (0.243)	0.149 (0.478)
Prod. diversification <sub>t-1</sub> × GR <sub>t</sub>	0.002 (0.023)	0.116** (0.054)	-0.178** (0.080)	0.695*** (0.234)
Prod. diversification <sub>t-1</sub> × COVID <sub>t</sub>	0.017 (0.023)	0.054 (0.064)	-0.047 (0.110)	0.326 (0.283)
Fixed effects	YQ & Firm	YQ & Firm	YQ & Firm	YQ & Firm
NielsenIQcontrols	Y	Y	Y	Y
Compustat controls	N	Y	N	Y
Observations	62,862	4,167	63,389	3,884
R <sup>2</sup>	0.875	0.865	0.879	0.912
Adjusted R <sup>2</sup>	0.872	0.857	0.876	0.907

Note:

\*p<0.1; \*\*p<0.05; \*\*\*p<0.01

Table 8: Revenue growth during market crises

Revenue growth is measured as the percentage change in observed revenue from the prior to current quarter . Revenue growth volatility is measured as the standard deviation of weekly revenue growth during quarter  $t$ . Market competition and product diversification range between 0 and 1 with high values indicating more competition or more dispersed revenue. GR is a dummy variable equal to 1 based on the NBER dates of the 2008 financial crisis and COVID is a dummy variable equal to 1 during the year 2020. Unreported NielsenIQ controls include log revenue, log age, and percent non-food revenue. Non-food revenue percentage is allowed to have differing effects during crisis periods. Unreported Compustat controls are log assets and debt-to-assets. All control variables are lagged. Observations are filtered to require above median NielsenIQ revenue to Compustat sales ratio for public firms and eliminating 2017 and first quarter of 2018 due to a data concern. Year-quarter and firm fixed effects are included. Observations are quarterly. Standard errors are reported in parentheses and are clustered by firm.

	<i>Dependent variable:</i>			
	Revenue growth $_t$		StDev(Revenue growth $_t$ )	
	Private	Public	Private	Public
	(1)	(2)	(3)	(4)
Mkt competition $_{t-1}$	-1.051 (0.796)	-0.353 (0.586)	-0.116 (0.083)	-0.038 (0.103)
Mkt competition $_{t-1} \times GR_t$	-0.064 (0.116)	-0.503* (0.275)	-0.002 (0.028)	-0.061* (0.035)
Mkt competition $_{t-1} \times COVID_t$	0.145 (0.101)	-0.365* (0.189)	-0.041 (0.031)	-0.095** (0.046)
Prod. diversification $_{t-1}$	0.086 (0.070)	0.169 (0.140)	-0.027** (0.012)	-0.075*** (0.027)
Prod. diversification $_{t-1} \times GR_t$	0.004 (0.017)	0.030 (0.050)	0.0001 (0.005)	0.007 (0.012)
Prod. diversification $_{t-1} \times COVID_t$	0.045** (0.019)	0.026 (0.030)	0.017** (0.008)	0.022** (0.010)
Fixed effects	YQ & Firm	YQ & Firm	YQ & Firm	YQ & Firm
NielsenIQ controls	Y	Y	Y	Y
Compustat controls	N	Y	N	Y
Observations	69,790	4,438	69,788	4,438
R <sup>2</sup>	0.145	0.253	0.563	0.674
Adjusted R <sup>2</sup>	0.125	0.214	0.552	0.657

Note:

\*p<0.1; \*\*p<0.05; \*\*\*p<0.01

Table 9: Stock returns during market crisis

Realized returns are the cumulative realized stock return based on CRSP data. Return volatility is the quarterly standard deviation of daily returns. Market competition and product diversification range between 0 and 1 with high values indicating more competition or more dispersed revenue. GR is a dummy variable equal to 1 based on the NBER dates of the 2008 financial crisis and COVID is a dummy variable equal to 1 during the year 2020. Unreported NielsenIQ controls are log revenue, log age, and percent non-food revenue. Unreported Compustat controls include log assets, book-to-market, and debt-to-assets. Non-food revenue percentage is allowed to have differing effects during crisis periods. All control variables are lagged. Observations are filtered to require above median NielsenIQ revenue to Compustat sales ratio for public firms and eliminating 2017 and first quarter of 2018 due to a data concern. Year-quarter and firm fixed effects are included. Observations are quarterly. Standard errors are reported in parentheses and are clustered by firm.

	<i>Dependent variable:</i>	
	Quarterly returns <sub>t</sub>	Return volatility <sub>t</sub>
	(1)	(2)
Mkt competition <sub>t-1</sub>	0.084 (0.247)	-0.024 (0.017)
Mkt competition <sub>t-1</sub> × GR <sub>t</sub>	0.567 (0.443)	0.056*** (0.016)
Mkt competition <sub>t-1</sub> × COVID <sub>t</sub>	-0.319* (0.168)	0.018 (0.016)
Prod. diversification <sub>t-1</sub>	-0.101* (0.053)	-0.003 (0.005)
Prod. diversification <sub>t-1</sub> × GR <sub>t</sub>	-0.032 (0.091)	-0.011** (0.005)
Prod. diversification <sub>t-1</sub> × COVID <sub>t</sub>	-0.019 (0.031)	-0.003 (0.003)
Fixed effects	YQ & Firm	YQ & Firm
NielsenIQ controls	Y	Y
Compustat controls	Y	Y
Observations	2,228	2,228
R <sup>2</sup>	0.285	0.726
Adjusted R <sup>2</sup>	0.235	0.707

*Note:* \*p<0.1; \*\*p<0.05; \*\*\*p<0.01

Table 10: Product introduction rates and alternative measures of competition

Product entry is the number of UPCs appearing in the retail scanner data for the first time this quarter divided by the number of existing products in the prior quarter. Number of rivals and average market share per aisle are used as alternative measures of competition. Prod. diversification refers to the concentration-based estimates of product diversification. GR is a dummy variable equal to 1 during the 2008 financial crisis. COVID is a dummy variable equal to 1 during the pandemic. All columns included NielsenIQ controls and the public firm subsample includes controls from Compustat. NielsenIQ controls include log annual retail scanner revenue, log age, and the proportion of total revenue from non-food items. Non-food revenue has interaction terms with market crises to allow the relation to vary during market crises. Compustat controls include log assets, debt-to-assets, and the proportion of total firm sales observed. Firms with below median observed revenue are excluded from the sample. Data from 2017 and first quarter 2018 is excluded due to a data collection complication. Standard errors are reported in parentheses and clustered by firm.

	Product entry (%)			
	Private	Public	Private	Public
	(1)	(2)	(3)	(4)
Log(# Rivals <sub>t-1</sub> )	0.003 (0.003)	-0.004 (0.005)		
Log(# Rivals <sub>t-1</sub> ) × GR <sub>t</sub>	-0.001 (0.001)	0.001 (0.003)		
Log(# Rivals <sub>t-1</sub> ) × COVID <sub>t</sub>	-0.001* (0.001)	-0.003 (0.003)		
Avg. firm mkt share <sub>t-1</sub>			-0.029 (0.034)	-0.046 (0.032)
Avg. firm mkt share <sub>t-1</sub> × GR <sub>t</sub>			0.026** (0.012)	-0.003 (0.013)
Avg. firm mkt share <sub>t-1</sub> × COVID <sub>t</sub>			0.005 (0.011)	0.001 (0.013)
Prod. diversification <sub>t-1</sub>	0.008** (0.004)	0.020** (0.008)	0.008* (0.004)	0.016* (0.009)
Prod. diversification <sub>t-1</sub> × GR <sub>t</sub>	0.006** (0.002)	0.001 (0.005)	0.006** (0.002)	0.001 (0.005)
Prod. diversification <sub>t-1</sub> × COVID <sub>t</sub>	-0.006*** (0.002)	-0.006 (0.004)	-0.006*** (0.002)	-0.006 (0.004)
Fixed effects	YQ & Firm	YQ & Firm	YQ & Firm	YQ & Firm
Observations	69,790	4,438	69,790	4,438
Adjusted R <sup>2</sup>	0.217	0.439	0.217	0.439

Note:

\*p<0.1; \*\*p<0.05; \*\*\*p<0.01

Table 11: Product introduction rates and alternative measures of diversification

Product entry is the number of UPCs appearing in the retail scanner data for the first time this quarter divided by the number of existing products in the prior quarter. Mkt competition refers to the concentration-based estimate of competition faced used in the main analysis. Number of aisles and average product similarity are used as alternative measures of diversification. GR is a dummy variable equal to 1 during the 2008 financial crisis. COVID is a dummy variable equal to 1 during the pandemic. All columns included NielsenIQ controls and the public firm subsample includes controls from Compustat. NielsenIQ controls include log annual retail scanner revenue, log age, and the proportion of total revenue from non-food items. Non-food revenue has interaction terms with market crises to allow the relation to vary during market crises. Compustat controls include log assets, debt-to-assets, and the proportion of total firm sales observed. Firms with below median observed revenue are excluded from the sample. Data from 2017 and first quarter 2018 is excluded due to a data collection complication. Standard errors are reported in parentheses and clustered by firm.

	Product entry (%)			
	Private (1)	Public (2)	Private (3)	Public (4)
Mkt competition <sub>t-1</sub>	0.016 (0.014)	0.013 (0.031)	0.029* (0.016)	0.003 (0.033)
Mkt competition <sub>t-1</sub> × GR <sub>t</sub>	-0.008 (0.012)	-0.023 (0.020)	-0.017 (0.014)	-0.023 (0.022)
Mkt competition <sub>t-1</sub> × COVID <sub>t</sub>	0.015 (0.011)	-0.047* (0.027)	0.025** (0.013)	-0.048* (0.028)
Log(# Aisles <sub>t-1</sub> )	0.0004 (0.001)	0.001 (0.003)		
Log(# Aisles <sub>t-1</sub> ) × GR <sub>t</sub>	0.002*** (0.001)	-0.0001 (0.002)		
Log(# Aisles <sub>t-1</sub> ) × COVID <sub>t</sub>	-0.002*** (0.001)	-0.003** (0.001)		
Avg. similarity (%)			-0.014 (0.012)	-0.061 (0.048)
Avg. similarity (%) × GR <sub>t</sub>			-0.005 (0.016)	-0.070 (0.093)
Avg. similarity (%) × COVID <sub>t</sub>			0.008 (0.012)	0.066 (0.041)
Fixed effects	YQ & Firm	YQ & Firm	YQ & Firm	YQ & Firm
Observations	69,790	4,438	51,709	4,192
Adjusted R <sup>2</sup>	0.217	0.438	0.250	0.445

Note:

\*p<0.1; \*\*p<0.05; \*\*\*p<0.01

Table 12: Estimated markups and alternative measures of competition

Estimated markups are measured as the percentage difference between a firm's average product price in an aisle and the price of comparable store brand products, weighted by the proportion of total revenue from a given aisle. Number of rivals and average market share per aisle are used as alternative measures of competition. Prod. diversification refers to the concentration-based estimates of product diversification. GR is a dummy variable equal to 1 during the 2008 financial crisis. COVID is a dummy variable equal to 1 during the pandemic. All columns included NielsenIQ controls and the public firm subsample includes controls from Compustat. NielsenIQ controls include log annual retail scanner revenue, log age, and the proportion of total revenue from non-food items. Non-food revenue has interaction terms with market crises to allow the relation to vary during market crises. Compustat controls include log assets, debt-to-assets, and the proportion of total firm sales observed. Firms with below median observed revenue are excluded from the sample. Data from 2017 and first quarter 2018 is excluded due to a data collection complication. Standard errors are reported in parentheses and clustered by firm.

	Estimated markup (%)			
	Private (1)	Public (2)	Private (3)	Public (4)
Log(# Rivals <sub>t-1</sub> )	-0.018 (0.045)	-0.065 (0.098)		
Log(# Rivals <sub>t-1</sub> ) × GR <sub>t</sub>	-0.039 (0.028)	0.030 (0.059)		
Log(# Rivals <sub>t-1</sub> ) × COVID <sub>t</sub>	0.009 (0.016)	-0.008 (0.039)		
Avg. firm mkt share <sub>t-1</sub>			-0.393 (0.401)	-0.366 (0.892)
Avg. firm mkt share <sub>t-1</sub> × GR <sub>t</sub>			0.290 (0.237)	-0.479* (0.245)
Avg. firm mkt share <sub>t-1</sub> × COVID <sub>t</sub>			0.309 (0.230)	-0.086 (0.294)
Prod. diversification <sub>t-1</sub>	-0.137* (0.080)	0.389* (0.234)	-0.144* (0.080)	0.324 (0.222)
Prod. diversification <sub>t-1</sub> × GR <sub>t</sub>	-0.039 (0.033)	0.165** (0.070)	-0.033 (0.032)	0.206*** (0.069)
Prod. diversification <sub>t-1</sub> × COVID <sub>t</sub>	-0.002 (0.035)	0.066 (0.071)	-0.004 (0.034)	0.076 (0.082)
Fixed effects	YQ & Firm	YQ & Firm	YQ & Firm	YQ & Firm
Observations	62,862	4,167	62,862	4,167
Adjusted R <sup>2</sup>	0.844	0.840	0.844	0.841

Note:

\*p<0.1; \*\*p<0.05; \*\*\*p<0.01

Table 13: Estimated markups and alternative measures of diversification

Estimated markups are measured as the percentage difference between a firm's average product price in an aisle and the price of comparable store brand products, weighted by the proportion of total revenue from a given aisle. Mkt competition refers to the concentration-based estimate of competition faced used in the main analysis. Number of aisles and average product similarity are used as alternative measures of diversification. GR is a dummy variable equal to 1 during the 2008 financial crisis. COVID is a dummy variable equal to 1 during the pandemic. All columns included NielsenIQ controls and the public firm subsample includes controls from Compustat. NielsenIQ controls include log annual retail scanner revenue, log age, and the proportion of total revenue from non-food items. Non-food revenue has interaction terms with market crises to allow the relation to vary during market crises. Compustat controls include log assets, debt-to-assets, and the proportion of total firm sales observed. Firms with below median observed revenue are excluded from the sample. Data from 2017 and first quarter 2018 is excluded due to a data collection complication. Standard errors are reported in parentheses and clustered by firm.

	Estimated markup (%)			
	Private (1)	Public (2)	Private (3)	Public (4)
Mkt competition <sub>t-1</sub>	-1.109*** (0.308)	-1.021 (0.691)	-1.381*** (0.323)	-0.868 (0.733)
Mkt competition <sub>t-1</sub> × GR <sub>t</sub>	0.446*** (0.163)	0.103 (0.339)	0.102 (0.177)	0.078 (0.376)
Mkt competition <sub>t-1</sub> × COVID <sub>t</sub>	0.648*** (0.203)	-0.139 (0.426)	0.609** (0.244)	-0.038 (0.458)
Log(# Aisles <sub>t-1</sub> )	-0.032 (0.020)	0.050 (0.048)		
Log(# Aisles <sub>t-1</sub> ) × GR <sub>t</sub>	-0.008 (0.009)	0.037* (0.021)		
Log(# Aisles <sub>t-1</sub> ) × COVID <sub>t</sub>	0.006 (0.010)	0.029 (0.020)		
Avg. similarity (%)			-0.151 (0.185)	-2.278** (1.010)
Avg. similarity (%) × GR <sub>t</sub>			0.887* (0.460)	3.924** (1.663)
Avg. similarity (%) × COVID <sub>t</sub>			-0.240 (0.181)	-0.376 (0.570)
Fixed effects	YQ & Firm	YQ & Firm	YQ & Firm	YQ & Firm
Observations	62,862	4,167	47,525	3,957
Adjusted R <sup>2</sup>	0.845	0.840	0.846	0.839

Note:

\*p<0.1; \*\*p<0.05; \*\*\*p<0.01

Table 14: Revenue growth and alternative measures of competition

Revenue growth is measured as the percentage change in revenue from the prior quarter. Number of rivals and average market share per aisle are used as alternative measures of competition. Prod. diversification refers to the concentration-based estimates of product diversification. GR is a dummy variable equal to 1 during the 2008 financial crisis. COVID is a dummy variable equal to 1 during the pandemic. All columns included NielsenIQ controls and the public firm subsample includes controls from Compustat. NielsenIQ controls include log annual retail scanner revenue, log age, and the proportion of total revenue from non-food items. Non-food revenue has interaction terms with market crises to allow the relation to vary during market crises. Compustat controls include log assets, debt-to-assets, and the proportion of total firm sales observed. Firms with below median observed revenue are excluded from the sample. Data from 2017 and first quarter 2018 is excluded due to a data collection complication. Standard errors are reported in parentheses and clustered by firm.

	Revenue growth (%)			
	Private (1)	Public (2)	Private (3)	Public (4)
Log(# Rivals <sub>t-1</sub> )	-0.032 (0.041)	-0.195* (0.102)		
Log(# Rivals <sub>t-1</sub> ) × GR <sub>t</sub>	-0.024*** (0.007)	-0.089** (0.037)		
Log(# Rivals <sub>t-1</sub> ) × COVID <sub>t</sub>	-0.006 (0.007)	0.013 (0.019)		
Avg. firm mkt share <sub>t-1</sub>			-4.681*** (1.077)	-2.742** (1.138)
Avg. firm mkt share <sub>t-1</sub> × GR <sub>t</sub>			0.399*** (0.134)	0.522* (0.282)
Avg. firm mkt share <sub>t-1</sub> × COVID <sub>t</sub>			0.259 (0.187)	-0.051 (0.132)
Prod. diversification <sub>t-1</sub>	0.102 (0.068)	0.260 (0.169)	0.035 (0.069)	0.056 (0.135)
Prod. diversification <sub>t-1</sub> × GR <sub>t</sub>	-0.0003 (0.018)	0.027 (0.047)	0.005 (0.018)	0.016 (0.067)
Prod. diversification <sub>t-1</sub> × COVID <sub>t</sub>	0.038** (0.018)	0.027 (0.030)	0.033* (0.018)	0.030 (0.033)
Fixed effects	YQ & Firm	YQ & Firm	YQ & Firm	YQ & Firm
Observations	69,790	4,438	69,790	4,438
Adjusted R <sup>2</sup>	0.124	0.218	0.130	0.228

Note:

\*p<0.1; \*\*p<0.05; \*\*\*p<0.01

Table 15: Revenue growth and alternative measures of diversification

Revenue growth is measured as the percentage change in revenue from the prior quarter. Mkt competition refers to the concentration-based estimate of competition faced used in the main analysis. Number of aisles and average product similarity are used as alternative measures of diversification. GR is a dummy variable equal to 1 during the 2008 financial crisis. COVID is a dummy variable equal to 1 during the pandemic. All columns included NielsenIQ controls and the public firm subsample includes controls from Compustat. NielsenIQ controls include log annual retail scanner revenue, log age, and the proportion of total revenue from non-food items. Non-food revenue has interaction terms with market crises to allow the relation to vary during market crises. Compustat controls include log assets, debt-to-assets, and the proportion of total firm sales observed. Firms with below median observed revenue are excluded from the sample. Data from 2017 and first quarter 2018 is excluded due to a data collection complication. Standard errors are reported in parentheses and clustered by firm.

	Revenue growth (%)			
	Private (1)	Public (2)	Private (3)	Public (4)
Mkt competition <sub>t-1</sub>	-1.068 (0.793)	-0.329 (0.582)	-0.332 (0.673)	-0.042 (0.570)
Mkt competition <sub>t-1</sub> × GR <sub>t</sub>	-0.066 (0.116)	-0.526* (0.275)	-0.136 (0.134)	-0.697** (0.340)
Mkt competition <sub>t-1</sub> × COVID <sub>t</sub>	0.141 (0.100)	-0.367* (0.187)	0.296** (0.122)	-0.248 (0.184)
Log(# Aisles <sub>t-1</sub> )	-0.034*** (0.010)	0.035* (0.020)		
Log(# Aisles <sub>t-1</sub> ) × GR <sub>t</sub>	0.002 (0.004)	0.010 (0.014)		
Log(# Aisles <sub>t-1</sub> ) × COVID <sub>t</sub>	0.021*** (0.006)	-0.006 (0.008)		
Avg. similarity (%)			0.131 (0.099)	0.382 (0.563)
Avg. similarity (%) × GR <sub>t</sub>			0.283*** (0.091)	0.040 (0.706)
Avg. similarity (%) × COVID <sub>t</sub>			0.063 (0.101)	-0.648*** (0.231)
Fixed effects	YQ & Firm	YQ & Firm	YQ & Firm	YQ & Firm
Observations	69,790	4,438	51,709	4,192
Adjusted R <sup>2</sup>	0.125	0.213	0.120	0.178

Note:

\*p<0.1; \*\*p<0.05; \*\*\*p<0.01

Table 16: Revenue growth volatility and alternative measures of competition

Revenue growth volatility is measured as the quarterly standard deviation of weekly revenue growth. Number of rivals and average market share per aisle are used as alternative measures of competition. Prod. diversification refers to the concentration-based estimates of product diversification. GR is a dummy variable equal to 1 during the 2008 financial crisis. COVID is a dummy variable equal to 1 during the pandemic. All columns included NielsenIQ controls and the public firm subsample includes controls from Compustat. NielsenIQ controls include log annual retail scanner revenue, log age, and the proportion of total revenue from non-food items. Non-food revenue has interaction terms with market crises to allow the relation to vary during market crises. Compustat controls include log assets, debt-to-assets, and the proportion of total firm sales observed. Firms with below median observed revenue are excluded from the sample. Data from 2017 and first quarter 2018 is excluded due to a data collection complication. Standard errors are reported in parentheses and clustered by firm.

	Revenue growth volatility (%)			
	Private (1)	Public (2)	Private (3)	Public (4)
Log(# Rivals <sub>t-1</sub> )	-0.014* (0.008)	-0.007 (0.019)		
Log(# Rivals <sub>t-1</sub> ) × GR <sub>t</sub>	0.004* (0.003)	-0.002 (0.006)		
Log(# Rivals <sub>t-1</sub> ) × COVID <sub>t</sub>	-0.004 (0.004)	0.008 (0.012)		
Avg. firm mkt share <sub>t-1</sub>			-0.068 (0.134)	0.019 (0.146)
Avg. firm mkt share <sub>t-1</sub> × GR <sub>t</sub>			0.032 (0.029)	0.005 (0.035)
Avg. firm mkt share <sub>t-1</sub> × COVID <sub>t</sub>			-0.012 (0.035)	0.017 (0.027)
Prod. diversification <sub>t-1</sub>	-0.025** (0.012)	-0.072** (0.029)	-0.027** (0.012)	-0.074*** (0.027)
Prod. diversification <sub>t-1</sub> × GR <sub>t</sub>	0.001 (0.005)	0.008 (0.012)	-0.00005 (0.005)	0.008 (0.014)
Prod. diversification <sub>t-1</sub> × COVID <sub>t</sub>	0.014* (0.009)	0.025** (0.011)	0.016* (0.008)	0.022** (0.011)
Fixed effects	YQ & Firm	YQ & Firm	YQ & Firm	YQ & Firm
Observations	69,788	4,438	69,788	4,438
Adjusted R <sup>2</sup>	0.553	0.656	0.552	0.656

Note:

\*p<0.1; \*\*p<0.05; \*\*\*p<0.01

Table 17: Revenue growth volatility and alternative measures of diversification

Revenue growth is measured as the percentage change in revenue from the prior quarter. Mkt competition refers to the concentration-based estimate of competition faced used in the main analysis. Number of aisles and average product similarity are used as alternative measures of diversification. GR is a dummy variable equal to 1 during the 2008 financial crisis. COVID is a dummy variable equal to 1 during the pandemic. All columns included NielsenIQ controls and the public firm subsample includes controls from Compustat. NielsenIQ controls include log annual retail scanner revenue, log age, and the proportion of total revenue from non-food items. Non-food revenue has interaction terms with market crises to allow the relation to vary during market crises. Compustat controls include log assets, debt-to-assets, and the proportion of total firm sales observed. Firms with below median observed revenue are excluded from the sample. Data from 2017 and first quarter 2018 is excluded due to a data collection complication. Standard errors are reported in parentheses and clustered by firm.

	Revenue growth (%)			
	Private (1)	Public (2)	Private (3)	Public (4)
Mkt competition <sub>t-1</sub>	-1.068 (0.793)	-0.329 (0.582)	-0.332 (0.673)	-0.042 (0.570)
Mkt competition <sub>t-1</sub> × GR <sub>t</sub>	-0.066 (0.116)	-0.526* (0.275)	-0.136 (0.134)	-0.697** (0.340)
Mkt competition <sub>t-1</sub> × COVID <sub>t</sub>	0.141 (0.100)	-0.367* (0.187)	0.296** (0.122)	-0.248 (0.184)
Log(# Aisles <sub>t-1</sub> )	-0.034*** (0.010)	0.035* (0.020)		
Log(# Aisles <sub>t-1</sub> ) × GR <sub>t</sub>	0.002 (0.004)	0.010 (0.014)		
Log(# Aisles <sub>t-1</sub> ) × COVID <sub>t</sub>	0.021*** (0.006)	-0.006 (0.008)		
Avg. similarity (%)			0.131 (0.099)	0.382 (0.563)
Avg. similarity (%) × GR <sub>t</sub>			0.283*** (0.091)	0.040 (0.706)
Avg. similarity (%) × COVID <sub>t</sub>			0.063 (0.101)	-0.648*** (0.231)
Fixed effects	YQ & Firm	YQ & Firm	YQ & Firm	YQ & Firm
Observations	69,790	4,438	51,709	4,192
Adjusted R <sup>2</sup>	0.125	0.213	0.120	0.178

Note:

\*p<0.1; \*\*p<0.05; \*\*\*p<0.01

Table 18: Realized returns and alternative measures

Realized returns are the quarterly cumulative returns from CRSP. Return volatility is measured as the quarterly standard deviation of daily realized returns. Number of rivals and average market share per aisle are used as alternative measures of competition. Mkt competition and Prod. diversification refer to the concentration-based estimates used in the main analysis. Number of aisles and average product similarity are used as alternative measures of diversification. GR is a dummy variable equal to 1 during the 2008 financial crisis. COVID is a dummy variable equal to 1 during the pandemic. All columns included NielsenIQ and Compustat controls. NielsenIQ controls include log annual retail scanner revenue, log age, and the proportion of total revenue from non-food items. Non-food revenue has interaction terms with market crises to allow the relation to vary during market crises. Compustat controls include log assets, debt-to-assets, book-to-market, and the proportion of total firm sales observed. Firms with below median observed revenue are excluded from the sample. Data from 2017 and first quarter 2018 is excluded due to a data collection complication. Standard errors are reported in parentheses and clustered by firm.

	<i>Dependent variable:</i>			
	Realized returns (%)			
	(1)	(2)	(3)	(4)
Log(# Rivals <sub>t-1</sub> )	-0.059 (0.039)			
Log(# Rivals <sub>t-1</sub> ) × GR <sub>t</sub>	-0.00004 (0.064)			
Log(# Rivals <sub>t-1</sub> ) × COVID <sub>t</sub>	-0.010 (0.020)			
Avg. firm mkt share <sub>t-1</sub>		-0.083 (0.170)		
Avg. firm mkt share <sub>t-1</sub> × GR <sub>t</sub>		-0.260* (0.145)		
Avg. firm mkt share <sub>t-1</sub> × COVID <sub>t</sub>		0.048 (0.093)		
Mkt competition <sub>t-1</sub>			0.044 (0.252)	0.022 (0.233)
Mkt competition <sub>t-1</sub> × GR <sub>t</sub>			0.717 (0.568)	0.695 (0.539)
Mkt competition <sub>t-1</sub> × COVID <sub>t</sub>			-0.313* (0.170)	-0.257 (0.173)
Prod. diversification <sub>t-1</sub>	-0.053 (0.053)	-0.091* (0.051)		
Prod. diversification <sub>t-1</sub> × GR <sub>t</sub>	-0.049 (0.094)	-0.027 (0.092)		
Prod. diversification <sub>t-1</sub> × COVID <sub>t</sub>	-0.024 (0.030)	-0.024 (0.033)		
Log(# Aisles <sub>t-1</sub> )			0.004 (0.022)	
Log(# Aisles <sub>t-1</sub> ) × GR <sub>t</sub>			0.024 (0.029)	
Log(# Aisles <sub>t-1</sub> ) × COVID <sub>t</sub>			-0.003 (0.012)	
Avg. similarity (%)				-0.183 (0.484)
Avg. similarity (%) × GR <sub>t</sub>				-0.419 (0.743)
Avg. similarity (%) × COVID <sub>t</sub>				0.582** (0.262)
Fixed effects	YQ & Firm	YQ & Firm	YQ & Firm	YQ & Firm
Observations	2,228	2,228	2,228	2,160
Adjusted R <sup>2</sup>	0.234	0.234	0.235	0.236

Note:

\*p<0.1; \*\*p<0.05; \*\*\*p<0.01

Table 19: Realized return volatility and alternative measures

Realized returns are the quarterly cumulative returns from CRSP. Return volatility is measured as the quarterly standard deviation of daily realized returns. Number of rivals and average market share per aisle are used as alternative measures of competition. Mkt competition and Prod. diversification refer to the concentration-based estimates used in the main analysis. Number of aisles and average product similarity are used as alternative measures of diversification. GR is a dummy variable equal to 1 during the 2008 financial crisis. COVID is a dummy variable equal to 1 during the pandemic. All columns included NielsenIQ and Compustat controls. NielsenIQ controls include log annual retail scanner revenue, log age, and the proportion of total revenue from non-food items. Non-food revenue has interaction terms with market crises to allow the relation to vary during market crises. Compustat controls include log assets, debt-to-assets, book-to-market, and the proportion of total firm sales observed. Firms with below median observed revenue are excluded from the sample. Data from 2017 and first quarter 2018 is excluded due to a data collection complication. Standard errors are reported in parentheses and clustered by firm.

	<i>Dependent variable:</i>			
	Return volatility (%)			
	(1)	(2)	(3)	(4)
Log(# Rivals <sub>t-1</sub> )	0.001 (0.003)			
Log(# Rivals <sub>t-1</sub> ) × GR <sub>t</sub>	0.0002 (0.002)			
Log(# Rivals <sub>t-1</sub> ) × COVID <sub>t</sub>	0.0002 (0.002)			
Avg. firm mkt share <sub>t-1</sub>		-0.012 (0.011)		
Avg. firm mkt share <sub>t-1</sub> × GR <sub>t</sub>		-0.027*** (0.008)		
Avg. firm mkt share <sub>t-1</sub> × COVID <sub>t</sub>		-0.002 (0.005)		
Mkt competition <sub>t-1</sub>			-0.024 (0.018)	-0.030 (0.018)
Mkt competition <sub>t-1</sub> × GR <sub>t</sub>			0.054*** (0.018)	0.066*** (0.017)
Mkt competition <sub>t-1</sub> × COVID <sub>t</sub>			0.018 (0.016)	0.019 (0.017)
Prod. diversification <sub>t-1</sub>	-0.003 (0.005)	-0.003 (0.005)		
Prod. diversification <sub>t-1</sub> × GR <sub>t</sub>	-0.013*** (0.005)	-0.011** (0.005)		
Prod. diversification <sub>t-1</sub> × COVID <sub>t</sub>	-0.003 (0.003)	-0.003 (0.003)		
Log(# Aisles <sub>t-1</sub> )			-0.001 (0.001)	
Log(# Aisles <sub>t-1</sub> ) × GR <sub>t</sub>			-0.002* (0.001)	
Log(# Aisles <sub>t-1</sub> ) × COVID <sub>t</sub>			-0.00004 (0.001)	
Avg. similarity (%)				-0.042** (0.020)
Avg. similarity (%) × GR <sub>t</sub>				0.067 (0.048)
Avg. similarity (%) × COVID <sub>t</sub>				0.042** (0.021)
Fixed effects	YQ & Firm	YQ & Firm	YQ & Firm	YQ & Firm
Observations	2,228	2,228	2,228	2,160
Adjusted R <sup>2</sup>	0.704	0.708	0.706	0.701

Note:

\*p<0.1; \*\*p<0.05; \*\*\*p<0.01

Table 20: Product portfolio changes within a matched sample

Product entry is the number of UPCs appearing in the retail scanner data for the first time this quarter divided by the number of existing products in the prior quarter. Product exits are the percentage of total UPCs that were observed the prior quarter but are not present in the current quarter. Exits are required to remain absent from the sample for a calendar year to ensure that seasonal variants are not wrongly categorized as permanent exits. Public and private firms are matched using nearest neighbor matching, based on Mahalanobis distance, resulting in a sample of 61 matched pairs. Matching variables are annual log revenue, number of products, and firm age. Public is a dummy variable equal to 1 for the public firms.

Controls include log annual retail scanner revenue, log age, and the proportion of total revenue from non-food items. Non-food revenue has interaction terms with market crises to allow the relation to vary during market crises. Market competition and product diversification are concentration-based estimates. Interaction terms are not included for market competition and product diversification due to concerns about overfitting. Data from 2017 and first quarter 2018 is excluded due to a data collection complication. The sample period is ended in 2019 for product exits to accommodate the longer observation window necessary to determine if an exit is permanent. Each regression is estimated with and without firm fixed effects.

Standard errors are reported in parentheses and clustered by firm.

	<i>Dependent variable:</i>			
	Product entry <sub>t</sub> (%)		Product exits <sub>t</sub> (%)	
	(1)	(2)	(3)	(4)
Public <sub>i</sub>	0.007** (0.003)		0.008*** (0.003)	
Public <sub>i</sub> × GR <sub>t</sub>	-0.001 (0.003)	-0.001 (0.003)	-0.005* (0.002)	-0.005** (0.002)
Public <sub>i</sub> × COVID <sub>t</sub>	-0.004 (0.004)	-0.006* (0.004)		
Mkt competition <sub>t-1</sub>	0.046** (0.022)	-0.006 (0.030)	0.069*** (0.021)	0.007 (0.016)
Prod. diversification <sub>t-1</sub>	0.007 (0.006)	0.011* (0.006)	0.003 (0.005)	-0.010 (0.009)
Year-quarter FE	Y	Y	Y	Y
Firm FE	N	Y	N	Y
NielsenIQ controls	Y	Y	Y	Y
Compustat controls	N	N	N	N
Observations	6,222	6,222	5,734	5,734
R <sup>2</sup>	0.175	0.408	0.180	0.492
Adjusted R <sup>2</sup>	0.167	0.391	0.172	0.476

Note:

\*p<0.1; \*\*p<0.05; \*\*\*p<0.01

Table 21: Estimated markups within a matched sample

Estimated markups are the percentage difference between a firm's average product price and the average price of comparable store brand items. Public and private firms are matched using nearest neighbor matching, based on Mahalanobis distance, resulting in a sample of 61 matched pairs. Matching variables are annual log revenue, number of products, and firm age. Public is a dummy variable equal to 1 for the public firms. Controls include log annual retail scanner revenue, log age, and the proportion of total revenue from non-food items. Non-food revenue has interaction terms with market crises to allow the relation to vary during market crises. Market competition and product diversification are concentration-based estimates. Interaction terms are not included for market competition and product diversification due to concerns about overfitting. Data from 2017 and first quarter 2018 is excluded due to a data collection complication. Each regression is estimated with and without firm fixed effects. Standard errors are reported in parentheses and clustered by firm.

	<i>Dependent variable:</i>	
	Estimated markup <sub>t</sub> (%)	
	(1)	(2)
Public <sub>i</sub>	0.054 (0.099)	
Public <sub>i</sub> × GR <sub>t</sub>	0.062 (0.063)	0.059 (0.057)
Public <sub>i</sub> × COVID <sub>t</sub>	0.055 (0.074)	0.041 (0.057)
Mkt competition <sub>t-1</sub>	1.160 (0.888)	-0.812 (0.514)
Prod. diversification <sub>t-1</sub>	0.189 (0.155)	0.206 (0.193)
Year-quarter FE	Y	Y
Firm FE	N	Y
NielsenIQ controls	Y	Y
Compustat controls	N	N
Observations	5,669	5,669
R <sup>2</sup>	0.076	0.786
Adjusted R <sup>2</sup>	0.067	0.779
Residual Std. Error	0.594 (df = 5608)	0.289 (df = 5493)

*Note:* \*p<0.1; \*\*p<0.05; \*\*\*p<0.01

Table 22: Revenue growth within a matched sample

Revenue growth is measured as the percentage change in revenue from the prior quarter. Revenue growth volatility is measured as the quarterly standard deviation of weekly revenue growth. Public and private firms are matched using nearest neighbor matching, based on Mahalanobis distance, resulting in a sample of 61 matched pairs. Matching variables are annual log revenue, number of products, and firm age. Public is a dummy variable equal to 1 for the public firms. Controls include log annual retail scanner revenue, log age, and the proportion of total revenue from non-food items. Non-food revenue has interaction terms with market crises to allow the relation to vary during market crises. Market competition and product diversification are concentration-based estimates. Interaction terms are not included for market competition and product diversification due to concerns about overfitting. Data from 2017 and first quarter 2018 is excluded due to a data collection complication. Each regression is estimated with and without firm fixed effects. Standard errors are reported in parentheses and clustered by firm.

	<i>Dependent variable:</i>			
	Revenue growth <sub>t</sub>		StDev(Revenue growth <sub>t</sub> )	
	(1)	(2)	(3)	(4)
Public <sub>i</sub>	-0.011 (0.032)		0.013 (0.017)	
Public <sub>i</sub> × GR <sub>t</sub>	0.002 (0.016)	0.007 (0.017)	-0.005 (0.006)	-0.003 (0.006)
Public <sub>i</sub> × COVID <sub>t</sub>	-0.012 (0.021)	-0.042 (0.038)	-0.020 (0.013)	-0.026* (0.014)
Mkt competition <sub>t-1</sub>	-0.596 (0.590)	-2.638 (2.366)	0.216* (0.119)	-0.259*** (0.079)
Prod. diversification <sub>t-1</sub>	0.018 (0.038)	0.275** (0.126)	-0.028 (0.029)	0.005 (0.028)
Year-quarter FE	Y	Y	Y	Y
Firm FE	N	Y	N	Y
NielsenIQ controls	Y	Y	Y	Y
Compustat controls	N	N	N	N
Observations	6,222	6,222	6,222	6,222
R <sup>2</sup>	0.043	0.137	0.095	0.566
Adjusted R <sup>2</sup>	0.034	0.111	0.086	0.553
Residual Std. Error	0.454 (df = 6161)	0.436 (df = 6041)	0.116 (df = 6161)	0.081 (df = 6041)

Note:

\*p<0.1; \*\*p<0.05; \*\*\*p<0.01