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Giroldo, Renato and Hollenbeck, Brett

Cornerstone Research, UCLA Anderson School of Management

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# Concentration, Retail Markups, and Countervailing Power: Evidence from Retail Lotteries

Renato Zaterka Giroldo
Cornerstone Research *

Brett Hollenbeck
Anderson School of Management
UCLA†‡

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**Abstract**

In this note, we investigate the causal link between market concentration and markups in a retail setting. We study the Washington retail cannabis industry, which features exogenous variation in market concentration that resulted from retail licenses being awarded via lotteries. We observe markups directly. We find a negative causal relationship between markups and concentration, where more concentrated markets have significantly lower markups and wholesale prices. The results provide direct evidence of countervailing buyer power by retailers. These results highlight the value of using industry specific data and rich models of competition to advance the debate on concentration and markups.

*Keywords:* markups, market concentration, retail, countervailing buyer power, cannabis policy

*rgiroldo@ucla.edu

†brett.hollenbeck@anderson.ucla.edu

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# 1 Introduction

In this paper, we investigate the causal link between market concentration and markups. In recent years there has been growing interest in the level and trend of markups throughout the economy. This interest stems from a number of recent articles that have documented empirical evidence for an upward trend in markups (notably De Loecker, Eeckhout, and Unger (2020) and Grullon, Larkin, and Michaely (2019)) and leading to a debate over what could potentially be driving this trend in markups and to what extent it can be attributed to an increase in market concentration (Covarrubias, Gutierrez, and Philippon (2019)). This debate extends across industries and includes a focus on the retail sector (Smith and Ocampo (2021), Ganapati (2021)).

One popular view is that market concentration is rising, driven by lax antitrust policy and growing industry, and that this has caused an increase in markups and profitability due to lower competition, at the expense of workers and consumers (Furman (2015), Gutierrez and Philippon (2018), Gutierrez and Philippon (2019)). Others have argued that an increase in concentration is not necessarily harmful to consumers even if it corresponds to an increase in markups. While market concentration is the most frequently used measure of market power in the macroeconomic market power literature, owing largely to convenience, market concentration is not a primitive but is the outcome of competition and it is possible for an increase in concentration to coincide with a decrease in market power, as measured by markups (Syverson (2019)).

As noted by Berry, Gaynor, and Scott Morton (2019), there is no single well-defined causal effect of concentration on markups. Instead, concentration is the outcome of competition and this relationship will depend on a the nature of competition in an industry. For example, if the ease with which consumers can substitute among producers in an industry rises due to a decrease in trade costs or search costs, consumers will shift purchases to more efficient or productive firms. This would cause both concentration increase, but would also increase consumer welfare and have ambiguous effects on markups. Some recent work has suggested that globalization and/or technological change have increased substitutability and led to an increase in concentration in this way, inducing "winner-take-most" outcomes in many industries (van Reenen (2018), Autor, Dorn, Katz, Patterson, and Van Reenen (2020)).

Proponents of this latter view also argue for more industry-level studies to understand the different mechanisms relating concentration and markups (Rose (2019)). While no industry study can, in itself, explain or document economy-wide trends, they offer other clear benefits relative to research relying on aggregate trends. They can measure and model specific features of competition relevant to the debate over concentration and markups, such as heterogeneity in consumer demand, the relative size of fixed and marginal costs, network effects, and other industry features. They therefore allow the researcher to provide more detailed insights into how industry features jointly generate the levels of concentration and markups. They also allow, under the right circumstances,

the ability to measure causal effects of these features and these causal effects are likely to have the greatest relevance for crafting competition policy. We contribute to this debate by conducting an industry-level study in a setting with highly advantageous data and conditions, that allow us to show that an increase in market concentration can directly cause a decrease in markups.

The setting is the legal cannabis retail market. This is a large and growing industry worth roughly $20 billion in the U.S. in 2020.[1] In one of the oldest and most mature examples of this market, Washington state, entry rights were allocated using a lottery in 2014. This allocation of entry rights generated random variation in the degree of concentration across markets. Retail markets are geographically distinct and substantial differences in concentration were generated by this lottery. Another advantageous feature of this industry is that we observe data on all transactions, including wholesale prices for each retail sale. The result is unusually high quality data on markups at the firm and market level. Markups are therefore directly observed and not estimated, unlike almost all other studies of markups, where they are estimated either by assuming a specific model of price competition or by using production function estimation methods that have become popular in recent years.[2] This removes any uncertainty that our results are a direct consequence of a model specification or estimation procedure.

Our empirical strategy consists of comparing markets that are similar on pre-lottery measures but for whom the lottery outcomes result in different levels of concentration. That is, if two markets both have been allocated 6 retail stores and have 20 applications filed for those stores, it may be the case that in one market 6 firms will enter (one per store) and in the other 3 firms will win all available licenses in the lottery and enter with two stores each, causing this market to be more concentrated. We therefore calculate market-level average retail prices, average wholesale prices, and average markups and then match markets on pre-lottery features and perform a simple comparison of how these outcomes vary depending on the level of market concentration.[3] The result we find is that markets that are more concentrated by random chance alone ultimately have significantly lower average markups and prices than less concentrated markets. This result by itself argues for richer models of competition than Cournot-style models that produce a mechanical increasing relationship between market concentration and markups and shows why concentration is a poor proxy for market power. It also highlights the importance of industry studies to advance

[1] See https://www.bloomberg.com/press-releases/2019-10-30/legal-marijuana-market-value-to-hit-59-billion-by-2025-global-market-insights-inc

[2] Most notably, De Loecker and Warzynski (2012) and De Loecker, Eeckhout, and Unger (2020). See also Flynn, Gandhi, and Traina (2019), Brand (2020), Bond, Hashemi, Kaplan, and Zoch (2020) for recent discussions of potential shortcomings of this method.

[3] In a companion paper (Hollenbeck and Giroldo (2021)), we use the same data and a similar identification strategy to study economies of scale for entrepreneurs entering the retail sector. We find that among entrepreneurs who apply for the same number of retail licenses, those who win more licenses are substantially more profitable. Hollenbeck and Giroldo (2021) focuses on entrepreneurial outcomes and therefore does not examine effects on competition and do not study market concentration or market-level outcomes such as markups. By contrast, this paper relies on the ability of the retail lottery to generate variation in market concentration and focuses on market-level outcomes that account for competition.

the debate on concentration and markups.

Next, we investigate the mechanisms that generate this result. We argue that at least two forces contribute to higher concentration causing lower markups in our setting. They are both distinct from prior literature showing that increases in concentration can coincide with decreases in market power (such as Syverson (2004) or Hortacsu and Syverson (2007)). This literature has focused on how an increase in substitutability causes demand to shift to more efficient firms leading to lower markups and producing higher levels of concentration. In our setting, however, concentration is a primitive and not an outcome.

First, our results are consistent with countervailing buyer power. Countervailing power is an old idea in economics, and suggests that an increase in market concentration in one part of an industry can benefit consumers by offsetting market power elsewhere (Galbraith (1963)). In our setting, this would imply that increasing retailer buyer power relative to suppliers can decrease input prices, with a portion of the savings passed along to consumers. The random variation in concentration that we observe across retail markets allows us to directly analyze the effects of this concentration on both input and final prices. While the literature has documented that downstream merger can theoretically improve social surplus (Gaudin (2017), Loertscher and Marx (2019)), there is limited empirical evidence on this.[4] We find direct evidence for countervailing power in our setting. We show that wholesale and retail prices are significantly lower in more concentrated markets and that this at least partially explains our main result.

Second, we argue that the increase in concentration coincides with a productivity shock for the firm that owns multiple stores. For example, this firm may face lower per-store fixed costs and greater ability to offer larger assortments due to fixed costs of dealing with suppliers. We show that more concentrated markets with co-owned stores also have larger overall product variety. Rhodes (2015) shows how, in the presence of search costs and consumers with multi-product demand, larger firms will offer larger assortments, increasing the price-sensitivity of the marginal customer and leading to lower prices. A related issue is prominence. Co-owned stores in a market may be more prominent to consumers in a way that leads them to offer lower prices to discourage search (Armstrong, Vickers, and Zhou (2009)). These mechanisms should act to reduce markups and are similar to the types of productivity and prominence shocks that may correspond to other types of increases in concentration in retail markets, notably horizontal mergers. But while it has been known that in richer models of competition, a result like the one we show is possible, it has not previously been clear whether this result is empirically relevant.

[4] An exception is Barrette, Gowrisankaran, and Town (2021), who estimate the potential effects of countervailing power in the hospital industry and find that insurer concentration has large effects on the price outcomes of hospital mergers. A related work is Rubens (2021) who studies the effects of industry consolidation on both markups and input prices in the Chinese cigarette manufacturing industry and finds that increased concentration reduces input prices significantly and reduces markups slightly.

## 2 Data and Setting

This section describes the institutional setting and key features of the data. Estimating the causal effect of market concentration on outcomes like prices and markups requires a setting with detailed data on these outcomes as well as exogenous variation in market concentration. The retail cannabis industry in Washington state contains both of these features. Washington state passed a law in 2014 that made cannabis products legal for licensed firms to produce and sell to any person over 21 years of age. To comply with federal guidelines the industry is closely monitored, leading to detailed data collected by the Washington State Liquor and Cannabis Board that is available to researchers by making public records requests. A key feature of the legal regime is that the total number of retail licenses was strictly capped. This license cap and how licenses were allocated forms the basis of our empirical strategy and we describe it at length below.

**License Lottery:**

When Washington created licenses for firms to enter the cannabis retail industry, it decided to limit entry to an initial total of 334 retailers for the state.[5] These licenses were allocated across cities according to their population, population density, and an estimate of past-month marijuana users taken from historical survey data.[6] More firms desired to enter this industry than the number of licenses available an the state used a lottery system to allocate them.

Lotteries were held separately at the city level, and 75 cities experienced excess demand for the available retail licenses, resulting in 75 different lotteries being held. In addition, in 48 cities there was not excess demand for licenses. We observe the full number of applicants and their identities in each market.[7] In July 2015, the state updated its licensing regime and increased the total number of retail licenses available from 334 to 556 and awarded these new licenses according to the same initial lottery draws. Firms were also not allowed to own more than three licenses. This lottery is described in more detail in Hollenbeck and Giroldo (2021).

As Table 1 shows, the allocation rule and lottery resulted in substantial variation in the number of stores per market and the degree of concentration in each market. The 75th percentile market has more than 6 times more stores per capita than the 25th percentile market. Similarly, the 75th percentile market has more than 4 times higher market concentration of sales than the 25th percentile market. We discuss how we measure market concentration in more detail in the next section.

**Transactions Data:**

Washington requires all firms in the cannabis industry to enter all transactions into an administrative database. Using this database we observe all sales in the industry, including both retail sales

[5]This number was chosen somewhat arbitrarily to match the number of state-owned liquor stores under Washington's state monopoly on retail alcohol sales that lasted until 2012.

[6]See Caulkins and Dahlkember (2013) for a detailed description of the allocation rule.

[7]The lottery results for the market of Longview, WA were not available.

Table 1: Summary Statistics on Market Size, Prices, Markups, and Concentration

| | Mean | 25th %ile | Median | 75th %ile |
|---|---|---|---|---|
| **Market Size:** | | | | |
| Number of Stores | 3.4 | 1 | 2 | 4 |
| Number Applications | 21.5 | 5 | 9 | 19 |
| Population | 46,331 | 5,714 | 17,926 | 37,729 |
| Stores per 1k pop. | .51 | .05 | 0.11 | 0.33 |
| Units sold | 73,418.7 | 12,151 | 33,772.2 | 81,729.8 |
| **Prices, Markups and Sales:** | | | | |
| Avg Retail Price | 8.8 | 8 | 8.7 | 9.5 |
| Avg Wholesale Price | 4.2 | 3.9 | 4.2 | 4.4 |
| Avg Markup | 1.1 | 1 | 1.1 | 1.3 |
| Avg Sales | 622,657 | 106,118 | 278,226 | 698,825 |
| Avg Units | 73,419 | 12,151 | 33772 | 81,730 |
| **Concentration:** | | | | |
| HHI | 6,421 | 3,435 | 5,613 | 10,000 |
| Adjusted-HHI | 0.14 | 0.04 | 0.07 | 0.18 |

Note: This table shows summary data on market-level variables where market is defined at the city level. Data shown are monthly averages or totals from 2016-2017. Units refer to the quantity sold in terms of weight.

to consumers and sales between wholesalers and retailers, both at the transaction level. These data include both retail price and wholesale price for each transaction. Observing wholesale cost data is particularly unusual as this is typically carefully guarded information.

In total, we observe roughly 80 million transactions worth $2.5 billion between July 2014 and September 2017. In the initial year of the industry prices were volatile as new firms entered both at the retail level and upstream and as consumer demand adjusted. We thereby focus most of our analysis on the later portion of the data when the market is relatively stable. Table 1 shows summary statistics for prices and markups in 2016-2017.[8]

We calculate markups at the transaction level as $\frac{p^r - wp}{wp}$, where $p^r$ is the pre-tax retail price and $wp$ is the wholesale price. Average markups are high at 1.1, with an average retail price of $8.8 corresponding to an average wholesale price of $4.2.

# 3 Market Concentration and Markups

In this section we present our empirical findings. We take advantage of exogenous variation in market concentration and our ability to observe markups directly. Measuring concentration is

[8]For more detailed description of this data, see Hollenbeck and Uetake (2021).

inherently difficult but we are aided by the fact that our industry setting features well-defined local retail markets.

Conditional on the number of licenses allocated to a market and the number of applications filed in the lottery, whether or not a market contains stores that belong to the same firm is effectively the result of random chance. Here, we measure market concentration at the firm level not the store level. This is because stores that are owned by the same firm will internalize the effects of price competition among themselves, and the presence of co-owned stores in a market therefore corresponds directly to higher market concentration.

We first show evidence for this fact by comparing concentration across markets depending on how many firms that own multiple stores are present in each market. To do so we calculate the level of concentration in a market using the Herfindahl-Hirschman Index (HHI), as well as a normalized version of the HHI that adjusts for the number of firms in a market. Using firm level market shares $s_i$ for all $N$ firms in a market, these are calculated as:

$$HHI = \sum_i s_i^2 \tag{1}$$

$$HHI^* = \frac{HHI - \frac{1}{N}}{1 - \frac{1}{N}} \tag{2}$$

The normalization of HHI* is meant to account for the mechanical relationship between HHI and N. If all firms in a market have exactly equal market shares, HHI will be equal to $\frac{1}{N}$ but HHI* will always be equal to 0 regardless of N. Table 1 shows summary statistics on both of these measures and how they vary across markets. In general, we find only modest differences in market shares across retail stores within a market in terms of their sales or revenue. Therefore, most variation in concentration across markets is determined by the number of stores, and in the markets where some stores are co-owned, the number of firms. As a result, when one firm owns multiple stores in a market this implies that it will be more concentrated than an equivalent market.

To quantify how much more concentrated markets become when the lottery results in them containing co-owned stores, we run a simple regression of market level HHI on the number of stores in a market and a dummy for whether or not the market contains one or more co-owned stores. Results are shown in Table 2. We find the coefficient on the co-owned stores dummy is roughly 750 and is highly significant. Thus, the increase in market concentration is slightly smaller than if an evenly split market shifted from 4 to 3 stores.[9]

**Empirical Specification:** Next, we measure the causal effect of this increase in concentration on markups and prices. To do so we estimate a simple matching model comparing markets with

[9]To see this, if all stores have equal market shares, HHI with 4 stores is 2500 and with 3 stores is 3333, yielding a difference of roughly 833.

Table 2: Regression of HHI on Co-Owned Stores Dummy

| | (1) HHI | (2) HHI* |
|---|---|---|
| Co-owned stores in market | 771.4** | 0.18** |
| | (240.055) | (0.065) |
| # stores=2 | -4222.4*** | |
| | (201.197) | |
| # stores=3 | -5638.5*** | -0.0025 |
| | (243.262) | (0.064) |
| # stores=4 | -6582.1*** | -0.037 |
| | (265.978) | (0.069) |
| # stores=5 | -7095.4*** | -0.063 |
| | (306.359) | (0.078) |
| # stores=6 | -8689.3*** | -0.28 |
| | (721.797) | (0.175) |
| # stores=7 | -7987.7*** | -0.081 |
| | (685.671) | (0.165) |
| # stores=8 | -8235.5*** | -0.12 |
| | (412.240) | (0.102) |
| # stores=9 | -8640.0*** | -0.21 |
| | (541.047) | (0.133) |
| # stores=10 | -9356.8*** | -0.28 |
| | (721.797) | (0.175) |
| # stores=11 | -8688.1*** | -0.10 |
| | (685.671) | (0.165) |
| # stores=13 | -8949.9*** | -0.12 |
| | (685.671) | (0.165) |
| # stores=14 | -9148.3*** | -0.18 |
| | (502.894) | (0.123) |
| # stores=15 | -9820.6*** | -0.30 |
| | (721.797) | (0.175) |
| # stores=39 | -9552.6*** | -0.13 |
| | (685.671) | (0.165) |
| Constant | 9954.6*** | 0.14*** |
| | (116.732) | (0.040) |
| Observations | 89 | 55 |
| $R^2$ | 0.966 | 0.226 |

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: This table shows the results from a regression of HHI and normalized HHI on the number of stores in a market as well as a dummy for whether there is at least one co-owned pair of stores.

co-owned stores (treatment) to those without (control). Our approach consists of matching markets using the number of licenses allocated, the number of applications filed, and the ratio of these, all of which are pre-lottery outcomes. We argue that conditional on these two variables, assignment of the treatment is effectively random.

We perform the match using two related methods. We first use nearest neighbor matching, calculated using the Mahalanobis distance. We also test using inverse probability weighting (IPW) and we present results for both methods. We use a dummy to indicate treatment rather than using concentration as a continuous treatment because there are well-known conceptual problems with regressing outcome variables like price on concentration Berry, Gaynor, and Scott Morton (2019). Instead, we show that the treatment of having at least one pair of co-owned stores does indeed result in higher concentration and note that the variation across markets in this dummy is purely exogenous.

**First Stage and Balance of Covariates:** We first test the identifying assumption that the lottery generates exogenous variation in concentration. In Table 3 we show the results of our matching regression for four dependent variables. In each case we are interested in the effect of the presence of co-owned stores in a market as our measure proxy of concentration.

Table 3: First Stage and Balance Tests

| | (1) HHI | (2) Population | (3) # of Medical Stores | (4) # Multi-Applicants |
|---|---|---|---|---|
| Co-owned Store(s) in Market | 619.0** | 6269.5 | -0.0091 | -0.033 |
| | (191.599) | (7947.192) | (0.007) | (0.601) |
| Observations | 1244 | 1244 | 1244 | 1155 |

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: This table shows a regression of HHI on the presence of co-owned stores. Columns 2-4 test balance in the matching estimator by comparing markets with and without co-owned stores on population, prior presence of pre-legalization medical marijuana stores, and the number of multiple-license applicants in the lottery. Matching is done using a nearest neighbor algorithm using number of licenses, number of applications, and the probability of treatment to match, with exact matching on month.

In column 1 we observe that markets in which multiple stores are allocated to the same firm have significantly higher concentration as measured by HHI. This result is similar to the result shown in Table 2 except it uses the same matching regression specification that we use for our main results. Next, we show that markets are relatively balanced in the treatment and control group in that there are not significant differences in population, in the number of stores that were part of the medical marijuana system that predates the legal market created in 2014, and in the number

of applications in the market-level lottery that are filed by multi-applicant firms. We consider the number of medical stores to be a proxy for the history and nature of marijuana demand in a market. The last variable, # multi-applicants, tests if there is variation across market types in whether the market was attractive to the type of firm that filed multiple applications and was thus eligible to co-own a set of stores.

**Results on Price and Markups:** Next we use data from 2016-2017 to calculate average retail prices, average wholesale prices, assortment size, and markups weighted by sales at the market-month level. As noted in the previous section, we use transaction level data on retail and wholesale prices to calculate markups using the standard definition. Table 4 shows results for the matching estimation as well as an IPW specification. Table 5 also shows effects for assortment size offered by retailers, measured using number of products per store and number of manufacturers per store.

Table 4: Effects of Concentration on Market Outcomes

| | (1) NN Match Avg Prices | (2) NN Match Avg WP | (3) NN Match Markups | (4) IPW Avg Prices | (5) IPW Avg WP | 64) IPW Markups |
|---|---|---|---|---|---|---|
| Co-owned Store(s) in Market | -0.27*** | -0.081** | -0.035** | -0.25*** | -0.089** | -0.029* |
| | (0.075) | (0.026) | (0.013) | (0.072) | (0.032) | (0.013) |
| Observations | 1244 | 1244 | 1244 | 1244 | 1244 | 1244 |

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: This table shows the results of the effect of greater concentration on market-level average retail prices, average wholesale prices, and markups. In Columns 1-3 matching is done using a nearest neighbor algorithm using number of licenses, number of applications, and the probability of treatment to match, with exact matching on month. Columns 4-6 uses IPW, weighting on the same set of pre-lottery covariates. Concentration is measured using a dummy for the presence of co-owned stores and the unit of observation is a city-month.

Our results show that both retail prices and wholesale prices are significantly lower in markets with co-owned stores, despite the fact that these markets are more concentrated. These markets also feature larger product variety. In addition, these markets have significantly lower markups than otherwise similar markets that are less concentrated. These effects are large in magnitude and robust to specification. With average sales of around 700,000 units per market per year, the average annual savings to customers implied by the retail price difference is roughly $185,000 in the more concentrated markets.[10]

[10] A "unit" is defined in the administrative dataset on transactions as one gram of marijuana flower, or the equivalent amount for other product types such as edible or vaporizer products.

Table 5: Effects of Concentration on Assortment

| | (1) Avg. # Products | (2) Avg. # Manufacturers |
|---|---|---|
| Co-owned Store(s) in Market | 6.94* | 1.80** |
| | (2.853) | (0.646) |
| Observations | 1155 | 1155 |

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: This table shows the results of the effect of greater concentration on market-level average number of products sold at each store and number of manufacturers sold at each store. Matching is done using a nearest neighbor algorithm using number of licenses, number of applications, and the probability of treatment to match, with exact matching on month. Concentration is measured using a dummy for the presence of co-owned stores and the unit of observation is a city-month.

These results provide direct evidence of countervailing buyer power causing lower prices in more concentrated markets. They show that firms set lower markups on top of lower wholesale prices, with the result being substantially lower retail prices. This contradicts some widely used models of firm concentration and markups. In particular, research that assumes product market competition produces Cournot outcomes require that greater concentration mechanically translates to higher markups. Our results show that when many strategic variables are available to firms and are chosen simultaneously, and when consumers respond endogenously, more concentrated markets may have lower average prices and markups than less concentrated markets. Together, these results highlight the importance of using industry specific data with careful examination of the mechanisms involved to advance the debate on concentration and markups.

# 4 Discussion and Conclusion

We use a novel setting with highly advantageous features to provide causal empirical evidence that an exogenous increase in market concentration can cause a decrease in markups. We show that this is caused at least partially by countervailing power, in which a more concentrated retail sector pushes down both wholesale and retail prices. This mechanism is novel to the ongoing debate over potentially growing concentration and the effect on markups. While it is generally known that in rich models of competition an increase in concentration can coincide with a decrease in markups, it is less clear how realistic these models are. We go beyond correlation studies to show that an increase in concentration that is exogenously imposed can itself cause lower markups.

While countervailing power can partially explain why more concentrated markets have lower retail prices by putting downward pressure on wholesale prices, we also find that more concentrated

retail markets also charge lower markups in addition to paying lower wholesale prices. This is consistent with the literature on consumer search and firm pricing, which has shown how larger and more prominent firms may set lower markups to discourage consumers from searching extensively (Armstrong, Vickers, and Zhou (2009)). This literature also points out how, in the presence of multiproduct demand, larger retailers will prefer to offer more products and increase the price sensitivity of the marginal consumer visiting the store, thereby leading to lower average markups (Rhodes (2015)).

This study shows both the value and limitations of industry-specific research. By focusing on a single industry we are able to carefully control for institutional details and use direct causal inference to help clarify an important result and the mechanism driving it. At the same time, a single industry with unusual features cannot address economy-wide trends or the relative prevalence of different mechanisms generating these trends across heterogeneous industries. Ideally, this tension can be resolved by more industry-specific research across many industries that together provide a clearer picture of how industry concentration relates to markups and ultimately consumer welfare.

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