Finance and Economics Discussion Series

Federal Reserve Board, Washington, D.C.
ISSN 1936-2854 (Print)
ISSN 2767-3898 (Online)

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2025-080

Please cite this paper as:
Taragin, Charles, Benjamin Wallace, and Eddie Watkins (2025). "Financial Structure and Mergers," Finance and Economics Discussion Series 2025-080. Washington: Board of Governors of the Federal Reserve System, https://doi.org/10.17016/FEDS.2025.080.

Financial Structure and Mergers

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September 8, 2025

Abstract

We study how corporate debt influences the competitive outcomes of horizontal and conglomerate mergers. In contrast to standard models where debt does not affect pricing, our framework shows that mergers can spread fixed debt obligations across a broader product portfolio, creating an "insurance effect" against adverse demand shocks. This effect interacts with the traditional recapture effect from reduced competition. Using numerical simulations and a case study of a major casino merger, we find that debt can either dampen or amplify post-merger price increases, depending on the merger's structure and the market environment.

JEL classification: L41, L13, K21, G32, G34
Keywords: financial structure; merger simulation; horizontal markets

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1 Introduction

Modern firms maintain substantial debt levels on their balance sheets. Between 2003 and 2022, large, publicly traded firms typically exhibited debt-to-equity ratios ranging from 0.4 to 3.[1] In addition, mergers themselves are often financed by debt. During this period, approximately 23% of the value of all commercial loans was used to finance mergers, with firms typically borrowing between $90 million and $700 million for merger-related purposes.[2] The average amount of debt for merger purposes more than doubled between 2003 and 2022, see Figure 1. Rising debt levels have also made it increasingly likely that merging firms already hold significant debt, regardless of whether new financing is required for the transaction.

Despite the prominent role debt plays in financing both firm operations and acquisitions, the standard oligopoly models underlying horizontal merger policy treat both the level and changes in a firm's debt as a fixed cost. This simplification implies that debt does not influence the core trade-off between lost rivalry and potential efficiency gains in merger review, as described by Williamson (1968). As a result, these models overlook important channels through which financial structure shapes strategic interactions. For example, traditional merger analyses struggle to account for recent concerns about private equity firms acquiring companies in unrelated markets or industries (i.e. conglomerate mergers) without appealing to difficult to measure features such as differing time horizons.[3]

In this paper, we depart from the standard oligopoly models by explicitly allowing firms' pricing decisions under demand uncertainty to depend on their financial structures. Rather than assuming firms can readily adjust their debt levels in response to market conditions, we begin by taking debt as given– reflecting institutional or historical factors that shape firms' balance sheets prior to a merger. Focusing on exogenous debt aligns with standard oligopoly models and enables us to isolate the impact of existing debt burdens on post-merger market outcomes without conflating these effects with financing decisions endogenous to the merger process.

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[1]Analysis based on authors' calculations of 9,164 firms tracked by Compustat in their Financial Ratios Suite, Wharton Research Data Services, `https://wrds-www.wharton.upenn.edu/` . Reported debt-to-equity ratios are the 25th and 75th percentiles.

[2]Based on authors' calculations from LSEG Data & Analytics, Dealscan and LoanConnector, Wharton Research Data Services, `https://wrds-www.wharton.upenn.edu/`. During this period, Dealscan identified 85,601 borrowers across 179,638 commercial loans. We identify a loan as merger-related if the "Deal Purpose" variable contains the string "Acquisition","Merger","Takeover", or "Leveraged Buyout". Reported loan ranges are for the 25th and 75th percentile of distribution of merger-related loans.

[3]See for example, The FTC, DoJ, and HHS request for information on how "Private equity firms...involved in health care system transactions... may lead to a maximizing of profits at the expense of quality care."

Our framework builds on Brander and Lewis (1986) and Showalter (1995), who show that debt can alter strategic behavior under demand uncertainty. We extend their setting from single-product duopolists to differentiated, multi-product Bertrand oligopolists, which is more suited to many merger contexts.We show theoretically that when debt and demand uncertainty coexist, equilibrium prices increase in both a firm's own debt and its rivals' debt levels. Intuitively, higher debt makes firms less responsive to adverse demand shocks, inducing them to set higher prices, and rivals respond by raising their prices due to strategic complementarity.

Debt also introduces a novel "insurance effect" in merger analysis: by diversifying demand risk across a broader product portfolio, a merged firm can partially offset the standard upward pricing pressure resulting from reduced rivalry. However, because the merged entity pools both parties' existing debt, it can also introduce upward price pressure. The net effect is ambiguous and depends on the balance between these channels. We provide conditions under which mergers are efficiency-enhancing: for example, if the merged firm's debt level does not substantially increase, the combined entity can better absorb adverse demand shocks, thereby improving its ability to cover costs and remain profitable during downturns.

Relaxing the assumption that debt is exogenous, we show that mergers alter firms' optimal debt choices, though the direction of this effect is ambiguous in theory due to competing incentives. The merged firm's greater ability to spread risk makes it less sensitive to additional debt, but strategic interactions with rivals and the balance between debt- and equity-holder incentives complicate the outcome. Having established that the merger's net effect on equilibrium debt levels is theoretically ambiguous, we next turn to numerical simulations to further investigate the implications of the model when debt is treated as exogenous.

To more precisely gauge the impact of debt on merger outcomes, we employ numerical simulations that quantify the relationship between firms' debt and post-merger price effects. Our simulations show that mergers involving debt-financed firms lead to smaller price increases than those predicted by standard models without debt. The magnitude of this difference depends on the likelihood of adverse demand shocks, captured by our model as large draws of the outside good's value. Furthermore, we identify a strong positive correlation between the merging firms' pre-merger debt levels and the resulting post-merger price effects, suggesting that party debt can serve as an informative metric for assessing potential competitive harm, complementing traditional measures such as the Herfindahl-Hirschman Index (HHI). Finally, to explore how changes in debt interact with the channels we identify in the model, we run simulations in which we exogenously alter the merged firms' debt level. Consistent with the empirical findings of Chevalier (1995), we observe that increasing the merging parties' debt amplifies post-merger price effects, whereas reducing their debt has the opposite effect. Collectively, these results underscore the critical importance of a merger's financial structure in shaping competitive outcomes.

We then turn to conglomerate mergers between firms that do not overlap in product markets, which allows us to isolate the effects of debt from the loss of rivalry. Similar to the within-market insurance effect, we find that conglomerate mergers diversify firms' exposure to demand shocks across markets and thereby reduce overall risk. However, pooling the parties' debt can outweigh this insurance effect. We provide a simple example illustrating how our model can rationalize concerns that private equity firms use debt-based acquisitions to limit competition. Specifically, we show that conglomerate mergers are most likely to harm competition when a firm with no products acquires a large, low-debt firm.

Again, we use simulations to quantify the magnitude of cross-market merger effects, including instances where firms overlap in some, but not all, markets pre-merger. In contrast to the standard model where mergers between firms in non-overlapping markets have no effect on prices, in our model the insurance effect can be large enough to lower prices. Thus, the benefits of this insurance effect are partially passed on to consumers. Furthermore, we find that as the number of overlapping markets between merging firms increases, the insurance effect diminishes and the loss of rivalry effect begins to dominate, often leading to higher post-merger prices. Our results suggest that divesting assets in markets with little to no overlap between merging firms can harm competition because such divestitures reduce the value of the insurance effect without significantly restoring the lost rivalry.

Finally, we demonstrate the relevance of our model by applying it to the merger between Eldorado and Caesars in the Atlantic City casino market. Standard merger analysis suggests this merger caused prices to increase for both slots and table games. However, this analysis overlooks the insurance effect, leading to overestimated price increases, holding debt fixed. Furthermore, we show that allowing firms to adjust their debt levels in line with the observed changes amplifies the price increases, confirming both our simulation evidence and intuition behind our model.

Our work contributes to three strands of the literature. First, we contribute to the broad literature on the effects of horizontal mergers. These include theoretical contributions on the effects of mergers including Perry and Porter (1985), Salant et al. (1983), and Nocke and Whinston (2022); merger simulations including Werden and Froeb (1994), Epstein and Rubinfeld (2002) and Hausman and Leonard (2005); and merger retrospectives such as Carlton et al. (2019) for airline mergers and Garmon (2017) for hospital mergers. Unlike previous work, we study how financial structure interacts with firms' strategic pricing after a merger. Our model also generates a novel source of merger specific efficiencies not previously considered.

Second, we contribute to the literature on how financial structure affects strategic decisions. We follow Brander and Lewis (1986) which first establishes how debt can influence the output decisions of strategic firms.[4] Relative to this work, we model strategic competition differently by considering the implications of mergers and examining cross-market effects of debt. We also contribute by modeling strategic linkages across markets and letting firms account for multiproduct pricing incentives. Mazur (2022a) and Mazur (2022b) consider how capital investments and market structure are changed by bankruptcy protection. Instead, we focus on changes in outcomes from mergers rather than capital investment. Finally, Liu (2021) studies how bargaining incentives change following private equity acquisition in the hospital market. These acquisitions make firms bargain more aggressively but do not have a pro-competitive insurance effect. Our work also contributes to understanding the mechanism between the choice of debt and price effects identified in empirical papers such as Chevalier (1995).

Other works have shown that debt can impact strategic incentives such as the ability to sustain collusion, Vojislav (1988), or the exposure to predatory pricing, Bolton and Scharfstein (1990). Empirically, Phillips (1995) finds that firms with a higher debt to equity ratio have lower market share and higher prices, both are consistent with our model. Finally, both Kovenock and Phillips (1997) and Zingales (1998) find that firms with higher debt are more likely to exit. In contrast to these works, we focus on how debt affects the outcome of mergers rather than how debt impacts market structure through collusion or exit.

Finally, our work adds to studies of the casino industry. Osinski and Sandford (2021) performs a merger retrospective in this industry; however, they use the using traditional frameworks that do not account for debt. Our paper also adds to the many papers that study how to model gaming markets, such as Barrow and Borges (2014), Cotte and LaTour (2009), Eadington (1999), Nichols and Tosun (2013) and Nichols (1998).

The rest of the paper is organized as follows. Section 2 presents theoretical and simulation results on how debt influences the price effects of mergers between competitors. Section 3 extends the analysis to mergers across non-overlapping markets. Section 4 discusses our empirical application to the casino industry. Section 5 concludes.

[4]This literature shares features but is separate from the literature that examines the incentives created by common ownership, which demonstrates how owners' equity linkages soften strategic competition. See for example, O'Brien and Salop (1999) and Schmalz (2018).

2 Debt and Within Market Mergers

In this section, we consider the implications of debt on horizontal mergers within a single market. We proceed in the following manner. First, we set up the model and provide an analysis of firms' incentives. Second, we use simulations to quantify the magnitude of merger effects on prices when firms hold debt relative to the standard analysis that does not incorporate debt.

The timing of the game is as follows. First, two firms are randomly selected to merge. Next all firms simultaneously set debt levels.[5] Third, specialized agents that hold equity in the firm set prices. Finally, uncertainty over the value of the outside good and taste shocks are resolved, consumers purchase goods, and profits are realized.

2.1 Model

There are 3 player types: consumers, owners of firm debt, and equity holders. A measure M of consumers demand a single unit of one of the J available goods or the outside good 0, and we specify the utility that consumer i receives from purchasing good $j \in \{J, 0\}$ as

$$u_{ij} = \alpha p_j + \delta_j + \epsilon_{ij}.$$

Here, δ_j is the mean value for the good among consumers, p_j the price of the good, $\alpha < 0$ the sensitivity to price, and ϵ_{ij} individual-product specific taste shocks that we assume are distributed Type I extreme value.

Our first departure from the standard discrete choice Bertrand-Nash framework is that we assume that the mean value of the outside option is $\delta_0 = z \sim f(z)$ with support $[\underline{z}, \bar{z}]$.[6] This assumption introduces randomness to the market elasticity without affecting the substitution between goods within the market. Given our assumptions, the market share for each good j can be decomposed as

$$s_j(\vec{p}; z) = \frac{\exp(\alpha p_j + \delta_j)}{\sum_k \exp(\alpha p_k + \delta_k)} \frac{\sum_k \exp(\alpha p_k + \delta_k)}{\exp(z) + \sum_k \exp(\alpha p_k + \delta_k)} = s_{j|I}(\vec{p})(1 - s_0(\vec{p}; z)).$$

Debt holding introduces our second departure from the standard model. Each firm f controls a set of products, $N_f \in J$, and sets the price of these products simultaneously with the other firms. Each firm is partially financed by debt, $D_f \geq 0$; however, prices

[5]We assume that debt is sourced in a competitive capital market and that the equity holders have no influence over the choice of debt level either through bargaining or because of asymmetric information.

[6]Like the standard framework, we normalize $p_0 = 0$. One can view the market-time fixed effect included in many empirical specifications as capturing this variation in δ_0.

are set by equity holders.[7] The debt holders are paid from the profits first and receive all profits in the case of bankruptcy, while the equity holders receive any residual profit after the debt is covered.

Given our assumptions on consumer behavior, for each debt level, D_f, and set of prices, $\vec{p}$, there exists a unique, firm specific, value of the outside good such that the firm exactly covers its debt,

$$M \sum_{k \in N_f} (p_k - c_k) s_k(\vec{p}; z_f^*) = D_f. \tag{1}$$

Finally, we assume that firms set prices before the uncertainty about the value of the outside option is resolved. This means that, at the time of pricing, firms do not know the realized state of consumer demand and cannot adjust their initial prices in response to this information.[8] This timing assumption is standard in the literature (see, for example, the two-period sales model of Lazear (1986)) and is empirically supported by macroeconomic studies of price rigidity (e.g., Nakamura and Steinsson (2008) and references therein).

Given this setup, equity holders set prices to maximize expected profits subject to the the break-even condition, (1):

$$\max_{\{p_k\}_{k \in N_f}} \int_{\underline{z}}^{z_f^*(\vec{p})} \left(M \sum_{k \in N_f} (p_k - c_k) s_k(\vec{p}; z) - D_f \right) dF(z) \tag{2}$$
$$s.t.\ M \sum_{k \in N_f} (p_k - c_k) s_k(\vec{p}; z_f^*(\vec{p})) = D_f.$$

That is, the equity holders only account for profits in states where the outside option is a relatively poor substitute, so that it is more likely that there will be profits available after the debt is covered. We suppress the dependence of z_f^* to prices for the remainder of the paper.

Taking the first order condition of equation (2) lets us specify the margin for each

[7] We consider the strategic impact of debt separately from other reasons to issue debt in this model. For an alternative specification which embeds debt choice in a principal-agent framework of capital investment and effort, see Brander and Spencer (1989).

[8] Formally, we could extend our model to T discrete periods, where in each period $t > 1$, firms observe the realization of z and can set new prices accordingly. In this richer setting, there still exists a unique, firm-specific value of the outside good, z_f^{**}, such that

$$M \sum_{k \in N_f} (p_k - c_k) s_k(\vec{p}; z_f^{**}) = D_f - (T-1) \int_{\underline{z}}^{\bar{z}} M \sum_{k \in N_f} (p_k - c_k) s_k(\vec{p}; z) dF(z).$$

Thus, the incentives in the initial period of our baseline model are preserved in this more general framework.

product j controlled by firm f as

$$m_j \equiv p_j - c_j = \frac{-1}{\alpha\left[1 - \sum_{k \in N_f} s_{k|I}\left(1 - \frac{\int_{\underline{z}}^{z_f^*} s_0(1-s_0)dF}{\int_{\underline{z}}^{z_f^*}(1-s_0)dF}\right)\right]}. \quad (3)$$

Equation (3) implies that equilibrium margins in a Nash Bertrand model with logit demand and debt possess similar properties as equilibrium margins in the standard model without debt.[9]

Finally, we evaluate how price changes impact consumer surplus in our model with debt. Building from the results of Small and Rosen (1981) and Choi and Moon (1997), we find that the compensating variation in our model is given by

$$CV = -\frac{1}{\alpha}\mathbf{E}_z\left[\ln\left(\frac{\exp(z) + \sum_k \exp(\delta_k + \alpha p_k^{post})}{\exp(z) + \sum_k \exp(\delta_k + \alpha p_k^{pre})}\right)\right], \quad (4)$$

which is the standard expression that also accounts for the randomness in the value of the outside option. Equation (4) implies that we can focus on how industry prices change in our simulations and empirical analyses because the price changes give the direction and approximate magnitude of consumer surplus changes.[10,11]

2.2 Equilibrium prices, limited liability, and uncertain demand

Standard economic models used for merger analysis, such as the Antitrust Logit Model (Werden and Froeb (1994)), imply that both pre-merger and post-merger equilibrium product prices are independent from firms' fixed costs like debt. Here, we show that neither uncertain demand nor debt are, by themselves, necessary to establish a relationship between equilibrium prices and debt. We then extend Theorem 1 of Showalter (1995) to show that combining uncertain demand and limited liability establishes that the equilibrium prices that solve equation (2) are increasing in both own and rival debt for a market with multiproduct oligopolists. All proofs are in Appendix A.

[9]That is, equilibrium margins are an increasing function of firm share, and for all $j, k \in N_f$, $m_j = m_k$. Moreover, when there is no uncertainty in the outside good's competitiveness, equation (3) reduces to the familiar equilibrium margin condition $m_j = \frac{-1}{\alpha\left[1-\sum_{k\in N_f} s_{k|I}(1-s_0)\right]}$, where s_0 is evaluate at a fixed, known value of z.

[10]Throughout we focus on the Paasche index, which gives the weighted average price change using post-merger inside shares as weights.

[11]One could also be concerned that an increase in debt could cause a firm to not compete because it could not cover its debt for any realization of the outside good's value. This reduction of competition is beyond the scope of our analysis on price effects but could be explored in a more general version of the model.

Proposition 2.1 (Uncertain Demand, No Debt-holders)**.** In a Nash-Bertrand pricing game with uncertain demand and no debt-holders, equilibrium prices are a function of only demand and cost parameters.

Proposition 2.1 formalizes the idea that in models without debt, pricing is based solely on technology and preference parameters. Thus, pricing is the same as in standard Bertrand-Nash competition except that firms account for uncertainty over the realization of preferences.

Proposition 2.2 (Certain Demand, Debt-holders)**.** In a Nash-Bertrand pricing game without uncertain demand but with debt-holders, equilibrium prices are not a function of debt.

Proposition 2.2 establishes that without demand uncertainty, only firms whose profits exceed their debts enter, and because these firms are always profitable, they do not condition prices on debt. Thus, debt enters the problem as a sunk costs, which provides justification for previous work that does not account for debt and assumes that demand is known.

Proposition 2.3 (Uncertain Demand, Debt-holders)**.** In a Nash-Bertrand pricing game, uncertain demand and debt-holders, all else equal, increasing (decreasing) the debt of any one firm in the market increases (decreases) the equilibrium prices of all firms.

The intuition behind Proposition 2.3 is that as a firm's debt increases, the equity holders need a higher profit level to earn a payoff. Thus, these agents ignore relatively low profit states of the world by setting higher prices. These low profit states are those in which the outside option is a relatively good substitute for the inside goods, so the debt holder would like to set a lower price to attract more customers. Because firms' best response functions in the pricing game slope upwards, the other firms in the market respond by raising their prices.

2.3 Post-merger Incentives

In this section, we illustrate how debt affects firms' incentives in our model. Specifically, we illustrate that the existence of debt creates a countervailing incentive to the standard upward pricing pressure caused by a horizontal merger. We then establish a test for whether the merger-specific efficiencies created by debt could offset the loss of rivalry. Finally, we show that mergers also influence firms' choices regarding debt levels.

We begin by observing that a merger between firms f and g alters the break-even value of the combined firm, z^*_{fg}. This change occurs for two reasons: first, the merged firm's debt rises to $D_{fg} = D_f + D_g \geq \max\{D_f, D_g\}$; second, the merged firms' profits increase for any given value of the outside good. As a result, the merger affects firms' incentives in two key ways. On one hand, the standard reduction in competition leads to upward pressure on prices. On the other hand, the merged firm's ability to diversify demand risk across a broader product portfolio allows it to earn higher profits for any given outside good value, which puts downward pressure on prices by making the firm more willing to compete in lower demand states. However, because the total debt held by the merged firm weakly increases, Proposition 2.3 implies that this higher debt level exerts additional upward pressure on prices.

To see these effects, we take the difference between first order conditions pre- and post-merger at the pre-merger equilibrium prices. This difference is given by

$$\underbrace{\int_{z_f^*}^{z_{fg}^*}[\sum_{j\in N_f,\notin N_g} s_j + \alpha s_j(1-s_j)(p_j-c_j)]f(z)dz}_{Change\ in\ Break-Even} + \underbrace{\int_{\underline{z}}^{z_{fg}^*}[\sum_{k\in N_g,\notin N_f}(p_k-c_k)\alpha s_j s_k]f(z)dz}_{UPP}\,.$$

The UPP term is strictly positive at pre-merger prices. The change in break-even term combines the insurance effect and the change in debt level. Therefore, for the equilibrium effect on price to be negative, the insurance effect must be negative and greater in magnitude than the other two effects.

Thus, the key source of ambiguity for comparing the price effects of a merger with and without debt is how the magnitude of effects compare. Because the relative magnitudes are theoretically ambiguous, even when holding total debt level fixed, we turn to simulations in the next section to analyze the distribution of outcomes.

We now provide the one case in which we can unambiguously show that the merger generates an efficiency.

Proposition 2.4. If the merged firms accounts for higher values of outside good, then the merger generates an efficiency.

By examining equation (3), we see this equation is negative at z_f^*. Therefore, if $z_{fg}^* > z_f^*$, then the first term is strictly negative. We provide an example to illustrate this mechanism in Appendix B.

Finally, in Appendix C we show that the merger also affects the firms' optimal choice of debt. Similar to pricing incentives, the merger introduces several competing incentives, which makes signing the effects theoretically ambiguous. Importantly, the ability to spread profits over more products means that the merged firm is less responsive to an increase in debt than the non-merged firm, and the rival firms are also less responsive to debt post-merger. However, this responsiveness interacts with the tension between debt holders' incentive for a lower price and equity holders' incentives for higher prices. Finally, there is both a UPP like effect for debt and a competition softening incentive that provide incentives for the merged firm to increase their post-merger debt levels.

2.4 Numerical Simulations

We use numerical simulations to explore how debt affects merger outcomes within a single market. To accomplish this, we fix market size $M = 1$, the number of single-product firms $N \in \{3, 4, 5, 6\}$ and sample pre-merger inside market shares. Because the outside share s_0 is strictly increasing in z, we sample pre-merger, firm-specific, break-even outside shares $s_{0j}(z_j^*)$ from the Beta distributions depicted in Figure 2. We then use these break-even shares to recover critical values z_j^*. We sample values of price responsiveness, α, and constant marginal costs, mc_j, as a percentage of the model-implied cost of the outside good. Next, we compute pre-merger equilibrium prices by adding the marginal costs to the equilibrium margins calculated using equation (3). Finally, we recover firm-level debt D_f using equation (1).

To simulate the effects of a horizontal merger, we assume that Firms 1 and 2 merge and solve for post-merger equilibrium prices using the pre-merger demand, cost parameters, and debt levels, along with the new ownership structure. We provide more details of the calibration exercises in Appendix D.

Finally, to help interpret the results, we simulate the merger effects assuming that $z_f = z_f^*$. Under this condition, z_f is known and equation (3) reduces to the familiar equilibrium margin condition. Thus, we compare our model to a counter-factual in which the firm's debt and equity holders' incentives are aligned.

2.5 Simulation Results

We simulate approximately 18,000 markets using the strategy outlined above. Table 1 summarizes the markets. More than 97% of our simulated markets have post-merger HHIs that are greater than 1,800 and HHI changes that are greater than 100, which the 2023 Horizontal Merger Guidelines describe as "highly concentrated" markets that are "presumed to substantially lessen competition or tend to create a monopoly."

Table 1 also reveals that share-weighted pre-merger prices under the debt model are always less than those under the break-even ("BE") model, with median average pre-merger prices under the debt model about 3% less than the BE model. Finally, Table 1 indicates that merging party debt varies substantially, ranging from \$1.9 at the 2.5th percentile to about \$45 at the 97.5th percentile, with a median of party debt of about \$11. These debt levels are typically associated with firm leverage between 5-14%, which suggests our simulation results are most informative for firms with leverage in similar ranges.[12]

2.5.1 Baseline Results

Figure 3 plots merger price effects for the debt (left) and BE (right) models. Each panel depicts the results for a different distribution of outside shares sampled from a Beta distribution depicted in Figure 2. Whiskers depict the 2.5^{th} and 97.5^{th} percentiles of a particular outcome, boxes depict the 25^{th} and 75^{th} percentiles, and the solid horizontal line depicts the median.

Across all distributional assumptions, price effects from the BE model first-order stochastically dominate the price effects from the debt model, with median price effects under the debt model about 77% as large as the BE model. There is substantial variation in these price effects across outside share distributions, with the left-skewed distribution having the greatest disparity (debt price effects about 45% of BE price effects) and the right-skewed distribution having the least disparity (debt price effects about 83% of BE price effects). The intuition for this result is that as we move from left-skew to right-skew distributions, the outside option becomes a relatively weaker substitute for the inside goods. Thus, the direct effect is that the firms in the left-skew face more elastic demand resulting in less ability to exercise market power.

Like the BE model, mergers in a single-market setting under the debt model never cause prices to fall. That is, the loss of rivalry outweighs the efficiencies generated by mergers in our model. Thus, if there are no additional efficiencies, horizontal mergers still harm consumers in our model.

2.5.2 Party Debt Levels

While Proposition 2.3 establishes that equilibrium price levels will be higher as debt increases, the relationship between debt levels and equilibrium price changes from a horizontal merger is ambiguous. We use numerical simulation to explore the relationship between pre-merger party debt levels and post-merger price changes.

Table 3 displays the Pearson correlation coefficients between the party's combined debt level and price effects. Overall, we find that the price effects and combined party debt levels are strongly correlated ($\rho_D = 0.79$) and that conditioning on the outside share

[12] We use the debt to profit ratio as the measure of firm leverage throughout our simulation exercises.

distribution does not meaningfully affect the strength of this relationship. Thus, our simulations suggest that mergers between firms with higher debt levels are more likely to be harmful than mergers between firms with lower debt levels.

The monotonic relationship between party debt and price effects is particularly noteworthy in light of the ongoing debate about the predictive power of concentration measures like the post-merger HHI or changes in HHI (see Nocke and Whinston (2022)). Table 3 indicates that party debt levels are more strongly correlated with the price effects than the post-merger HHI, and comparable to the change in HHI. When only party information is available, these correlations suggests that party debt could serve as a useful alternative for antitrust agencies to use. However, when sufficient information is available to construct HHI measures, the moderate correlations between party debt and the HHI measures suggest that an ensemble measure might perform better.

2.5.3 Party Debt Changes

Next, we exogenously change the merging parties' post-merger debt levels to investigate how merger financing impacts outcomes. This exercise is motivated by two observations. First, some acquisitions are financed using debt as we discuss in the introduction. Second, mergers may be used as an opportunity to reduce debt because for example, the acquirer believes that the target is over-leveraged.

Figure 4 explores the price effect of mergers in which we exogenously change one parties' debt levels by a fixed percentage $\Delta D\% \in \{-100, -50, 0, 100, 150\}$, holding the debt of all other firms. For these exercises, we fix a merger, exogenously change one of the merging parties debt levels by $\Delta D\%$, and compare the price effects relative to the merger in which $\Delta D\% = 0$.

The left panel, which depicts simulation results when the outside share is sampled from the left-skewed distribution, reveals that there is an increasing but convex relationship between median merger price effects and party debt changes. Relative to holding debt fixed, a merger that also increases one of the parties' debt by 50% increases the median price effect by about 20%, while a merger that increases debt by 100% increases prices by 44%. By contrast, decreasing the parties' debt attenuates the price effect, and the reduction in debt can be large enough to cause post-merger prices to fall. With a 50% reduction in debt, the median price increase is 16% lower than when debt is held fixed, and prices fall in 2.1% of mergers. Likewise, when the merging firms eliminate one parties' debt entirely, the median price increase is 26% less than when debt is held fixed, and prices fall in about 3.9% of mergers. Overall, these results suggest that mergers in which parties increase debt are more likely to lead to higher prices than those in which parties decrease debt.[13]

3 Debt and Cross-Market Mergers

In this section, we consider mergers that occur between firms operating in multiple markets, including conglomerate mergers between firms that do not overlap in any geographic or product market. One feature of conglomerate mergers is that they do not lead to a loss in rivalry between firms, allowing us to focus attention on the implications of the insurance effect. As in section 2.1, we begin by laying out the model. We then analyze how the merger changes pricing incentives. Finally, we conclude the section with simulation evidence for mergers in which we let the number of market overlaps vary from 0, the theory in section 3.1, to all markets, an approximation to the theory in section 2.1.

3.1 Model

As in section 2, a firm f holds a level of debt $D_f \geq 0$. Each firm operates in $L \leq N$ of the markets. Each market k has a measure M_k of consumers which can differ by market. Firms' pricing agents receive residual profits after this debt level is covered, and set prices before uncertainty of the competitiveness of the outside option is revealed. We assume that the competitiveness of the outside options is independent across markets.[14]

If a firm merges across markets, we assume that its pricing agent maximizes profits over all markets accounting for its aggregate debt level. A firm that operates in $L \leq N$ of the markets solves

$$\max_{p_1,\ldots,p_L} \int_{\underline{z}_L}^{\bar{z}_L} \cdots \int_{\underline{z}_1}^{z_1(z_{-1})} \left(\sum_{k \in L} M_k(p_k - c_k)s_k - D_f \right) dF_1 \cdots dF_L$$

$$s.t. \sum_{k \neq 1 \in L} M_k(p_k - c_k)s_{k|I}(1 - s_{0,k}(z_k)) + M_1(p_1 - c_1)s_{1|I}(1 - s_{0,1}(z_1(z_{-1}))) = D_f \;\forall\; z_{-1}.$$

Here z_{-1} denotes the vector of the values of the outside good in all markets other than market 1. The constraint captures the idea that if the firm fixes the value of the outside option in all but one market, there is a unique value of the outside option in the final

[13]The middle and right panels, which depicts simulation results when the the outside share is sampled from the uniform and right-skewed distributions, yield results that are similar to, but more muted than, those from the left-skewed distribution. In particular, for each of the non-negative debt changes, the merger effects under the right-skewed distribution first order stochastically dominate the effects under the uniform distribution, which in turn dominate the effects under the left-skewed distribution.

[14]While not our focus, one could consider different correlation structure in the model too. For example, letting the outside goods' competitiveness be perfectly correlated would let us consider aggregate shocks.

market that satisfies the break-even condition. Thus, we can view the problem as if the firm has one focal market and sets prices over the expected value of the outside goods in all other markets.

3.2 Post-merger Incentives

We begin the analysis by focusing on what changes from letting firms maximize joint profits across multiple markets. Then we discuss what happens when this behavioral assumption is violated and then compare the results to our full model. Finally, we show how our model can be used to study private equity acquisitions with a simple example.

The analysis of firms' incentives that operate in a single market are unchanged from the case in section 2. Similarly, if our assumption on pricing are violated, then the cross-market merger does not affect incentives.[15]

When our assumptions are satisfied, then the merger changes the firms' pricing incentives to balance two effects. First, there is the insurance effect. Because the firm earns profits in additional markets, it can cross-subsidize low profit states in one market with profits from other markets. This insurance effect leads the firm to account for prices in lower demand states and places downward pressure on equilibrium prices. Second, the firm needs to satisfy the aggregate debt. Thus, the firm needs to cover a weakly higher debt, which means that the firm needs to account for relatively higher demand states and places upward pressure on prices. In general, we cannot determine the relative magnitude of these two incentives so we turn to simulations in the following subsection.

To illustrate the trade-off we can compare the first order conditions for a firm operating in a single market to a firm operating, for ease of exposition, in two markets. We also set the size of the markets the same and consider single product firms. Comparing these conditions at the single market equilibrium prices gives, for the focal market,

$$\int_{\underline{z}_2}^{\bar{z}_2} \left[\int_{\underline{z}_1}^{z_1(z_{-1})} (s_1 + (p_1 - c_1)\alpha s_1(1 - s_1))dF_1 - \int_{z_1^*}^{z_1(z_{-1})} (s_1 + (p_1 - c_1)\alpha s_1(1 - s_1))dF_1 \right] dF_2.$$

The first interior integral is the insurance effect. As the outside option in market 2 becomes less competitive, the firm does not need as much profit in market 1 to cover its debt. Hence, this term lets the firm account for relatively lower demand states in market 1, which puts downward pressure on market 1 prices. The second interior integral

[15] For example, the merged firm could structurally separate the pricing decision across markets. However, nominally separate decision makers could be made to account for cross-market profits using managerial compensation contracts beyond the scope of our analysis. See Anton et al. (2022) for intuition about how such contracts can be designed.

gives the debt expansion effect. This term captures the possibility that the firm needs to subsidize low demand states in market 2 with profits from market 1, and that the entire debt has increased requiring weakly higher profits than pre-merger.

The debt expansion channel is a central concern in the study over private equity's role in acquisitions, and our model can be used to illustrate this concern. Consider two firms that participate in separate markets, firm A in market 1 and firm B in market 2. Firm A has a large market share and little debt while Firm B has small market share and high debt pre-merger. If firm B buys firm A, then the combined firm must cover its larger debt primarily through profits in market 1. Taking the limit of the product market share of firm B to 0 mimics the private equity case such that the transaction generates only upward pricing pressure in market 1.

3.3 Numerical Simulations

We use numerical simulations to explore how debt affects merger outcomes across multiple markets. In particular, the simulations allow us to answer two questions:

1. to what extent are the benefits from insurance passed through to consumers in the form of lower prices, and

2. what is the incremental benefit of insurance to merging parties who are already operating in multiple geographic markets?

We answer these questions by extending the simulation strategy discussed in Section 2.4 to allow for firms to operate across multiple markets. Because solving for equilibrium prices across multiple markets becomes quickly numerically intractable, we restrict the number of markets to $N \in \{1, \ldots, 8\}$, and assume that outside shares are drawn from a uniform distribution. We also assume that the non-merging firms operate in all N markets, while the merging firms overlap in $O \in \{0, \ldots, N\}$ markets. In these simulations, the no overlap case, $O = 0$, captures the effects of conglomerate mergers considered in Section 3.1, while the full overlap case, $O = N$, approximately captures the theoretical situation considered in 2.1: other values of O capture intermediate cases. We can answer our first question for any number of overlaps, while comparing the results across the number of overlaps lets us answer our second question.

3.4 Simulation Results

We simulate 237,500 mergers across 1.29 million markets using the strategy outlined above. Table 2 summarizes the markets. In contrast to the single-market simulations described in Section 2.5, letting the merging parties overlap in a subset of markets results in about half our simulated markets as "highly concentrated."[16]

Table 2 also reveals that pre-merger prices tend to be lower in our model for multi-market merges in comparison to single-market mergers while the converse holds in the break-even model. By contrast, the debt distribution in the multi-market setting stochastically dominates the debt distribution in the single-market setting, with median debt in the multi-market setting about 7 times as large as the single-market setting, though with similar leverage.

Figure 5 depicts the distribution of market-level merger price effects, conditional on the number of markets where the merging parties overlap. Price effects are calculated using post-merger shares for the Debt (green, left) and BE (orange, right) models. As before, whiskers depict the 2.5^{th} and 97.5^{th} percentiles of a particular outcome, boxes depict the 25^{th} and 75^{th} percentiles, and the solid horizontal line depicts the median.

Figure 5 highlights an important feature of the BE model that it shares with many models used in merger review: when the parties do not overlap in a market, mergers do not affect prices. By contrast, Figure 5 demonstrates that under the Debt model, mergers can either increase or decrease average prices even when the parties do not operate in the same markets. In particular, the Debt model predicts that post-merger prices can change between 9.2% (97.5 percentile) and -5.2% (2.5 percentile), although median price effects are about 0%. That is, in the absence of overlaps, the insurance and debt expansion effects appear to cancel out in most cases that we consider.

Letting the merging parties overlap in exactly one of up to 8 markets causes the price effects under the debt model to typically be greater than the price effects under the BE model. However, the BE model price effects are censored at 0, while about 33% of Debt model markets experience a price reduction that is typically less than 5.2%. Additional overlaps also increase price effects but at a decreasing rate. For example, with four overlaps the median market experiences a 2% price increase under both models, with 15.4% of markets under the Debt model experiencing a price reduction that is typically less than 4.7% while with eight overlaps, the median market experiences a 3% price increase under both models, and 8.4% of markets experience price reductions that are typically less than 2.4%.

Thus, the results of our simulations provide answers to our questions. First, the results suggest that when debt is an important part of competition the impacts of mergers cannot be evaluated separately in each market in which the firms compete. This is because the

[16]Importantly in answering our first question, our simulations include mergers in which Δ HHIs are 0 because the firms do not overlap.

benefits of the insurance effect are partially passed through to consumers even when the parties do not overlap pre-merger, which we see in the non-trivial share of markets that experience price decreases post-merger. Second, the benefits of the insurance effect are reduced as the number of markets in which the firms overlap increases. In particular, this result illustrates that firms benefit from getting access to additional independent revenue streams; however, the benefit is greatest for the first additional profit stream and appears to fade rapidly.

Taking these results together provides insights into how divestitures impact competition. In both models, divesting an asset in an overlap market is beneficial to competition because this divestiture helps remedy the loss of rivalry. In contrast, divesting an asset in a market with little to no party overlap can actually harm competition in the debt model. The harm arises because the divestiture reduces the insurance effect and places relatively more upward pressure on prices than from the merger alone. This result further reinforces the importance of evaluating a merger holistically rather than market-by-market when debt is an important feature of competition.

4 Analysis of Eldorado's Acquisition of Caesars' Atlantic City Properties

In this section, we examine how the theoretical considerations discussed above present when evaluating an actual merger: Eldorado's acquisition of Caesars' Atlantic City properties. We select this merger and this market for three reasons. First, the uncertainty that casinos actually face aligns with the theoretical uncertainty of firms in our model. Second, there are publicly available data on casino-level debt payments, as well as product-level information on prices, margins and shares. Third, we observe how all Atlantic City casino debt payments changed following the merger, which allows us to explore how changes in debt affect equilibrium prices.[17]

On July 20, 2020, Eldorado purchased Caesars for approximately $17 billion, including Caesars' two properties in Atlantic City: Caesars and Harrahs.[18] This transaction included casino properties in other markets where the parties overlapped, such as Nevada, Colorado, and Louisiana. The Federal Trade Commission investigated this merger and allowed it to proceed on the condition that Eldorado divested assets in Nevada and

[17]We also observe the actual price and quantity changes that occurred following the merger. However, the COVID-19 pandemic begins around the same time as the consummation of this merger, making it difficult to disentangle the merger and pandemic effects given our limited data.

[18]While the debt data do not let us link a loan to a specific merger, Eldorado took out approximately $7 billion dollars in June 2020 for merger related activities.

Louisiana.[19]

The New Jersey Attorney General's Office ("NJAG") collects and publicly reports data on casinos at the level of detail needed for our model. To operate a casino in the state of New Jersey, casino operators are required to report data that let us construct property- and game-level price, margin, shares, and debt that we use to calibrate our merger simulations.[20] We use the data from the NJAG six quarters before and after the consummation of the merger in our analyses.

Finally, the casino industry has characteristics that match the theoretical conditions of our model. Casinos set target prices, in terms of odds, for each game ahead of time; however, the realized revenue depends on consumer characteristics, such as relative preference for casinos versus other vacation activities, as well as customer preferences for different games. We follow the approach of Osinski and Sandford (2021) in defining casino prices and quantities for our analyses.[21]

Table 4 provides a summary of the data we use for the two categories of Atlantic City casino games we focus on: i) slots ($25 billion wagered) and ii) table games ($5 billion wagered). We report the margins, share of wagers, prices, and total debt repayments we use to calibrate study merger effects.[22] These payments are the empirical equivalent in this setting of the debt level in the theory model.[23] Table 4 also demonstrates that firms choose a wide range of debt levels, which suggests that accounting for debt in decision making can be important in this setting. For example, Borgata held no debt over our sample period, whereas Caesars made payments of $154 million. Casinos tended to increase debt post-merger with the exception of Bally's, which decreased debt. In light of our simulation results that indicate mergers where debt levels increase result in higher price effects, it is an interesting fact that Harrahs' went from having almost no debt pre-merger to having the second largest amount of debt post-merger. Finally, Table 4 illustrates an additional benefit of the casino market in that it lets us examine markets of different sizes whereas our simulations in section 3 assumed that all markets were the same size.

[19] See "FTC Eldorado Caesars Final Order" for a discussion of this case.

[20] See Appendix E for more information on how we leverage the NJAG data we use in all of our merger simulations.

[21] We provide a general discussion of the prices that casinos set and the observed price, after uncertainty is resolved, that casinos report in Appendix E.

[22] We impute margins for each game from property level margins as discussed in Appendix E. We also discuss why slot margins are likely near 100% in practice.

[23] Understanding debt repayment laws are important in mapping the model to empirical settings. While not considered here, one could consider a dynamic version of the model in which firms endogenize payment of debt levels each period accounting for competition and each firm's default risk.

4.1 Merger Simulation Results

We first present the results of standard merger analysis treating slots and table games as separate markets. We next consider the empirical consequences of letting debt link markets, that is we examine the difference from the standard model and the multimarket model we develop in section 3. Finally, we consider how our results change when we use the observed pre- and post-merger debt levels. This third simulation helps explore results comparable to those in Figure 4.[24]

As seen in Figure 6, the predicted market level price effects are impacted by our modeling assumptions. Using the baseline model without debt, we find that price increases 3.7% for slots, 0.4% for tables, and 3.1% for the weighted average of the two.[25]

Moving from the standard model to the multimarket model with debt confirms the results we illustrate in Figure 5 that considering the cross market effects generated by debt can be an important feature of competition to model in merger analysis. We find a 3% increase in slots, 1.4% in table games, and 2.7% for the weighted average.[26] This result illustrates that there are benefits to pooling risk across the different markets which lead to an overall reduction in prices. The overall effect masks a decrease in the price effects for slots, and a significant price increase for table games, which highlights the channels from section 3. First, casinos cover debt primarily with slot revenue because the market is approximately 5 times larger than table games. Thus, getting access to additional table profit through the merger lets the casinos price more aggressively in the slot market, the insurance effect. Second, each firm's debt approximately doubles because of the merger placing upward pressure on the merged firm's prices, the debt expansion effect.

Finally, moving from the model with fixed debt to the empirical equivalent of Figure 4 that lets the casinos adjust debt we find that there is additional upward pricing pressure such that prices increases 3.5% in slots, 1.8% in tables, and 3.2% for the weighted average. These results illustrate that standard analysis without debt can miss firm's incentives to change debt in a way that amplifies price effects. This occurs because the baseline model, which assumes that fixed costs such as debt do not affect competition, does not capture any incentive to increase debt strategically. The additional debt incentivizes firms to price less aggressively than the loss of competition alone would predict.[27]

[24] In the model, we hold fixed other changes that influence firms' debt levels. This assumption is unlikely to hold; however, we view the results of the exercises letting debt change as informative of the impact of mergers when firms can change debt levels.

[25] Base simulations were run using the `logit` function in the `antitrust` R package.

[26] Debt simulations were run using the `logit.debt` function in the `DebtMerger` R package.

[27] We report the results for each casino separately in terms of price and quantity changes in Table 5 in both the case holding debt fixed and letting all firms adjust debt.

5 Conclusion

This paper demonstrates that incorporating debt and demand uncertainty into merger analysis fundamentally changes the predicted price effects of horizontal and conglomerate mergers. Standard models, which treat debt as a fixed cost, miss important strategic interactions that arise when firms face both limited liability and uncertain demand. Our theoretical results show that, in such settings, equilibrium prices increase in both a firm's own debt and its rivals' debt levels. However, mergers can also generate an "insurance effect": by diversifying demand risk across a broader product portfolio, the merged firm partially offsets the upward pricing pressure typically associated with reduced rivalry.

Our numerical simulations confirm that, compared to standard models, mergers involving debt-financed firms generally result in smaller price increases– particularly when adverse demand shocks are likely. We also find that higher pre-merger debt levels are associated with greater post-merger price effects, suggesting that party debt is an informative yet complementary metric to traditional concentration measures like the HHI. Importantly, our simulations show that exogenously increasing debt amplifies price effects, while reducing debt mitigates them, highlighting the critical role of a merger's financing structure in shaping competitive outcomes.

We also study mergers that occur between firms operating in multiple markets, including conglomerate mergers with no market overlap. Here, the efficiency comes from the ability of the combined firm to better insure against unfavorable demand shocks in different markets. Our simulations show that, although this effect is typically modest, it can result in lower prices– a result not captured by standard models. As the number of overlapping markets increases, the benefit from diversification diminishes and the loss of rivalry becomes more pronounced. These findings suggest that evaluating mergers solely on a market-by-market basis may overlook important cross-market incentives and effects.

Our case study of the Eldorado-Caesars merger in the Atlantic City casino market underscores the importance of incorporating debt into merger review. We find that failing to account for how debt links incentives across markets can lead to both under- and overestimation of price effects. Moreover, our results indicate that firms may strategically use debt financing to exacerbate incentives to raise prices following a merger.

Overall, our findings highlight the critical importance of understanding the interplay between finance and industrial organization to fully capture firm behavior and merger effects. Future empirical work that separately identifies and quantifies the diversification-driven insurance effect, as distinct from the traditional recapture effect, would provide valuable insights for antitrust practitioners. Additionally, future research could focus on establishing specific debt-based thresholds at which mergers become significantly more likely to harm competition, similar to how changes in the HHI are currently used in antitrust analysis.

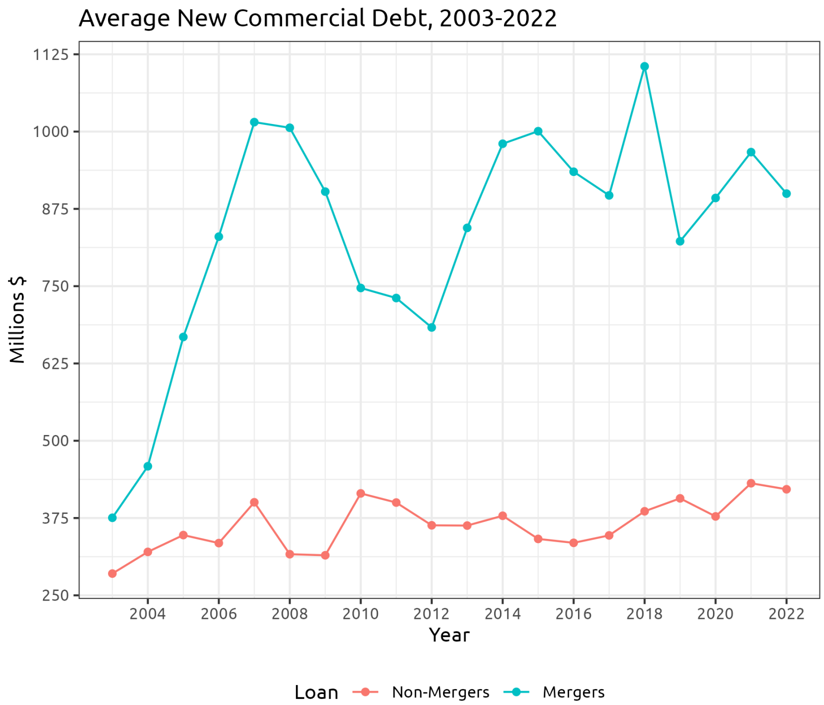

Figure 1: The figure displays average annual commercial loan size by loan type for 85,601 borrowers across 179,638 commercial loans. We identify a loan as merger-related if the "Deal Purpose" variable contains the string "Acquisition","Merger","Takeover", or "Leveraged Buyout". Source: LSEG Data & Analytics, Dealscan and LoanConnector, Wharton Research Data Services, `https://wrds-www.wharton.upenn.edu/`.

Table 1: Market-level summary statistics for single-market mergers.

Variable	50%	2.5%	25%	75%	97.5%
Pre-Merger HHI	2,824	1,930	2,319	3,562	4,620
HHI Change	831	142	423	1,507	2,946
Post-Merger HHI	3,710	2,323	2,903	5,078	7,028
AvgPrePrice	112.5	100.2	107.3	119.3	135.2
AvgPrePriceBE	116.1	101.8	109.8	123.3	138.7
# Firms	4.5	3.0	3.8	5.2	6.0
# Markets	1	1	1	1	1
Debt $	10.8	1.9	5.4	20.2	44.9
Leverage (%)	11.8	4.9	9.3	13.7	15.3

Table 2: Market-level summary statistics for multi-market mergers.

Variable	50%	2.5%	25%	75%	97.5%
Pre-Merger HHI	3,083	2,037	2,496	3,961	6,142
HHI Change	39	1	4	843	2,403
Post-Merger HHI	3,571	2,234	2,774	5,049	7,033
AvgPrePrice	114.7	100.6	108.6	123.0	149.3
AvgPrePriceBE	118.3	102.3	111.0	127.8	158.0
# Firms	4	3	3	5	6
# Markets	6	3	5	8	8
Debt $	61.1	15.7	37.8	94.8	170.3
Leverage (%)	11.5	6.5	9.5	13.5	16.8

Table 3: Pearson correlations for debt, HHI, and merger outcomes: single-market mergers.

			Distribution		
		Overall	left-skew	uniform	right-skew
Price Change	Debt	0.79	0.84	0.74	0.85
Price Change	HHI Change	0.84	0.85	0.87	0.88
Price Change	Post-Merger HHI	0.67	0.67	0.72	0.69
Post-Merger HHI	Debt	0.42	0.46	0.43	0.50
HHI Change	Debt	0.49	0.53	0.48	0.59

Table 4: Simulation inputs, Atlantic City casinos.

		Debt Paid		Slots ($25B)			Tables ($5B)		
Casino	Owner	Pre	Post	Share %	Win %	Margin %	Share %	Win %	Margin %
Borgata	MGM	0.0	0.0	26.6	8.6		26.5	17.5	51.1
Harrahs	**Caesars**	0.2	186.7	13.6	8.3	100	8.1	19.9	40.7
Tropicana	**Eldorado**	143.8	183.8	11.8	9.6	100	8.0	16.8	62.0
Hard Rock	Hard Rock	112.4	149.6	10.7	9.4		15.9	15.2	48.9
Caesars	**Caesars**	154.8	217.4	9.5	9.1	100	11.9	16.0	38.5
Oceans	Luxor	69.7	88.2	7.5	9.8		10.5	13.6	30.1
Golden Nugget	Landry's	8.0	19.5	7.5	9.4		6.1	18.6	37.0
Resorts	DGMB	7.6	7.1	6.8	9.3		6.3	15.1	33.9
Bally's	Bally's	37.3	14.8	6.2	9.3		6.8	15.7	

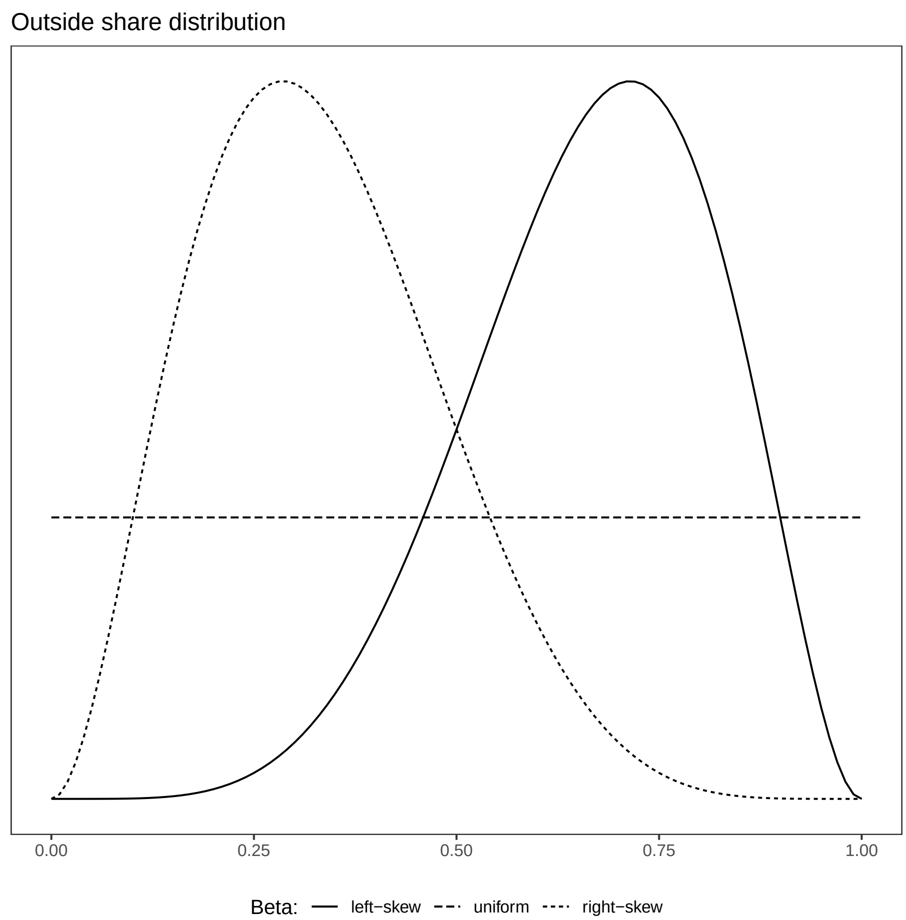

Figure 2: The figure displays the densities of Beta distribution used to simulate firm and market specific outside shares: right-skew ($F_\beta(3, 6)$), uniform ($F_\beta(1, 1)$) and left-skew ($F_\beta(6, 3)$).

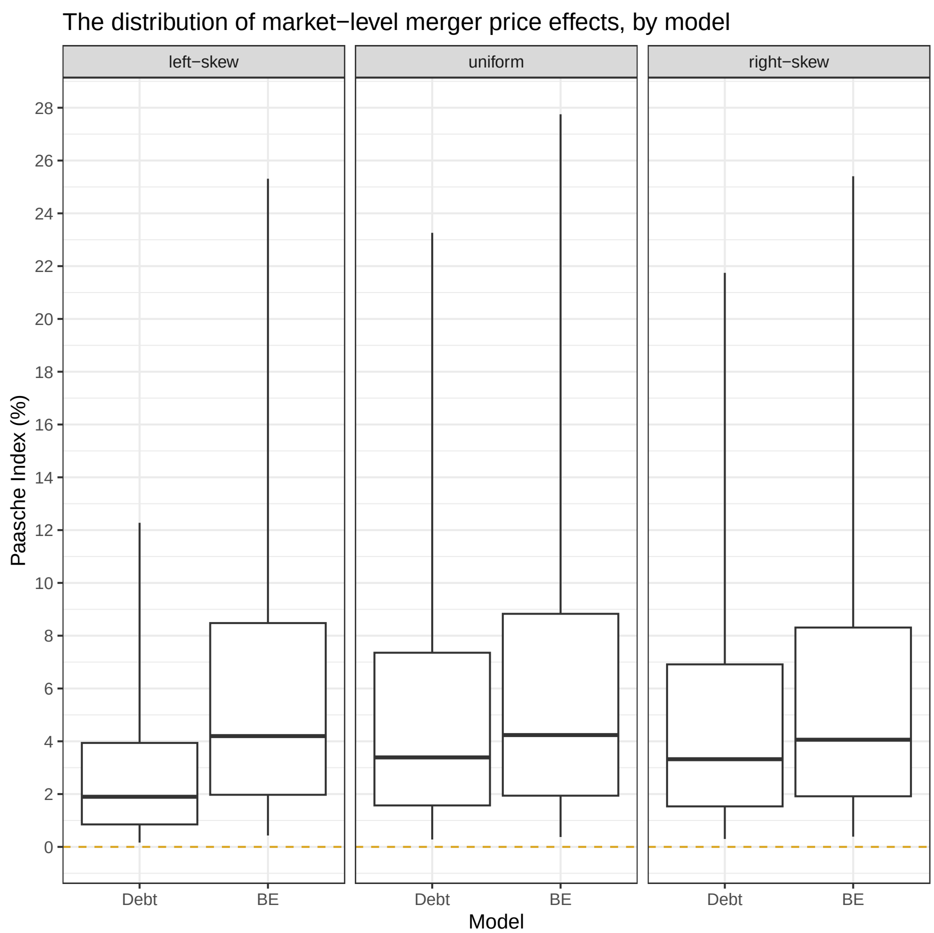

Figure 3: The figure displays box and whisker plots summarizing the distribution of all market-level merger price effects for two models: a Nash Bertrand pricing game with debt and outside share uncertainty ($Debt$), and a Nash Bertrand pricing game without debt and no outside share uncertainty (BE). Outside shares are sampled from either a right-skewed Beta distribution, a uniform distribution, or a left-skewed Beta distribution. Whiskers depict the 2.5^{th} and 97.5^{th} percentiles of a particular outcome, boxes depict the 25^{th} and 75^{th} percentiles, and the solid horizontal line depicts the median.

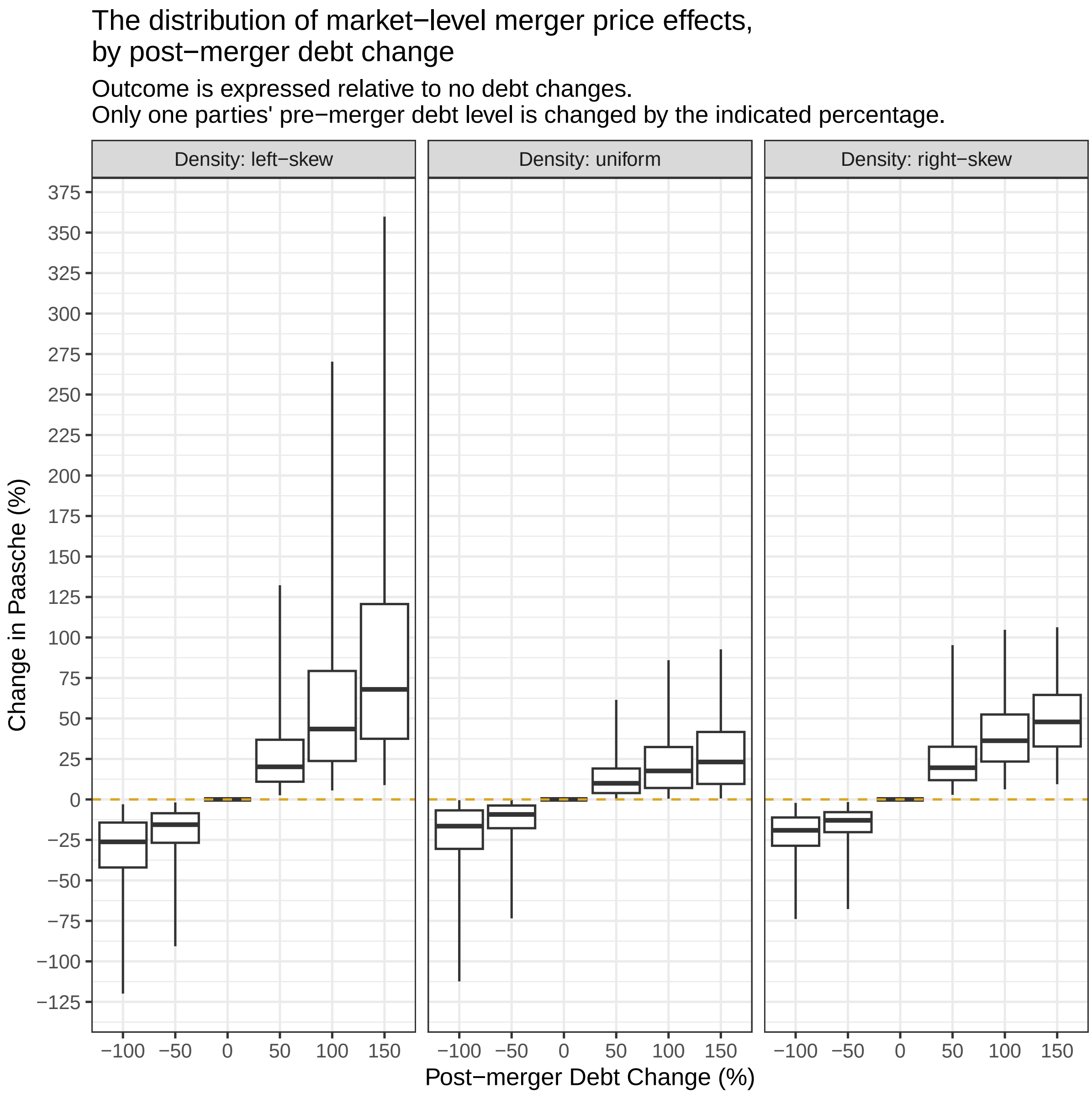

Figure 4: The figure displays box and whisker plots summarizing the distribution of all market-level merger price effects when the debt level of one party changes, holding fixed the debt-level of all other parties. Price effects are expressed as a percentage change in the Paasche index relative to post-merger prices when debt levels are fixed at pre-merger levels. Outside shares are sampled from either a right-skewed Beta distribution, a uniform distribution, or a left-skewed Beta distribution. Whiskers depict the 2.5^{th} and 97.5^{th} percentiles of a particular outcome, boxes depict the 25^{th} and 75^{th} percentiles, and the solid horizontal line depicts the median.

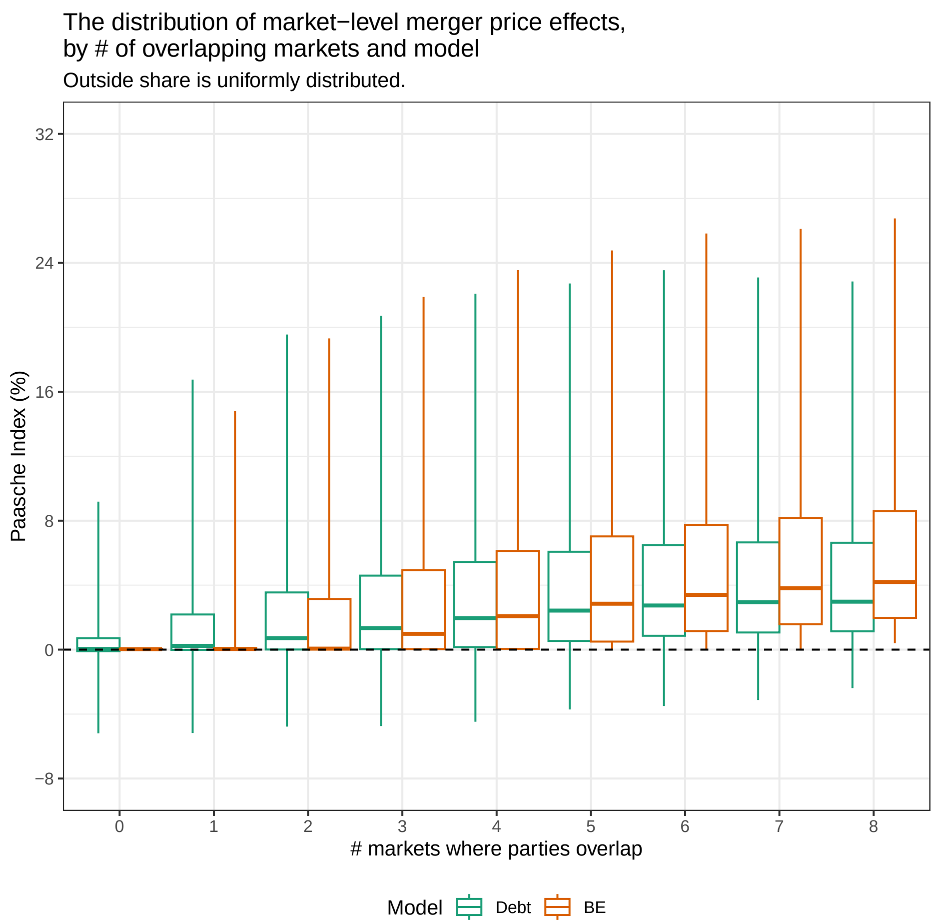

Figure 5: The figure displays box and whisker plots summarizing the distribution of all market-level merger price effects by the number of overlapping merging party markets for two models: a Nash Bertrand pricing game with debt and outside share uncertainty ($Debt$), and a Nash Bertrand pricing game without debt and no outside share uncertainty (BE). Outside shares are sampled from a uniform distribution. Whiskers depict the 2.5^{th} and 97.5^{th} percentiles of a particular outcome, boxes depict the 25^{th} and 75^{th} percentiles, and the solid horizontal line depicts the median.

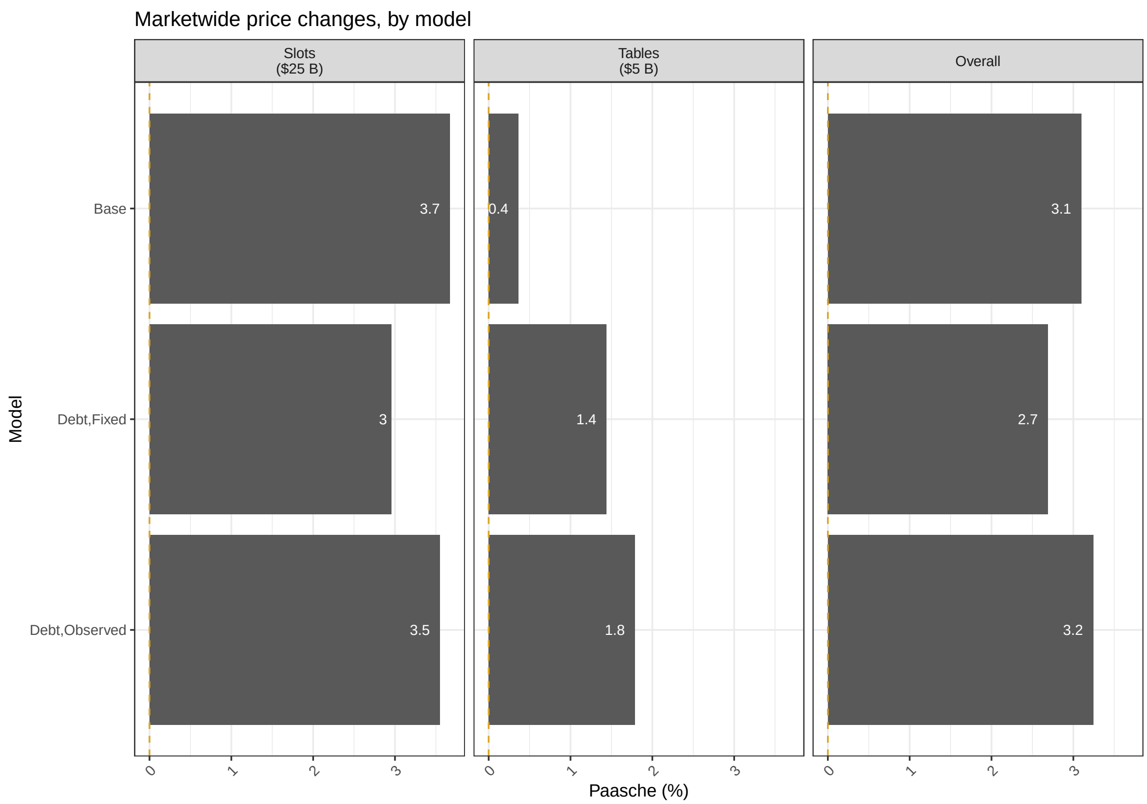

Figure 6: The barchart summarizes the market-level price changes for three Nash Bertrand models with Logit demand: no debt (*Base*), debt levels held fixed at pre-merger levels (*Debt, Fixed*), and debt levels allowed to change to observed post-merger levels. (*Debt, Observed*). *Overall* is the share-weighted average of *Slots* and *Tables*. Base simulations were run using the `logit` function in the `antitrust` R package. Debt simulations were run using the `logit.debt` function in the `DebtMerger` R package.

Table 5: Casino-level, multi-product merger simulations with debt

			Price Change (%)			Output Change (%)		
Market	Casino	Owner	Baseline	Fixed	Observed	Baseline	Fixed	Observed
Slots	Borgata	MGM	0.63	0.91	1.20	2.46	4.09	5.40
	Harrahs	**Caesars**	8.66	9.26	13.02	-5.95	-5.79	-8.47
	Tropicana	**Eldorado**	15.71	15.78	19.32	-15.15	-13.88	-16.33
	Hard Rock	Hard Rock	0.21	0.34	0.81	2.91	4.81	5.89
	Caesars	**Caesars**	7.87	9.26	13.02	-5.95	-5.79	-8.47
	Oceans	Luxor	0.14	0.23	0.45	2.99	4.94	6.34
	Golden Nugget	Landry's	0.14	0.25	0.33	2.99	4.93	6.52
	Resorts	DGMB	0.13	0.23	0.30	3.01	4.96	6.56
	Bally's	Bally's	0.12	0.20	0.23	3.02	4.99	6.66
Tables	Borgata	MGM	0.01	0.24	0.25	0.22	2.21	2.30
	Harrahs	**Caesars**	0.76	2.13	2.24	-1.94	-3.58	-3.78
	Tropicana	**Eldorado**	2.31	6.68	6.80	-5.28	-13.34	-13.52
	Hard Rock	Hard Rock	0.00	0.15	0.20	0.23	2.50	2.51
	Caesars	**Caesars**	0.94	2.65	2.78	-1.94	-3.58	-3.78
	Oceans	Luxor	0.00	0.11	0.13	0.23	2.63	2.70
	Golden Nugget	Landry's	0.00	0.05	0.05	0.23	2.73	2.83
	Resorts	DGMB	0.00	0.06	0.06	0.23	2.72	2.83
	Bally's	Bally's	0.00	0.06	0.05	0.23	2.71	2.86

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A Proofs

Proof of Proposition 2.1. When demand is uncertain but there are no debt-holders, equity holders solve:

$$\max_{\{p_k\}_{k\in N_f}} \int_{\underline{z}}^{\bar{z}} \left(M \sum_{k\in N_f} (p_k - c_k) s_k(\vec{p}; z) \right) dF(z).$$

Taking the first order condition and rearranging yields the equilibrium price for product $j \in N_f$: $p_j = c_j + \frac{-1}{\alpha\left[1-\sum_{k\in N_f} s_{k|I}\left(1-\frac{\int_{\underline{z}}^{\bar{z}} s_0(1-s_0)dF}{\int_{\underline{z}}^{\bar{z}}(1-s_0)dF}\right)\right]}$, which is not a function of D_f. This is the same condition that would occur if the firm solved for optimal prices in the absence of debt. □

Proof of Proposition 2.2. Suppose that $z = z^m$, is known to all players. In the first stage of the game, for firm f, either $z^m \leq z_f^*$ in which case debt-holder know with certainty that firm f will at best only earn enough profits to cover their debt and therefore never enters, or $z^m > z_f^*$ and firm f receives D_f, enters, and sets equilibrium price $j \in N_f$ to satisfy $p_j = c_j + \frac{-1}{\alpha\left[1-\sum_{k\in N_f} s_{k|I}(1-s_0(z^m))\right]}$. As a result, equilibrium price p_j for firms who enter is never a function of observed firm debt. Note however, that changes in the value of z^m can change the composition of firms who enter.

□

We first establish the relationship between the break-even value of a firm and its debt level which we do in the following lemma.

Lemma A.1. An increase in firm f's debt, leads to a decrease in firm f's break-even state, and has no effect on other firm's break-even state.

To establish this lemma, we totally differentiate the break-even condition of firm f and g with respect to the debt level of firm f:

$$-s_0(z_f^*)(1 - s_0(z_f^*)) \sum_{k\in N_f} (p_k - c_k) s_{k|I} dz_f^* = dD_f$$

$$-s_0(z_g^*)(1 - s_0(z_g^*)) \sum_{k\in N_g} (p_k - c_k) s_{k|I} dz_g^* = 0 * dD_g.$$

Inspection gives the desired result. The intuition is that an increase in debt requires higher profits to break-even which requires that the firm accounts for more favorable states of the world as its debt increases. Similarly, an increase in another firm's debt has no direct impact on a given firm's break-even condition.

Proof of Proposition 2.3. Here, we prove that all firm's prices increase if one firm's debt level increase. We first establish this for single-product firms and then extend the results to multi-product firms.

Because logit demand satisfies the IIA property, we are able to exploit the aggregative nature of the game in our proofs following the works of Anderson et al. (2020) and Nocke and Schutz (2018). To do so we rewrite the strategic variable of firm j as $a_j = \exp(\delta_j - \alpha p_j)$, that is the contribution that product j makes to the inclusive value. Then we construct the aggregator as $A = \sum_k^N a_k$ and we consider the firm's type to be its debt level D_j.

Given this framework, we can rewrite the firm's profit function as

$$\max_{\{a_j\}_{j \in N_f}} \int_{\underline{z}}^{z_j^*} \left(M(\frac{\delta_j - \ln a_j}{\alpha} - c_j) \frac{a_j}{A + \exp(z)} - D_j \right) f(z) dz \tag{5}$$
$$s.t.\ M(\frac{\delta_j - \ln a_j}{\alpha} - c_j) \frac{a_j}{A + \exp(z_j^*)} = D_j.$$

Notice from the same argument from Lemma A.1, $\frac{dz_j^*}{dD_j} \leq 0$, so the cut-off value of the outside good also decreases in debt in this rewritten version of the model.

We will sign the effect of debt on firm j's marginal profit, and then apply the result of Anderson et al. (2020), to show how all firm's strategies adjust in response to an increase in firm j's debt. The first and second order conditions are

$$\frac{\partial \pi_j}{\partial a_j} = (\frac{\delta_j - \ln a_j}{\alpha} - c_j - \frac{1}{\alpha}) \int_{\underline{z}}^{z_i^*} \frac{1}{A + \exp(z)} dF - (\frac{\delta_j - \ln a_j}{\alpha} - c_j) a_j \int_{\underline{z}}^{z_i^*} \frac{1}{(A + \exp(z))^2} dF$$

$$\frac{\partial^2 \pi_j}{\partial a_j \partial D_j} = [(\frac{\delta_j - \ln a_j}{\alpha} - c_j - \frac{1}{\alpha}) \frac{1}{A + \exp(z_j^*)} dF - (\frac{\delta_j - \ln a_j}{\alpha} - c_j) a_j \frac{1}{(A + \exp(z_j^*))^2} dF] f(z_j^*) \frac{dz_j^*}{dD_j}.$$

Rearranging the last expression gives

$$[(\frac{\delta_j - \ln a_j}{\alpha} - c_j)(1 - \frac{a_j}{A + \exp(z_j^*)}) - \frac{1}{\alpha}] \frac{f(z_j^*)}{A + exp(z_j^*)} \frac{dz_j^*}{dD_j}.$$

The term outside the bracket is negative, so we only need to sign the term in the bracket. At z_j^* this expression is positive because this is the “best” state in the rewritten problem.[28] Thus, an increase in debt reduces the marginal profit in the rewritten problem, which under Anderson et al. (2020) means that an increase in debt shifts firm j's inclusive best response function in, i.e. the best response in response to the aggregate actions of all firms. This result means that firm j and all its rival's actions decrease as D_j increases, as well as the aggregator, firm j's inside share decreases and all its rivals' inside share increases. Because a_j and p_j move in opposite directions, this means that an increase in debt leads all firms to increase prices.

To extend to multi-product firms, we exploit the aggregative structure of the game and make the following changes. Define the ι-markup for each product $k \in N_f$ of firm f as $\mu^f \equiv \alpha(p_k - c_k)$ and by the arguments in Nocke and Schutz (2018), this term is the

[28] Alternatively, one can think about this result by noticing that the effect of raising a_j has the opposite effect on profit as raising p_j and the first order condition with respect to price was negative at z_j^*.

same for all products.[29] Second, define $a_k \equiv \exp(\delta_k - \alpha c_k)$ as the product's contribution to the inclusive value if the product was priced at marginal cost. Lastly, define the firm f's type $T^f = \sum_{k \in N_f} a_k$.

We then rewrite the firm's first order condition as the uni-dimensional problem of choosing μ^f

$$\max_{\mu^f} \int_{\underline{z}}^{z_f^*} \left[M \frac{\mu^f}{\alpha} \frac{T^f \exp(-\mu^f)}{\sum_n T^n \exp(-\mu^n) + \exp(z)} - D_f\right] dF(z) \tag{6}$$
$$s.t. M \frac{\mu^f}{\alpha} \frac{T^f \exp(-\mu^f)}{\sum_n T^n \exp(-\mu^n) + \exp(z_f^*)} = D_f.$$

Now we can proceed as in Nocke and Schutz (2018) by taking the derivatives with respect to the ι-markup and debt level of the firm which gives

$$\frac{\partial \pi_f}{\partial \mu^f} = \frac{1-\mu^f}{\alpha} \int_{\underline{z}}^{z_f^*} \frac{T^f \exp(-\mu^f)}{\sum_n T^n \exp(-\mu^n) + \exp(z)} dF + \frac{\mu^f}{\alpha} \int_{\underline{z}}^{z_f^*} \left(\frac{T^f \exp(-\mu^f)}{\sum_n T^n \exp(-\mu^n) + \exp(z)}\right)^2 dF$$

$$\frac{\partial^2 \pi_f}{\partial \mu^f \partial D_f} = \left[\frac{1-\mu^f}{\alpha} \frac{T^f \exp(-\mu^f)}{\sum_n T^n \exp(-\mu^n) + \exp(z_f^*)} dF + \frac{\mu^f}{\alpha} \left(\frac{T^f}{(\sum_n T^n \exp(-\mu^n) + \exp(z_f^*)}\right)^2 dF\right] f(z_j^*) \frac{dz_j^*}{dD_j}.$$

The term inside the bracket has the opposite sign as in the single firm problem and that as above the ι-markup moves in the opposite direction of the a_j that we considered in the single firm product. Thus, an increase in debt increases each firm's margins and hence prices. Similarly, the firm that experiences an increase in debt experiences a decrease in the aggregate inside share of its products while all other firms experience an increase in aggregate inside share.

□

B An Example of the Effect of Debt on Mergers

To illustrate the mechanisms in the full model, and to demonstrate that the efficiencies created by debt can lead to a decrease in prices post-merger, we present a simple model here.

We consider a duopoly in which symmetric firms compete in Bertrand-Nash competition. Each firm has 0 marginal costs and firm i's quantity sold, which is given by linear demand for ease of computation here, is given by

$$q_i = a - p_i + 0.5 p_j.$$

We introduce uncertainty by assuming that the intercept is a random variable that can take on a high or low value, a_h and a_l, with the probability that the high state occurs given by w.

To see how the insurance effect impacts pricing, we consider the following values of the variables, $a_h = 10$, $a_l = 5$, $w = 0.19$ and $D_1 = D_2 = 12$.

[29]This result depends on the IIA property of logit demand and can be seen from equation (3).

Table 6: Table with Equilibrium Object Formulas and Specific Values

	Pre-merger		Post-merger	
Outcome	Formula	Value	Formula	Value
$p_i(\mathbf{E}[a])$	$\frac{2}{3}\mathbf{E}[a]$	3.97	$\mathbf{E}[a]$	5.95
$p_i(a = a_h)$	$\frac{2}{3}a_h$	6.67	a_h	10
$\pi(\mathbf{E}[a])$	$\frac{4}{9}(\mathbf{E}[a])^2$	15.73	$(\mathbf{E}[a])^2$	35.40
$\pi[a = a_l]$	$\frac{2}{3}\mathbf{E}[a]a_l - \frac{2}{9}(\mathbf{E}[a])^2$	11.97	$2\mathbf{E}[a]a_l - (\mathbf{E}[a])^2$	24.10

Given this set up, we can derive an expression for equilibrium price when both states are considered, expected profits, and profits if the low demand state arises both pre- and post-merger. These equilibrium outcomes are given in general (specific) form in Table 6.

In this example, the equity holders cannot cover debt in the low demand state pre-merger at optimal price accounting for both states. Thus, these agents will only account for the high demand state when setting prices, which results in a price of 6.67. In contrast, the merged firm can cover its joint debt $D_m = 24$ even if the low state is realized, so the firm accounts for both states when setting prices. This expansion of relevant state caused by debt results in prices falling to 5.95, a 10.8% decrease in prices.

C Merger Affect on Debt Choice

In this section, we layout the problem of the choice of debt level pre-merger. We show through the first order approach the incentives that the firm faces when setting debt optimally in our model. Finally, we show how the first order condition differs post-merger for the merged firms, and discuss the implications of these differences for the choice of debt.

Consider the problem of firm f when setting its debt level. We assume that the firm chooses its debt to maximize the total value of the firm. This implies that the optimization problem pre-merger is

$$\max_{D_f} \int_{\underline{z}}^{\bar{z}} \pi_f(\vec{p}(\vec{D}))dF(z).$$

That is, the firm is choosing debt to maximize the expected value over the distribution of outside good values accounting for how changing debt will impact prices and profits in the later stage of the game. To ease notation, we assume that each firm produces a single good pre-merger. The associated first order condition is:

$$\int_{\underline{z}}^{z_f^*} \pi_f^f f(z) dz \frac{dp_f}{dD_f} +$$
$$\int_{z_f^*}^{\bar{z}} \pi_f^f f(z) dz \frac{dp_f}{dD_f} +$$
$$\sum_{k \neq f} \int_{\underline{z}}^{\bar{z}} \pi_f^k f(z) dz \frac{dp_k}{dD_f} = 0.$$

Here subscripts denote firm and superscript denote which price the derivative is taken with respect to.

The first term captures the change to the equity holders' payoffs. The second term in the first order condition gives how the subsequent change in prices caused by raising debt changes the debt holders' payoffs. Raising debt lowers this value because in the states of the world in which the outside option is a strong substitute, raising prices lowers quantity enough to reduce the probability that the debt is covered. These two terms illustrate the tension between the debt and equity holders. The first term is 0 by the envelope condition. Finally, the third term gives the change in total value caused by the change in rivals' prices. This last term captures the incentive of the firm to raise debt to soften price competition from its rivals. This softening of competition benefits both the debt and equity holders.

Next we consider the debt choice problem when firms f and g merge. Proceeding as before, we take the first order condition for the merged firm and difference the pre-merger debt choice first order conditions of the independent firms. Evaluating this difference at the pre-merger optimal debt level gives

$$\int_{\underline{z}}^{z_f^*} \pi_f^f f(z) dz \left(\frac{dp_f}{dD_{fg}} - \frac{dp_f}{dD_f} \right) + \int_{\underline{z}}^{z_g^*} \pi_g^g f(z) dz \left(\frac{dp_g}{dD_{fg}} - \frac{dp_g}{dD_g} \right) +$$
$$\int_{\underline{z}}^{\bar{z}} \pi_g^f f(z) dz \left(\frac{dp_f}{dD_{fg}} - \frac{dp_f}{dD_f} \right) + \int_{\underline{z}}^{\bar{z}} \pi_f^g f(z) dz \left(\frac{dp_g}{dD_{fg}} - \frac{dp_g}{dD_g} \right) +$$
$$\sum_{k \neq f,g} \int_{\underline{z}}^{\bar{z}} \pi_f^k f(z) dz \left(\frac{dp_k}{dD_{fg}} - \frac{dp_k}{dD_f} \right) + \int_{\underline{z}}^{\bar{z}} \pi_g^k f(z) dz \left(\frac{dp_k}{dD_{fg}} - \frac{dp_k}{dD_g} \right) +$$
$$\int_{z_f^*}^{z_{fg}^*} \left(\pi_f^f + \pi_g^f \right) dF(z) \frac{dp_f}{dD_{fg}} + \int_{z_g^*}^{z_{fg}^*} \left(\pi_f^g + \pi_g^g \right) dF(z) \frac{dp_g}{dD_{fg}}.$$

The first term again captures how changes in debt impact prices and the equity holders. The major change is that the merged firms' price responsiveness to debt that subsequently impacts how the probability of covering the firms' debt changes as prices increase. The second term captures the UPP like term. As in the pricing equation, some of the diversion goes to the merged firm when it raises the price of one of its products. By raising debt, the firm changes prices and hence the diversion that benefits both the debt and equity holders. Similarly to the first term, this depends on how prices respond to debt increases pre- and post-merger. The third term is the softening competition term, and again depends on how the merger impacts the responsiveness of prices to debt. The last term captures how the cutoff level changes and show impacts the incentive of the merged firm to raise prices.

Proceeding similarly as signing the price effects of the merger, we can show that the first term has the opposite sign of the second and third term, and that the sign of the fourth term depends on whether the cutoff shock increases or decreases post-merger. Given the ambiguity and the significantly more complicated expression for results, we instead turn to evaluation of changing the merged firm's debt level in our simulations.

D Description of Calibration

In this section, we provide more details about the simulations that we perform.

D.1 Within Market

We sample pre-merger inside market shares for each firm from a Dirichlet distribution with scale parameter equal to 2.5, This assumption generates markets that are distributed around equal shares for each product while ensuring that individual shares are unlikely to be near 0 or 1. We consider three different Beta distributions throughout: one with that is right-skewed, the uniform distribution, and one that is left-skewed.

We select the price coefficient by randomly drawing the coefficient from a uniform distribution bounded between -0.01 and -0.1.[30] We then randomly sample product-specific marginal costs from a uniform distribution bounded between 80% and 120% of the marginal cost of the outside good.

D.2 Across Markets

Our methodology proceeds as in the within market case except that we use the constraints and first order conditions for the multi-market model rather than the within market model.

E Description of Data

In this section, we provides a detailed description of how we use the NJAG data to construct the data we use for our merger simulations.

E.1 Monthly Gross Revenue Reports

To operate a casino in Atlantic City, each casino property is required to file a Monthly Gross Revenue Report that includes data on each property's win (or loss) both in terms of dollars and as a percentage of the handle, the handle, and various other characteristics

[30]This is consistent with assuming that the outside good is comprised of monopolistically competitive firms with identical marginal costs setting a price equal to \$100 and earning a margin randomly sampled from the uniform distribution bounded between \$10 and \$90.

of the property.[31,32] We use these data to obtain price and quantity data for each property and aggregate those data up to the quarterly level to match with the data obtained use to construct margins.

E.2 A Discussion of Casino "Pricing"

To be consistent with our theoretical model, we would use the exact odds set by the casino as our prices.[33] However, those data are not publicly available, so we use each property's win rate percentage as a proxy for price. This assumption is similar to demand estimates in the automobile industry that use manufacturer's suggested retail price in place of the actual price that customers pay.

The "hold rates" are the expected amount of each dollar wagered that the casino expects to keep given the odds that they set. The measure of price we use is the average win percentage, that is, the actual realized value that the casino kept of each dollar wagered by its guests. Win percentages, while a function of hold rates, are not actual prices set by the casino but are instead a realized result of the hold rate and consumer decisions.

Using win percentage as a proxy could be of particular concern for properties with a low volume of business as one large winning (or losing) day may skew the win rate data away from the hold rate. However, given enough play, win rate data should be a relatively unbiased estimate of the hold rate.[34]

E.3 Quarterly Financial Reports

Each casino property is required to file a Quarterly Financial Report, which are published on the NJAG's website.[35] These reports includes the following information: a Balance Sheet, Statement of Income, Statements of Changes in Stockholder's Equity, Statements of Cash Flows, and a Schedule of Promotional Expenses and Allowances. We use these data to obtain margins and debt payment levels for each property for the six months leading up to the merger and the six months following the merger.

We use the balance sheets to obtain property-level revenues and operating costs, which we then combine to calculate margins. Although the margins for slot machine and table game operations likely differ given the difference in the marginal costs of operating a slot machine relative to a table games, we assume the same margin based upon casino costs and revenues.[36] We must do so because casino operators in Atlantic City are only required

[31]The handle, or drop, is casino gaming industry nomenclature for how much money is wagered at each property during a given time period.

[32]The other characteristics provided in the Monthly Gross Revenue Reports include: the number of table game tables and slot machines authorized by the state; the square footage of the property; promotional credits wagered during the month; and simulcasting handle for the month.

[33]The industry refers to these odds as "hold rates."

[34]The Monthly Gross Revenue Reports for these casino properties can be found on the NJAG's website "Revenue Reports".

[35]The Quarterly Financial Reports can be found on the NJAG's website "Finance Reports".

[36]To operate a table game, casinos must pay a dealer, a pit boss to manage the dealers and security to monitor customers and identify "advantage players." Whereas, for slot machines, only routine

to report total casino operating costs and revenues.

E.4 Construction of our Debt Measure

To construct the measure of debt we use in our model, we utilize data from the statement of income found in each of the Quarterly Financial Reports. To do so, we use lines 15 and 16 in the Statement of Income, titled "Interest Expense - Affiliates/External." Rather than using the actual level of debt that each property is carrying, we chose to use the amount of interest paid on that principle for two reasons: (i) the majority of these properties are owned by a large casino operator, so the level of debt is less informative than the amount of interested paid at the property level, as the shutdown decision relating to debt at the property level is more relevant in terms of interest payments; and (ii) lenders primarily call in the principle on debt when a property is closed down permanently or changes hands.

E.5 Margins

Casino operators in Atlantic City report revenues and costs at the property level instead of for each game type separately. Therefore, we can calculate margins directly only for the entire property. Because table games have higher operating costs than slot machines on the margin and are more likely to be in line with the overall property margins, we use the margins constructed from the financial reports as our margins for table games.[37] We assume that we observe slot machines margins for the merging parties only, consistent with data usually available in an antitrust investigation.

maintenance and general support is required for operations.

[37]According to various gaming industry sources, the average yearly maintenance cost for operating a slot machine is less than $1,000. Although there are other marginal costs to operate a slot machine, the costs are far higher for table games. Overall, we view treating slot marginal costs as approximately zero as a reasonable assumption in this setting, and assign the imputed margins to table games.