

# How Does Advertising Depend on Competition? Evidence from U.S. Brewing

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**Abstract.** The relationship between market structure and advertising has been extensively studied, but has generated sharply opposing theoretical predictions, as well as inconclusive empirical findings, likely because of severe endogeneity concerns. We exploit the 2008 merger of Miller and Coors in the U.S. brewing industry to examine how changes in local concentration affect firms' advertising behavior. Well-established regional preferences over beer brands, and the sharp increase in concentration from the merger, make this an excellent setting to analyze this question. We find a significant positive effect of local market concentration on advertising expenditures: a 100-point increase in the Herfindahl–Hirschmann Index measure of concentration increases advertising per capita by about 5%. Our findings shed light on how and when firms choose to deploy advertising.

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## 1. Introduction

The relationship between competition and the propensity of firms to advertise is both complex and ambiguous, because of two opposing forces. Changes in advertising should, in principle, affect firm outcomes, which would therefore influence market concentration. At the same time, variation in industry structure will alter the incentives of member firms to invest in advertising. Not surprisingly, the theoretical literature on this topic has generated sharply opposing predictions, as we describe below. Moreover, the empirical literature has heavily emphasized causality running in a single direction—from advertising to market structure. While the endogeneity concern has been repeatedly acknowledged, it has rarely been satisfactorily addressed; perhaps as a result, the findings have been inconclusive.

Empirically identifying the relationship between advertising and market structure is important for at least two reasons. First, by pinning down the causal effect of concentration on advertising we can assess the importance of reverse causality, a long-standing concern in studies on the relationship between advertising and market structure. Second, understanding how market structure affects advertising provides a valuable insight into how firms themselves view advertising. This is especially important because the vast literature on advertising has focused on the consequences for consumer choice, profitability, and market structure, but has devoted relatively little attention to understanding how and when firms choose to deploy this tool.

In this paper, we exploit a large, recent change in market structure in the U.S. brewing industry to estimate the causal effect of concentration on advertising. The brewing industry is an excellent setting in which to investigate this question, for a number of reasons. First, advertising is a key strategic variable for brewers, and beer is, in general, one of the most heavily advertised products (Tremblay and Tremblay 2005).<sup>1</sup> Second, the change in market structure that we examine was driven by the 2008 joint venture between Miller and Coors—previously the second and third largest brewers in the country—which led to sharp increases in concentration. Third, there are well-established regional preferences over beer brands in the United States, and therefore a nationwide merger of these two large firms had heterogeneous effects across different markets, which enables our identification strategy. Finally, the merger itself can reasonably be viewed as exogenous to the advertising market, since there is no evidence that it was proposed because of secular changes in market conditions that plausibly directly determine advertising.

Our results imply that greater market concentration leads to higher advertising per capita among the merging firms. We establish our results using simple panel-data methods, by estimating fixed-effect regressions of the relationship between concentration and advertising within local markets. However, changes in concentration over time within a market may be driven by many factors that could also determine advertising—such as economic conditions, and the

strategic decisions by firms—so we view these results as only descriptive. We therefore employ the predicted impact of the merger on concentration as an instrumental variable to correct for any endogeneity. Similar to Dafny et al. (2012), our identification strategy exploits the fact that the national merger had very different predicted, and actual, effects across local markets. We find a positive and quantitatively important effect of changes in local market concentration on local advertising. The IV estimates imply that a 100-point increase in the Herfindahl–Hirschmann Index (HHI) measure of concentration raises per capita advertising by an average of around 5%, although the associated confidence intervals are large because of considerable volatility in advertising. We then study a different change in market structure—brought about by the entry of craft beers rather than due to the MillerCoors merger—and show that entry by new firms is associated with a decrease in advertising by national brewers.

Our findings help to sort out long-standing, but competing, theories of advertising. These theories offer conflicting predictions, since they can imply a positive, negative, or even zero effect of concentration on advertising. As far back as Marshall (1890), some economists have viewed advertising as “combative,” suggesting that firms employ it primarily as an instrument of competition, which implies that concentration should have a negative effect on the propensity to advertise.<sup>2</sup> The same prediction, though motivated by a different theory, follows from Becker and Murphy (1993), who argue that, if advertising is complementary to the product and viewed as a good by consumers, then firms with market power will undersupply advertising just as they undersupply the good itself.

By contrast, a different view of advertising—dating back to at least Telser (1964)—is that it can have positive externalities on rivals. Indeed, as we discuss later, recent empirical studies have found compelling evidence of such externalities in a number of different settings. These positive externalities would be internalized by a monopolist, implying that concentrated markets should see greater advertising. A similar prediction, but again deriving from a different theory, is by Dorfman and Steiner (1954), who argue that higher margin goods are more likely to be advertised. Since these higher margins are more likely achieved by firms with market power, there is again a prediction of a positive effect of concentration on advertising.<sup>3</sup>

We make a number of contributions to this literature on the relationship between market structure and advertising. First, the empirical research on this topic has focused on estimating the effect of advertising on concentration; few studies have examined the reverse effect.<sup>4</sup> Moreover, among both types of these studies, the methodology has involved comparing advertising-to-sales ratios across a cross section of

industries. By contrast, we examine a single industry and exploit local changes in concentration driven by an arguably exogenous national merger. In addition, our results help inform our priors regarding the direction of bias in previous empirical studies that did not fully account for the endogeneity in the relationship between advertising and market outcomes. This endogeneity has been acknowledged by multiple authors, but it has been too complex to completely address; according to Bagwell (2007, p. 1741), “the endogeneity concern is formidable.”

Our findings also shed light on the conflicting theoretical predictions regarding the relationship between advertising and market structure. The result that concentration has a positive effect on advertising argues against the predictions of a negative relationship by Marshall (1890) and Becker and Murphy (1993). Instead, our findings are consistent with both Dorfman and Steiner (1954) and with the notion of positive spillovers that was first described by Telser (1964). We then examine these theories further and find that, following the merger, the merging firms increased their advertising the most, while their biggest rival—Anheuser-Busch—did not change its advertising at all. This result appears to be consistent with positive spillovers if the main motivation is to internalize the beneficial effects of rival advertising. While recent research has found evidence of positive spillovers in other settings, no study has examined whether advertising firms are aware of positive spillovers, and therefore whether this phenomenon affects their behavior.<sup>5</sup>

This paper also contributes to the industrial organization literature on mergers and, more generally, on the relationship between market concentration and market outcomes. Mergers are an important area of study since they have significant consequences for public policy; antitrust authorities in North America devote a considerable portion of their resources to reviewing large mergers. The literature on mergers is vast, consisting of both merger simulations and analyses of consummated mergers.<sup>6</sup> However, despite the large literature on the topic, the emphasis has overwhelmingly been on estimating the price and welfare effects of mergers, possibly because of the public policy implications.<sup>7</sup> This is despite the fact that market structure has long been theorized to affect many aspects of firm behavior, and that merging firms often have a number of strategic instruments at their disposal with which to maximize profits, such as quality or the variety of products offered.

Nevertheless, most prior work on mergers has assumed that prices are the only characteristic that firms may change in response to increased market power.<sup>8</sup> As Farrell et al. (2009) point out, the industrial organization literature has little to say about the nonprice effects of mergers. This is an important omission since, in

industries where nonprice competition is an important strategic variable, mergers may well affect outcomes—and therefore, indirectly, welfare—other than prices or profitability. The brewing industry is, in fact, an important setting where firms compete fiercely for market share by deploying their advertising budgets. By showing the effect of concentration on advertising in an industry where advertising competition is economically very important, we extend our understanding of the economic effects of mergers.

This paper proceeds as follows. In Section 2 we provide background on the brewing industry and the merger between Miller and Coors. In Section 3 we present the data used in our study. We discuss our identification strategy in Section 4. In Section 5 we present our empirical findings. In Section 6 we present extensions, notably by studying how the entry of craft beers—which changed market structure in ways distinct from the merger—affected advertising by the national brewers. We discuss our results and conclude in Section 7.

## 2. Industry Background and the MillerCoors Joint Venture

The beer industry is an excellent setting to analyze our question of interest, for at least three reasons. First, advertising is an important strategic choice in this industry, given that brewers spend tremendous resources on advertising. Advertising-to-sales ratios are very high in the brewing industry; Tremblay and Tremblay (2005) estimate that this ratio is 8.7%, which is considerably more than in other industries with high advertising propensities, such as pharmaceuticals and automobiles. Advertising expenditures by the beer industry were over \$800 million in each year of our data, to be described in the next section.<sup>9</sup>

The second reason has to do with the nature of consumer preferences in this industry. As is commonly known, there are strong and well-established regional preferences over beer brands in the United States. While Anheuser-Busch is the clear market leader with its Budweiser and associated brands, its dominance is particularly apparent in the South and in the region around St. Louis where it operates its largest brewery. By contrast, Coors is the market leader in many markets in the West of the country, particularly California, and Colorado, where its primary brewery is located. Miller's largest brewery is located in Milwaukee and Miller brands are dominant in the upper Midwest. These regional preferences imply that the merger had very different predicted—and actual—effects in different markets, thus providing considerable, and plausibly exogenous, variation in market concentration for us to identify our main effects.

The third reason that we believe this setting is favorable is the nature of the merger itself. Prior to the

merger, the beer industry was already very concentrated, with a handful of firms accounting for the vast majority of beer sales in the country.<sup>10</sup> However, the MillerCoors merger caused national concentration to jump dramatically in 2008. Figure 1 presents quarterly revenue shares of what were the five largest firms in the industry prior to the MillerCoors merger, and it shows the rise in concentration caused by the merger in the third quarter of 2008. Clearly, the merger led to a large and abrupt jump in national concentration.

Moreover, there are compelling reasons to view the merger as being exogenous to the advertising market, because of the reasons for its approval. Miller and Coors announced their joint venture on October 9, 2007, and at that time were the second and third largest firms in the industry.<sup>11</sup> Importantly for our purposes, there is no *ex ante* evidence that the joint venture was proposed because of expectations about changes in consumer preferences, concentration, price growth, or the market for advertising. Instead, the merger was proposed, and ultimately approved, mainly because it was expected to result in efficiencies related to shipping and distribution. Because beer is primarily water, it is bulky and heavy and expensive to ship long distances. Prior to the merger, Coors beers were primarily produced in Golden, Colorado, with some production in a smaller, secondary facility in Elkton, Virginia. Miller was produced in six plants more evenly located across the United States. The merger was expected to reduce shipping costs significantly, primarily by moving the production of Coors brands into Miller plants and closer to retail locations (Heyer et al. 2009). For these reasons, the Department of Justice approved the merger after a lengthy review on June 5, 2008.

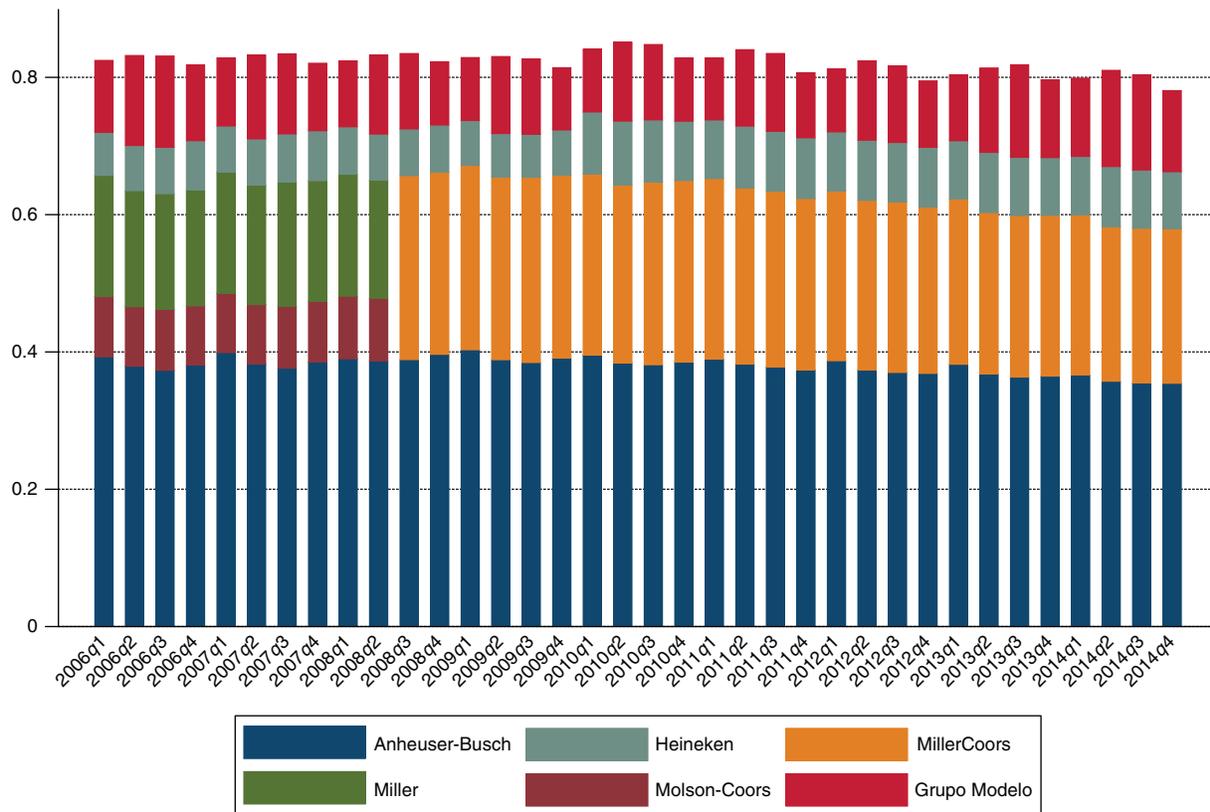
In summary, we believe that the beer industry, especially during the period of the MillerCoors merger, provides an excellent context around which to examine the relationship between advertising and market structure. This is because of the sharp increase in average concentration, with widely varying effects across markets, driven by a merger that can reasonably be considered exogenous to the advertising market, and in an industry where advertising is an important strategic variable whose value can be measured accurately in each local market.

## 3. Data

We use data from two main sources. First, we obtain data on beer sales by month and geographic market from Nielsen, through the Kilts Center for Marketing.<sup>12</sup> The data are obtained at the universal product code (UPC) level from point-of-sale retail scans across the United States. The original data set had sales information for over 16,000 UPCs in 206 designated market areas (DMAs).

While the Nielsen data set provides the most comprehensive sales data we know of, there is no

Figure 1. (Color online) Quarterly Concentration Ratios: 2006–2014



Note. The figure plots quarterly revenue shares for SAB Miller, Molson-Coors, and their three largest rivals based on retail sales across 87 geographic markets.

information on the parent companies that own the thousands of available beer brands. Ownership information is crucial for accurately constructing measures of concentration and for exploiting the change in concentration caused by the merger. We therefore hand coded the parent companies, based on available information on certain UPCs, as well as research on the web. In total, we obtained ownership information on 1,483 parent companies, accounting for 99% of UPCs.

Our second data source is Kantar media’s Ad\$pend database, which provides information on advertising by brewers. Kantar monitors advertising occurrences and expenditures for most brands in all major industries and across a wide range of media: national and local television, newspapers, magazines, and radio, as well as outdoor advertising (primarily on billboards). We queried the Kantar database to obtain monthly advertising expenditures by all major beer brands in each of these media for the years 2006–2012. We then summed up expenditures by manufacturer, and then further summed these across local media, to obtain a monthly database of local advertising for 101 major media markets, as well as a separate measure of national advertising for the same period. The media

markets defined by Kantar generally follow the DMA definitions used by Nielsen.

We then merged the Kantar and Nielsen databases to obtain a final database containing local advertising and market shares, for each of the three major beer manufacturers—Anheuser-Busch, Miller, and Coors—as well as Heineken, and a composite category that contains advertising spending of all other firms, along with the sum of squared market shares calculated using share data for all firms in the scanner data.<sup>13</sup> We focus on the advertising behavior of these four firms because they account for over 75% of sales and over 80% of advertising in our data. Moreover, these are the only firms with significant sales in all regions of the country; the remaining brands are mostly small or regional players and are unlikely to significantly affect the advertising market.<sup>14</sup> We dropped markets in the seven states that have restrictions against beer sales in supermarkets and other retail locations, including those states that only permit low-alcohol beer to be sold in supermarkets.<sup>15</sup> The final data set contains monthly advertising data, by manufacturer, for 87 markets, across 34 states, for the years 2006–2012. The regression sample is a balanced panel with 36,540 observations, which correspond to every combination

**Table 1.** Summary Statistics: Regression Sample

	N	Mean	SD	5%	95%
Local advertising (\$1,000s)	36,540	23.8	83.1	0	110.6
Local advertising/1,000 capita	36,540	5.1	10.6	0	25.0
Local HHI	36,540	2,915	775	1,718	4,126
Predicted change in local HHI	36,540	326	132	163	589
National advertising (\$1,000s)	420	11,016	10,141	967	34,180
National HHI	84	2,253	358	2,012	2,481

Notes. In the upper panel, observations are from a balanced panel of 87 markets, 84 year-months, and 5 manufacturer groups. The lower panel has a single observation per manufacturer-year-month.

of 87 DMAs, 5 manufacturer groupings, and 84 year-months.

Summary statistics on this regression sample are provided in Table 1. The upper panel summarizes local data, averaging across the 87 markets in our sample. Average local advertising expenditures for a manufacturer-month are approximately \$24,000, which varies widely across both manufacturers and markets. The mean HHI is 2,915, indicating a concentrated industry.<sup>16</sup> The predicted increase in the HHI following the merger, which we computed using the premerger market shares of Miller and Coors, is 326 points on average. However, this measure varies considerably across markets, from 163 points at the 5th percentile to almost 600 points at the 95th percentile.

The lower panel of Table 1 presents statistics on the national market. Advertising expenditures on national media are much higher than in local media, averaging \$11 million across manufacturer-months. The national HHI over our sample period was 2,253, which is considerably lower than the mean of the local HHI. This reflects the higher concentration in individual markets, which is a function of the varying local dominance of the three major beer manufacturers, as described in Section 2.

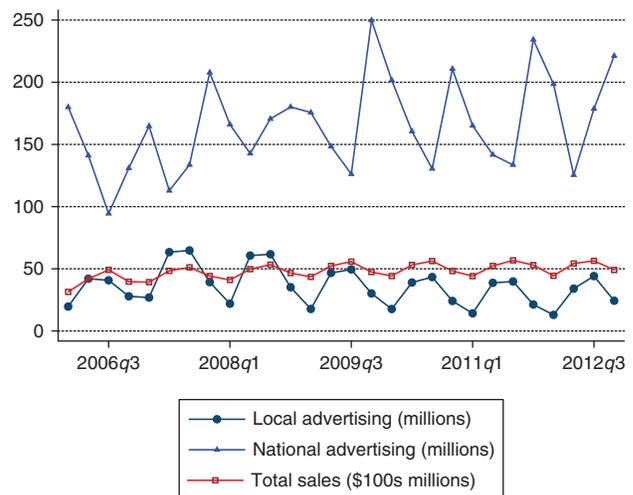
We emphasize that there is large variation in advertising intensity across geographic markets, which helps identify our results. Advertising expenditures are closely linked to population sizes, but brewers vary their advertising expenditures widely across markets, both in absolute terms and on a per-capita basis. This is evident from the upper panel of Table 1, which shows that both aggregate and per-capita advertising in local markets have high standard deviations relative to their means.<sup>17</sup> For example, Austin has similar advertising levels to those of Detroit, despite having only one-third the population.

We also note that there is considerable volatility in advertising spending over time, even within a given firm and market. This conforms to a well-established fact about the nature of advertising. A large number of prior studies have found evidence of “pulsing” whereby firms frequently switch advertising on and

off.<sup>18</sup> Such observations have been made in a wide range of industries and it appears that beer advertising is no exception. As a result, there are many observations where a firm has zero monthly advertising in a market in our data. Although this is not problematic for our identification strategy, such behavior adds noise to our estimates and makes it harder to establish statistically significant effects.

While pulsing is commonly observed in other industries, one additional reason that it may be prevalent in the brewing industry is the seasonal nature of consumption. Beer consumption peaks in July in every market in our sample and reaches its lowest point in February. However, this seasonal trend exhibits considerable variation across the country. The average jump in beer consumption between February and July is around 20% in warmer cities such as Phoenix, Miami, and Orlando, but over 80% in colder cities such as Milwaukee, Buffalo, and New York.

Beer advertising is also seasonal—probably because of seasonality in consumption—although advertising may also be affected by sporting events and economic conditions. Figure 2 plots advertising spending, by quarter, separately for national and local media, as well as total beer sales across all firms. Both measures of advertising exhibit strong seasonality though, interestingly, with opposite cycles. Local media spending, which is mostly on spot television markets and outdoor advertising—tends to peak in the summer months and has a clear seasonal correlation with beer sales. National media expenditures—which are primarily on network and cable television—are highest in the first and fourth quarters of the year. This is probably driven by larger audiences in the (much more expensive)

**Figure 2.** (Color online) Seasonal Variation in Advertising Expenditures

Notes. The figure plots advertising expenditures on beer in national and local media. Local expenditures refer to the sum of local market spending across 87 geographic markets.

national market in the fall and winter, as well as spending around Christmas and the weeks leading up to the Super Bowl.<sup>19</sup> Note, though, that the national market is not the main focus of this paper, because of our identification strategy, as we discuss below.

#### 4. Identification Strategy

We now discuss our strategy for identifying the causal effect of market concentration on the propensity of firms to advertise. Our approach exploits the effects of the national merger between Miller and Coors on local advertising. This approach has been used in a number of recent studies of mergers, including Hastings and Gilbert (2005), Dafny et al. (2012), and Ashenfelter et al. (2015). In particular, our analysis closely parallels that of Dafny et al. (2012), who use variation in how a merger of two large health insurance companies increased concentration across local markets to study how concentration influences insurance premiums.

We believe this research design is particularly well suited for analyzing mergers in the beer industry because of the unique nature of consumer preferences over beer brands. Nationally, Miller and Coors were the second and third largest firms in the United States prior to their joint venture. However, as discussed in Section 2, there are strong and well-established regional preferences over beer brands in the United States. Thus, while both firms' products were sold essentially everywhere in the United States, there were substantial differences in the firms' premerger market shares across the 87 DMAs in our data. This variation is important for our identification strategy, as it allows us to control for any firm-specific unobservable factors that had a common effect on per-capita advertising across local markets. Our framework implicitly does this by comparing changes in a firm's per-capita advertising across markets that were differentially affected by the merger.

Our main estimating equation takes the following form:

$$Y_{jmt} = \beta HHI_{mt} + \alpha_{jm} + \gamma_{jt} + \epsilon_{jmt}. \quad (1)$$

Here,  $Y_{jmt}$  is firm  $j$ 's advertising spending per thousand capita in market  $m$  during month  $t$ , and  $\alpha_{jm}$  is a full set of dummy variables for each DMA/firm combination. Including  $\alpha_{jm}$  allows the typical amount of monthly advertising to vary freely across DMAs and firms. For example, it allows Anheuser-Busch InBev to have persistently high advertising in Saint Louis and SAB Miller to have persistently high advertising in Chicago. We include  $\gamma_{jt}$ , which is a set of dummy variables for each year/month/firm combination. These dummies capture firm-specific changes in advertising common across markets. This allows the 2008–2009 recession, for example, to have a different effect on Anheuser-Busch InBev advertising spending across all markets than on Coors advertising spending.

The key independent variable in Equation (1) is  $HHI_{mt}$ , which is the sum of squared revenue shares across firms in market  $m$  during time period  $t$ . We can expand on Equation (1) by adding potential confounders related to local economic conditions that vary over time within each market and may predict advertising, including local unemployment rates, log earnings, and linear trends for each census region.<sup>20</sup> Throughout the paper, when conducting inference, we allow the variance of a firms' residual advertising to differ across markets, correlation in unobserved advertising across firms within a market, and arbitrary serial dependence in residual advertising within a market by clustering our standard errors at the designated market area level (Bertrand et al. 2004).

Ordinary least squares (OLS) estimates of Equation (1) are unlikely to produce consistent estimates of  $\beta$  because we are concerned that  $HHI_{mt}$  may be correlated with  $\epsilon_{jmt}$ . The main reason for this is reverse causality; the prior literature has explicitly considered a direct link from advertising to market concentration, specifically in the beer industry. For example, Greer (1971) and Tremblay and Tremblay (1995) argue that advertising has contributed to increased concentration among brewers. Additionally, George (2009) shows that the rise of national television markets may have helped the large national brands to exploit economies of scale in advertising at the expense of small, local brewers. Moreover, a high level of advertising raises sunk costs for incumbent firms, making it harder for new firms to enter, or for established firms to enter new markets (Sutton 1991).

Therefore, if there are omitted determinants of advertising in Equation (1), these are likely to be correlated with the HHI because of the feedback effect of advertising on concentration. The direction of the bias is ambiguous, since both demand and supply side shocks will affect a firm's advertising decision, but in opposite directions. Moreover, firm-specific demand or supply shocks have an unknown relationship with concentration, since this will depend on the size of the firm. For example, a demand shock to a dominant firm in a market is likely to increase concentration, while an increase in marginal costs for such a firm will decrease concentration. However, the reverse is true for shocks to a small firm.

As endogeneity is likely to be a significant concern for our study, we therefore implement an instrumental variables (IV) strategy, exploiting the 2008 merger between Miller and Coors that increased market concentration. We believe that the merger is likely to be a good instrument because it caused market concentration to vary by different amounts in different markets, based on the premerger shares of Miller and Coors. Indeed, as we show below, there is a strong correlation between *predicted* changes in concentration—based

on the market shares of Miller and Coors immediately prior to the merger—and *actual* changes in concentration, which we computed for the period following the merger. In other words, the merger can reasonably be viewed as generating an exogenous change to concentration, and one that varied widely across different markets.

Additionally, we believe the merger satisfies the exclusion restriction because we do not expect the merger to have directly affected the advertising market, other than through its effect on market concentration. This is for two reasons: first, there is no evidence that the merging firms in this particular case were motivated by the advertising market, or by secular changes in market fundamentals that would plausibly determine advertising behavior. As discussed in Section 2, the main reasons the Department of Justice approved the merger—which would otherwise have been controversial, given that it combined the second and third largest firms in the industry—was that it was expected to increase efficiency by reducing shipping costs and that remaining competition from Anheuser-Busch InBev would make price increases by MillerCoors unprofitable. In their lengthy review of the various arguments surrounding the merger, Heyer et al. (2009) do not mention the advertising market at all. Second, our study examines *local* changes in advertising expenditures driven by the *national* merger. In this context, it is unlikely that unobserved factors affecting advertising at the level of individual local markets are correlated with local changes in concentration that are driven by a merger in the national market.

To operationalize the IV strategy, it is important to note that the instrument takes the same value, for a given market, in all postmerger periods and for all firms. Thus, it is perhaps more intuitive to consider a version of the estimating equation with just two observations for each firm-market: before and after the merger. Specifically, consider a version Equation (1) where  $t$  is either 0 or 1, denoting the pre- and postmerger periods, respectively, and the variables of interest are averaged over all the months in each period. If we then take first differences of this model—across the two observations for each firm-market combination—we obtain

$$\Delta Y_{jm} = \beta \Delta HHI_m + \gamma_j + \Delta \epsilon_{jm}. \quad (2)$$

Note that the firm-market fixed effects are differenced out as they do not vary over time. Equation (2) relates the change in advertising per capita to the change in HHI, and includes firm fixed effects. We now propose using the predicted, or simulated, change in HHI in market  $m$ , which we denote by  $\text{sim}\Delta HHI_m$  as an instrument for the actual change in HHI in Equation (2). This is the same instrument used by Dafny et al. (2012) and

Ashenfelter et al. (2015). In particular,  $\text{sim}\Delta HHI_m$  is the increase in concentration that would have been predicted using market shares calculated just before the merger.<sup>21</sup> Specifically,

$$\begin{aligned} \text{sim}\Delta HHI_m &= 2 \times \text{PreMergerMillerShare}_m \\ &\quad \times \text{PreMergerCoorsShare}_m. \end{aligned}$$

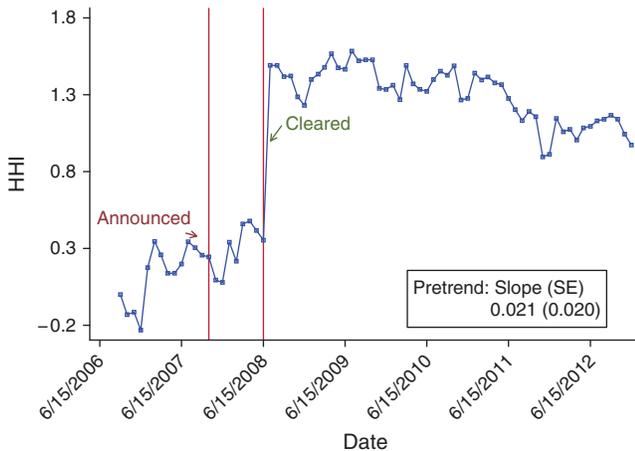
We now return to considering the version of the estimating equation that uses monthly data, as in Equation (1). Using disaggregated data has the advantage of exploiting added variation in market structure and advertising. However, monthly data may also introduce noise, especially if advertising or concentration experience changes for reasons unrelated to our research question. Therefore, we will present results—in the next section—using both monthly and aggregated (two-period) data. We note for now that implementing the IV strategy with the more disaggregated data implies that we define the interaction of  $\text{sim}\Delta HHI_m$  and a postmerger dummy as an instrumental variable for  $HHI_{mt}$  in Equation (1).<sup>22</sup>

It is useful to document the extent to which concentration increased just after the merger across local markets, and the ability of premerger market shares to explain any increases in local market concentration that happened with the merger. We provide evidence of the ability of the merger to predict actual changes in market concentration by fitting the following equation to the data using OLS:

$$\begin{aligned} HHI_{mt} &= \sum_{\tau=10}^{\tau=60} \beta_{\tau} \text{sim}\Delta HHI_m \times 1(t = \tau) \\ &\quad + \alpha_{jm} + \gamma_{jt} + \epsilon_{jmt}, \end{aligned} \quad (3)$$

where  $\text{sim}\Delta HHI_m$  is interacted with a set of dummies for each time period in the data set beginning a year before the mergers announcement date, and the other variables are defined as before. We produce an event-study graph, in Figure 3, by plotting the estimated coefficients  $\beta_{\tau}$  with respect to calendar dates. The graph allows us to explore whether there were preexisting trends in market concentration that were correlated with how the merger was predicted to impact local markets, which would be evidence against the exogeneity of the merger. We estimate the extent to which premerger concentration growth was systematically related to  $\text{sim}\Delta HHI$  by regressing the coefficients  $\beta_{\tau}$  from periods prior to the merger on a linear trend. The slope coefficient in this regression is the implied pre-trend, which is presented along with its standard error in the event-study figure.<sup>23</sup> The graph also allows us to determine whether any increase in concentration was persistent through our sample period, which could in principle help us determine the relevant time period in which the merger may have influenced advertising.<sup>24</sup>

**Figure 3.** (Color online) Estimated Coefficients from Regression of HHI on Simulated Change in HHI



Notes. HHI was regressed on year-month effects, region-firm effects, and interactions between  $sim\Delta HHI$  and year-month dummies. The figure plots estimated coefficients on these interactions.

Three key facts stand out about Figure 3. First, there is no evidence of a systematic trend in local concentration growth related to how the merger would affect each local market *prior* to the merger. This gives us confidence that the merger itself was not a response to underlying factors that were creating changes in concentration within the designated market areas in our sample. Second, the merger had a large impact on concentration just after it was consummated, exactly as would be expected. Third, the impact of the merger on concentration dropped only slightly during the postmerger time period and was largely persistent—entry or diversion of sales to rival firms’ brands did not reduce the combined MillerCoors market share significantly over the two and a half years following the merger. These facts help validate the relevance of the predicted change in concentration resulting from the MillerCoors merger as an instrument for concentration.

## 5. Regressions to Explain Advertising Expenditures

We now present our main empirical results. While the focus of this paper is on examining how *local* advertising responds to market structure changes, we first present results using aggregate national advertising data. Table 2 shows the relationship between national advertising expenditures and the national HHI measure of concentration, measured on a 10,000 point scale. In column (1), the dependent variable is the expenditure in national media—network and cable television and national newspapers—while in column (2) it is the sum of national and local advertising.

The results suggest that concentration appears to have no significant effect on advertising. However, these regressions do not identify the causal effect of

**Table 2.** Regression Estimates of National Advertising on Concentration

	(1) National	(2) Total
HHI	−0.009 (1.83)	−0.053 (1.86)
$R^2$	0.673	0.698
Obs.	420	420

Notes. An observation is a manufacturer-year-month. Regressions contain manufacturer and year  $\times$  month fixed effects. Standard errors are in parentheses. National refers to expenditures in national media, measured in millions. Total refers to the sum of national and local advertising.

concentration on advertising, for a number of reasons. As discussed above, concentration is clearly endogenously determined, and could well be a function of firms’ advertising. More importantly, we know that other significant changes occurred in the industry during this period. The most obvious was the deep economic recession that began in 2008 and coincided almost exactly with the MillerCoors merger. This is likely to have affected the advertising market since it is generally believed that advertising is procyclical.<sup>25</sup> In fact, it is quite likely that beer advertising would have fallen because of the recession, had it not been for the effects of the merger.<sup>26</sup> Other important changes that coincided with the merger and its aftermath include the rise of craft beer and the fragmentation of traditional media—as audiences increasingly switched to online consumption of media during this period—which would have reduced the value of nationwide advertising.

For these reasons, examining the national market for beer advertising is not particularly informative; moreover, the national market does not allow us to implement our instrumental variables strategy, which relies on variation in predicted concentration across markets. Therefore, we now turn to empirical exercises that exploit the differing effects of the merger in different parts of the country to examine the relationship between local market concentration and local advertising.

We begin by estimating OLS panel regressions relating advertising spending per capita, in each local market in our sample, to market concentration, as represented in Equation (1). The results are in Table 3. In columns (1) and (2) we utilize the entire variation available by employing monthly data, while in columns (3) and (4) we average the monthly data into a single observation in each of the pre- and postmerger periods, for reasons explained in Section 4. We exploit the panel structure of our data and include market fixed effects in each specification so that the relationship is identified by changes in concentration within each designated market area in our data. Columns (1) and (3) estimate the most parsimonious version of the model, including only market fixed effects and common time effects,

**Table 3.** OLS Estimates of the Effect of Concentration on Advertising

	Monthly		Pre/Post	
	(1)	(2)	(3)	(4)
HHI	2.34 (1.49)	2.34 (1.50)	-1.95 (3.16)	-1.95 (4.26)
Firm × Market effects	No	Yes	No	Yes
Firm × Date effects	No	Yes	No	Yes
R <sup>2</sup>	0.357	0.586	0.575	0.923
Obs.	36,540	36,540	870	870

Notes. An observation is a firm-market-period. Columns (1) and (3) also contain uninteracted firm, date, and market fixed effects. Standard errors clustered by market are in parentheses.

both constrained to be the same across different firms, as well as firm fixed effects. Columns (2) and (4) allow the time and market fixed effects to vary freely by manufacturer. The results of Table 3 are inconclusive; they suggest a positive relationship between market concentration and advertising when using monthly data, but a negative relationship when averaging over the pre- and postmerger periods. In all cases, though, the estimates are small and not statistically significant. Allowing the time and market effects to vary by firm has no effect on the point estimates.

As described in Section 4, simple OLS estimates of the advertising-concentration relationship may be biased because of reverse causality or because of correlation between within-market changes in concentration and omitted determinants of advertising. For this reason, we now move on to estimates of the effect of concentration on advertising that use only the variation in concentration resulting from the MillerCoors merger, which was motivated for reasons plausibly exogenous to unobservable determinants of advertising spending. Before presenting these results, we first verify a strong relationship between how the merger was anticipated to increase concentration across markets and how concentration actually changed; i.e., the “first stage” of the IV specification.

Table 4 presents the results from regressing the endogenous variable—the HHI level of concentration in each market—on the instrument, which is the predicted change in concentration from the merger. As discussed in Section 4, the instrument when using contemporaneous data is defined as  $sim\Delta HHI \times Post$ , which is equal to the simulated change in the HHI in each market for postmerger periods and zero for the premerger periods.<sup>27</sup> The results would be identical if we were to instead estimate the model in first differences using  $sim\Delta HHI$  as the instrument.

The results of Table 4 show that simulated HHI is a very good predictor of actual HHI, as expected given the results of the event study plotted in Figure 4. Further, the results are stable across specifications.

**Table 4.** Effect of Merger on Concentration (First-Stage)

	Monthly		Pre/Post	
	(1)	(2)	(3)	(4)
$sim\Delta HHI \times Post$	1.15*** (0.22)	1.15*** (0.22)	1.20*** (0.28)	1.20*** (0.37)
Firm × Market effects	No	Yes	No	Yes
Firm × Date effects	No	Yes	No	Yes
R <sup>2</sup>	0.828	0.828	0.916	0.916
Obs.	36,540	36,540	870	870
F-statistic	27.4	27.2	18.8	20.9
Partial R <sup>2</sup>	0.048	0.048	0.117	0.117

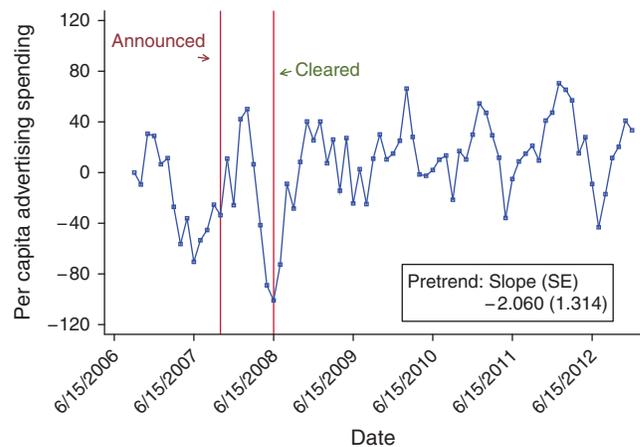
Notes. Columns (1) and (3) also contain uninteracted firm, date, and market fixed effects. Standard errors clustered by market are in parentheses.

\*\*\* $p < 0.01$ .

Columns (1) and (2) suggest that a one-point predicted increase in concentration leads to a 1.15 point increase in actual concentration. Columns (3) and (4) show that the coefficient is slightly higher when aggregating data across the pre- and postmerger periods. Allowing market and time effects to vary freely across firms has no effect on the estimates, which are statistically significant at the 0.01 level across all specifications. The first-stage partial F-statistic is well above the rule of thumb thresholds commonly used to diagnose weak instruments. Thus, the instrument appears to be a good predictor of variation in the endogenous variable.

We next present direct estimates of the effect of the merger on advertising, i.e., the “reduced form.” Table 5 presents the results of regressing advertising per capita on the instrument, for the same specifications

**Figure 4.** (Color online) Estimated Coefficients from Regression of per Capita Advertising on Simulated Change in HHI



Notes. Per-capita advertising spending was regressed on firm-year-month effects, market-firm effects, and interactions between  $sim\Delta HHI$  and year-month dummies. The figure plots estimated coefficients on the interactions between  $sim\Delta HHI$  and year-month dummies times the average increase in concentration across all geographic markets (0.036).

**Table 5.** Effect of Merger on Advertising (Reduced-Form)

	Monthly		Pre/Post	
	(1)	(2)	(3)	(4)
$sim\Delta HHI \times Post$	27.98** (12.76)	27.98** (12.88)	34.95** (17.08)	34.95 (22.99)
Firm $\times$ Market effects	No	Yes	No	Yes
Firm $\times$ Date effects	No	Yes	No	Yes
R <sup>2</sup>	0.357	0.586	0.576	0.923
Obs.	36,540	36,540	870	870

Notes. Columns (1) and (3) also contain uninteracted firm, date, and market fixed effects. Standard errors clustered by market are in parentheses.

\* $p < 0.1$ ; \*\* $p < 0.05$ .

considered in the OLS and first-stage regressions. Columns (1) and (2) present results using monthly data. The point estimate implies a positive and statistically significant relationship between how the Miller-Coors merger was anticipated to increase local market concentration and advertising spending per capita. In the average market, the merger was anticipated to raise concentration by 0.033 points (where the HHI is scaled to be between zero and one). This translates into a \$0.91 ( $0.033 \times 27.98$ ) increase in monthly advertising spending per thousand capita. Relative to the average premerger value of monthly advertising spending, this is a 16.6% increase in advertising spending per capita.

The results using just two periods of variation—shown in columns (3) and (4) of Table 5 are higher in magnitude but also less precise. The point estimates imply that the merger was predicted to increase advertising by \$1.16 per thousand capita, which is a 21% increase in advertising expenditures. However, the confidence interval is large, and includes zero in the specification of column (4) where we allow firm effects to vary by market and date.

The pattern of estimates in Table 5 suggests that our estimates of how the merger increased advertising is due to the sharp increase in concentration caused by the MillerCoors joint venture and how it impacted advertising. Furthermore, there is no evidence of underlying regional trends in concentration related to how the merger was expected to increase concentration. However, we examine the timing of when the merger changed advertising spending more directly and conduct a second event study by estimating the following equation:

$$Y_{jmt} = \sum_{\tau=10}^{\tau=60} \beta_{\tau} sim\Delta HHI_m \times 1(t = \tau) + \alpha_{jm} + \gamma_{jt} + \epsilon_{jmt}. \quad (4)$$

Equation (4) is a more flexible version of the reduced form specification and is analogous to Equation (3). The dependent variable is per-capita advertising spending and we include year-month effects that

**Table 6.** The Impact of Local Market Concentration on Advertising Spending (IV Estimates)

	Monthly		Pre/Post	
	(1)	(2)	(3)	(4)
HHI	24.42** (12.11)	24.42** (12.01)	29.06* (15.59)	29.06** (14.66)
Firm $\times$ Market effects	No	Yes	No	Yes
Firm $\times$ Date effects	No	Yes	No	Yes
Obs.	36,540	36,540	870	870

Notes. Columns (1) and (3) also contain uninteracted firm, date, and market fixed effects. Standard errors clustered by market are in parentheses.

\* $p < 0.1$ ; \*\* $p < 0.05$ .

are allowed to vary by firm, which control for (firm-specific) seasonality common to all markets, market-firm effects, and interactions between year/month dummies and the predicted increase in concentration.

The results are in Figure 4. While there is considerable volatility in the event study graph—likely related to the underlying volatility in advertising that we discussed in Section 3—there is no clear evidence of any underlying, preexisting regional trends in advertising that would call our identification strategy into question. There does appear to be a dip in advertising expenditures around the time the merger was approved, but this may be related to a spike in advertising a few months prior to that. In general, there is a high degree of volatility in the period after the merger was announced and before it was approved. Therefore, as a robustness check, we redid the reduced form specification dividing the data into three periods—before, during, and after the merger—and estimated separate coefficients for the interaction of the HHI with indicators for the announcement period and the postmerger period. As we discuss in Section 6.3, the results are robust to considering only the period after the merger was approved—relative to the premerger period. Thus, the dip in advertising just prior to the merger approval is not responsible for driving our results.

We now turn to IV estimates of the relationship between advertising and concentration, which are presented in Table 6. Note that, since we have one endogenous variable and one instrument— $HHI$  and  $sim\Delta HHI \times Post$ , respectively—two-stage least squares estimates are identical to the ratio of the corresponding coefficients on the first-stage and reduced-form regressions, i.e., Tables 4 and 5, respectively. The 2SLS coefficient on concentration from the specification that uses monthly data is 24.42, and from the one using the two-period specification is 29.06. Although both estimates are statistically different from zero, the confidence intervals are large, likely reflecting the volatility in advertising that we have discussed earlier.

The point estimates from the IV specification indicate a stronger relationship between market concentration and advertising than the simple OLS results. We believe that the IV results are consistent, and correctly identify the causal effect of concentration on advertising, for two reasons. First, we have supported the assumption that the merger is an exogenous shifter of local market concentration by showing, in Figure 3, that the variation in concentration caused by the Miller-Coors merger was not systematically related to preexisting trends in local market concentration. Second, we showed, in Figure 4, that preexisting trends in advertising were unrelated to the change in local market concentration caused by the merger.

As discussed in Section 4, we were unable to ex ante sign the bias in the OLS regression. Comparing the results of Tables 3 and 6, it appears that the IV specification corrects a downward bias in the OLS specification.<sup>28</sup> The point estimates from the IV specification in Table 6 imply that a 100-point increase in the HHI increases advertising by between 4.4% and 5.3% from its average value.<sup>29</sup> However, the merger itself increased the HHI by 360 points in the average market, implying that the total increase in advertising from the merger was 16%–19%. This is a large amount, but it is primarily driven by the size of the merger itself, which raised concentration substantially in a number of markets. Note again that the confidence intervals associated with these estimated effects are large, reflecting the uncertainty in our estimates that derives from the high degree of volatility in advertising.

## 6. Extensions and Robustness Checks

In this section we examine in more detail our main result—that increases in concentration appear to cause firms to increase their advertising expenditures—as revealed by our instrumental variables specification. We first examine heterogeneity in the main result across firms and markets. We then examine a different source of market structure changes—the entry of craft beers. Finally, we show that our results are robust to differences in specification and sample selection.

### 6.1. Heterogeneity

As noted in the Section 5, although our point estimates are statistically distinct from zero, the associated confidence intervals are wide. This may be due to the high volatility in advertising spending documented in Section 3, but another reason for imprecise estimates may be heterogeneity across firms. Thus far, we have examined how changes in concentration affect firms *on average*, but it may well be the case that there were different advertising responses to the merger across merging and nonmerging firms, or across markets with low and high levels of initial concentration.

**Table 7.** IV Results Estimated Separately for Firm Groupings

	MillerCoors	ABI	Heineken	Grupo	Boston Beer	Other
HHI	90.61** (44.82)	−9.18 (24.87)	−2.90 (15.04)	12.42 (12.66)	0.67 (1.83)	63.85*** (22.41)
Obs.	7,308	7,308	7,308	7,308	7,308	7,308

*Notes.* All regressions contain market and year \* month fixed effects. Standard errors clustered by market are in parentheses. ABI, Anheuser-Busch InBev.

\*\* $p < 0.05$ ; \*\*\* $p < 0.01$ .

To examine heterogeneity across firms, we estimate the model separately by manufacturer groups. To do this, we combine Miller and Coors into a single group, and examine how changes in local market concentration differentially affected the combined advertising of MillerCoors, as well as some of its larger rivals. In addition to Anheuser-Busch and Heineken, we estimated separate effects for Grupo Modelo—which owned the Modelo and Corona brands—and the Boston Beer Company, as well as a composite category for all other firms. The results are in Table 7. The results indicate that the overall increase in advertising from greater local concentration is mainly driven by the merging firms themselves, and by the smaller firms in the industry. By contrast, there did not appear to be any change in Anheuser-Busch’s advertising expenditures as a result of the change in concentration, or those of the other large brewers.

Thus, the results of Table 7 are one explanation for the somewhat imprecise estimates obtained in Tables 5 and 6. Since MillerCoors and Anheuser-Busch are by far the two largest firm groupings, accounting for almost 70% of the industry’s sales, it is perhaps not surprising that the average effect, estimated in Table 6, has large confidence intervals given that the two firms responded very differently to the merger. In addition, the results of Table 7 may have implications for the positive spillovers hypothesis, which we will discuss in more detail in the next section.

We then examined heterogeneity across markets, by dividing our sample according to whether the level of initial concentration was below or above the median across markets, prior to the merger. The goal is to examine whether mergers had different effects in markets that initially faced high versus low levels of concentration, or even whether there may be a non-monotonic relationship between advertising and concentration. There is evidence that competition has non-monotonic effects on R&D investment, which is similar to advertising in that it is a nonprice instrument of competition.<sup>30</sup>

The results are in Table 8. They show that the greatest effects of the merger were in markets with low initial levels of concentration, and that there were smaller effects of additional concentration in markets with high

**Table 8.** IV Results Estimated Separately for Low and High HHI Markets

	Monthly		Pre/Post	
	Low	High	Low	High
HHI	68.80** (29.95)	11.90* (6.44)	84.31** (38.32)	14.98** (7.19)
Obs.	18,060	18,480	430	440

Notes. All regressions contain firm × market and firm × date fixed effects. Standard errors clustered by market are in parentheses.

\* $p < 0.1$ ; \*\* $p < 0.05$ .

values of premerger HHI. In addition, we found no evidence of a nonmonotonic effect of competition on advertising when we included a polynomial in the HHI measure of concentration. The results of Table 8 are another explanation for the relatively imprecise estimates in our main results, which estimate an average coefficient across all markets.

### 6.2. Changes in Market Structure Caused by Entry

So far, our examination of the effects of concentration on advertising has exploited the merger of Miller and Coors. But market structure can also change because of the entry or exit of rivals. In fact, the U.S. brewing industry saw a large amount of entry during our sample period, due to the growth of craft beers. These are beers produced on a small scale, which are independent of the large national brewers, and tend to be distributed in local markets. As is well known, there has been a sharp rise in the number of craft breweries in recent years.<sup>31</sup>

We can use our data to examine whether there is a relationship between the entry of craft beers and the amount of advertising expenditures by the large, national brewers. An advantage of studying the entry of craft beers is that we can exploit considerable geographic and temporal variation. Craft beers have increased in importance in the last few years, but at different rates in different parts of the country. Elzinga et al. (2015) document how craft beer originated in California, and then spread sequentially into the Pacific Northwest, the Northeast, and then the upper Midwest. By contrast, lower Midwestern and Southern states were slower to see growth in craft beer, perhaps partly because of laws that prevented small-scale brewing (Tankersley 2016).

For our purposes, we define craft beer as all beer that is not produced by one of the five major brewing groups in the United States. Specifically, we exclude Anheuser-Busch, Miller, Coors, Heineken, and the Modelo and Corona brands. This definition has the advantage of being simple to construct and understand. However, it does include beers that do not meet the usual definition of craft, such as most foreign beers, as well as relatively large regional brewers such as

**Table 9.** Growth of Craft Brewers

Year	Manufacturers	Share
2006	62.2	15.4
2007	81.4	14.0
2008	88.9	14.0
2009	96.7	14.5
2010	100.0	13.8
2011	112.5	15.1
2012	124.1	17.0
2013	141.1	18.2
2014	157.3	19.8

Note. Values are calculated on the sample of 87 markets, excluding the top five brewers nationally.

the Boston Beer Company and Yuengling, which are not recognized as craft beers by the Craft Brewers Association.<sup>32</sup>

Table 9 documents some trends around craft beer entry across the 87 markets in our sample. The number of parent companies with positive sales was 62 in the average market in 2006, but this grew steadily to 157 by the end of the sample. The *share* of these brewers, by contrast grew more slowly, and actually fell in a couple of years. Moreover, the majority of sales of what we label “craft” beers are in fact foreign imports. As Elzinga et al. (2015) point out, accounts in the popular press appear to overstate the importance of domestic craft beers. Although their market share has grown in recent years, it is still quite small, certainly in relation to the national brewers but even in comparison with imported beers. Moreover, there is not much variation in the share of craft brewers over time, unlike in the number of brewers.

We examine whether the number of craft brewers, or their market share, in each local market is correlated with the local advertising expenditures of the five major brewing groups. We note that this exercise is primarily descriptive, as we do not have a good instrument for the share of craft beers in a market, unlike our analysis in Section 5. Table 10 presents the results of regressing local advertising per capita on the number of craft breweries with positive sales in the market (columns (1)–(3)) and the share of these breweries (columns (4)–(6)). The results in columns (1)–(3) suggest that the number of craft beer brands is negatively correlated with local advertising expenditures by the large national brewers; the point estimates indicate that entry by 10 new craft brewers is associated with about a 2.5% reduction in advertising per capita. This evidence is consistent with the results of Section 5, which showed that local advertising increases when markets become more concentrated. The results in columns (4)–(6) show no statistically significant relationship between the market share of these craft beers and advertising by national brewers.

**Table 10.** Effect of Craft Entry on Advertising

	(1)	(2)	(3)	(4)	(5)	(6)
Craft breweries	-0.13** (0.06)	-0.13** (0.06)	0.17*** (0.06)			
Craft beer share				0.73 (0.46)	0.73 (0.49)	0.52 (0.34)
Firm × Market effects	No	Yes	Yes	No	Yes	Yes
Firm × Date effects	No	Yes	No	No	Yes	No
Census region × Time trend	No	No	Yes	No	No	Yes
R <sup>2</sup>	0.497	0.795	0.788	0.497	0.794	0.786
Obs.	3,915	3,915	3,915	3,915	3,915	3,915

Notes. Columns (1) and (4) also contain uninteracted firm, date, and market fixed effects. Columns (3) and (6) also contain date fixed effects. Standard errors clustered by market are in parentheses.

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

Thus, there is perhaps mixed evidence on the relationship between craft beer entry and advertising. However, it is important to note that these results do not imply causal relationships. In particular, craft entry occurred sooner or faster in certain regions of the country in a way that may have been related to the determinants of advertising for the major brewers. Additionally, craft entry was also related to the regulatory environment in certain states, as described above, which may also be related to laws around advertising alcohol in those jurisdictions. Unlike with the HHI regressions presented in Section 5, where we used the MillerCoors merger as an instrument, the OLS estimates of craft beer entry should only be viewed as descriptive and not as the *ceteris paribus* impact of a change in competition on advertising. In addition, the fact that the number of craft brewers has a statistically significant relationship with advertising, while their overall market share does not, may partly be due to the larger available variation in the number of brewers, both cross-sectionally and temporally. By contrast, there is less variation in their market share, as was shown in Table 9, since craft beer remains quite small overall.

### 6.3. Robustness Checks

We also conducted a set of additional exercises to ensure that our results are robust. Our results so far have used either monthly data or the two-period model that averages data across the pre- and postmerger periods. As argued above, each specification has advantages and disadvantages, so we also examine the intermediate case where we average across years in our sample. Results using annual data are presented in Tables 11–14 in the online appendix, which are analogous to the results in Tables 3–6. As an additional robustness check, we also add a new specification in

column (3) in each of these tables, where we introduce separate time trends for each census region in our data. We do this to allow for different temporal effects across regions of the country, for example, because of the recession affecting regions differentially.<sup>33</sup> The results are very similar to those obtained using monthly or pre/post data, with small effects in the OLS specification, but larger and significant results in the IV specification, with magnitudes similar to those obtained above. Adding census region time trends makes the magnitudes of the coefficients larger than in our main results, but does not change the basic finding.

As described in Section 5, we conducted another robustness check to examine whether the effects of the merger may have been experienced even before the merger was officially approved. The merger was proposed in October 2007, and finally approved almost nine months later. We therefore divided our data into three time periods: premerger, during the announcement period, and postmerger, and reestimated the regressions with separate dummies for the two later time periods in the first-stage and reduced-form specifications. The reduced form results are presented in Table 15 in the online appendix, and show that the effects of the merger were experienced entirely in the period after the merger was officially approved, with almost no effect during the period of merger review.<sup>34</sup>

We then reestimated the regressions using only local television advertising as the dependent variable, rather than all advertising, since only television advertising is strictly defined at the DMA level. The results, shown in Table 16 in the online appendix, are similar to those using total advertising, with small and insignificant effects in the OLS specification, but larger, positive effects in the reduced-form and the IV.<sup>35</sup> Finally, we investigated whether lagged values of the HHI may provide greater explanatory power than contemporaneous values, since advertising may respond to market structure changes with a lag. In Table 17 in the online appendix we show that, in fact, contemporaneous HHI is the best predictor of local advertising expenditures, as the size and significance of the coefficient drops steadily with longer lags of this variable.

## 7. Discussion and Conclusion

In this paper we have empirically examined the effect of market structure changes on the propensity of firms to advertise. By exploiting a large change in market structure, brought about by the 2008 joint venture of Miller and Coors in the U.S. brewing industry, we measure how advertising responds to sharp changes in concentration explicitly caused by a change in the number of independently operated firms. This is an especially important and useful context for such a study, given the strategic importance of advertising in the brewing industry.

An important caveat to our results is that they only estimate the “net” or “reduced-form” effect of concentration on advertising. Overall, the merger is likely to have led to many changes, such as the intermingling of Miller and Coors’s distribution networks, possible positive spillovers in beer advertising, potential changes in the cost of supplying beer, endogenous price changes, and the strategic reaction of rivals. In addition, the merger may have changed firms’ strategic conduct for reasons beyond the changes in concentration. Thus, the exact mechanism through which the merger changed advertising is unclear. Understanding the direct effect of concentration on advertising—holding constant changes to firms’ costs or prices—would require specifying a more detailed model.

Our findings have three important implications. First, we are able to help resolve long-standing debates, and conflicting results, surrounding the relationship between concentration and advertising. Various theories—dating as far back as Marshall (1890)—suggest that this relationship can be either positive or negative since each variable will affect the other. Accordingly, empirical studies of this issue will be affected by endogeneity, but previous studies have not fully accounted for this endogeneity. By establishing the causal effect of concentration on advertising, within a single industry with clear identification, we help to resolve earlier theoretical debates and to understand the direction of bias in previous empirical studies.

Second, this paper contributes to the large literature on the effects of mergers. Past work in this area has heavily emphasized the price effects of mergers. However, in a number of industries, nonprice effects can also be an important aspect of competition. The brewing industry is, in fact, an excellent example of such a setting, given the high advertising expenditures by firms. Our results indicate that the sharp increase in concentration resulting from a merger between two large firms leads to increased advertising spending per capita.

Third, our results help to evaluate competing theories of advertising. By showing that the causal effect of concentration on advertising is positive, our results do not support the predictions of Becker and Murphy (1993) that firms with market power will undersupply advertising. Nor do our results support the notion that advertising is primarily combative, which was advanced by Marshall (1890), both because we show that advertising is higher in more concentrated markets and because we find some evidence that the large national brewers reduced advertising in markets that saw greater entry by craft brewers.

Instead, our results appear to be consistent with Dorfman and Steiner (1954) and with the idea of positive spillovers put forward by Telser (1964). Evaluating these theories further is difficult, as our model is not

well suited to identify the exact mechanism by which concentration drives advertising, as mentioned above. For example, testing the Dorfman-Steiner hypothesis that firms will advertise higher margin products more heavily would require us to isolate the effect of concentration on advertising by holding constant the price and cost effects of the merger. This would require imposing more structure on the relationships between these variables as well as finding additional instrumental variables.

We do find some evidence for the notion that advertising can have positive spillovers, suggesting this is a possible explanation for the results. Table 7 indicates that increases in advertising were greatest for the merging firms themselves, with no estimated effect for their largest rival, Anheuser-Busch, or for other large brewers. This is as would be expected if advertising spillovers are at play, since only the merging firms would internalize advertising externalities and thus increase advertising. One caveat is that the same table suggests that small firms also increased their advertising, albeit by less than MillerCoors, possibly undercutting this hypothesis.

Recent empirical research also suggests that positive spillovers may be one possible explanation for our results. Three recent studies provide compelling evidence, using large randomized trials, that advertising can have positive externalities on rivals, rather than pure business stealing effects; these include Anderson and Simester (2013), Lewis and Nguyen (2015), and Sahni (2016).<sup>36</sup> An implication of this is that firms in competitive markets will underinvest in advertising, which is consistent with our study. Moreover, the large effects that we estimate in our study are consistent with Shapiro (2018), who shows that if firms were to internalize the positive externalities that their advertising creates for rivals, aggregate advertising would be 50% higher than in a competitive equilibrium.<sup>37</sup>

Thus, our paper is the first to provide suggestive evidence that advertising firms may be aware of positive spillovers, and behave accordingly when the competitive environment changes. Importantly, our results do not suggest that positive spillovers necessarily exist, simply that advertisers may believe they do. We stress that this is an especially important finding given the nature of research into advertising. Past work in this area has strongly emphasized the way in which advertising relates to *consumers*. This is apparent in the debates about informative versus persuasive advertising, and how advertising affects consumer choice and therefore industry outcomes such as profitability and market structure. By contrast, there is comparatively little research on advertising choices by *firms*, and the circumstances under which they choose to strategically deploy this tool. By showing that firms increase advertising in markets that are more concentrated, we provide a valuable insight into the decisions that firms

make regarding their advertising budgets and what this implies about their thinking regarding this important instrument of competition.

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### Endnotes

<sup>1</sup>In terms of advertising to sales ratios, beer is well ahead of carbonated soft drinks and other heavily advertised goods.

<sup>2</sup>See the survey by Bagwell (2007) for an exhaustive summary of the various views of advertising.

<sup>3</sup>Other predictions of the relationship between advertising and concentration are also possible. For example, the two opposing effects described above may operate simultaneously, in which case the relationship may be nonmonotonic (Greer 1971). Further, some authors assume that advertising-to-sales ratios are constant in the short-to-medium term, primarily because firms allocate a constant share of revenues to their advertising budgets (Comanor and Wilson 1974, Sutton 1991). This would predict no effect of market structure changes on advertising.

<sup>4</sup>Examples of the former include Mueller and Rogers (1980, 1984) and Sass and Saurman (1995). Examples of the latter include Buxton et al. (1984) and Uri (1988).

<sup>5</sup>Shapiro (2018) recognizes that firms will underadvertise as a result of free riding on each others' advertising, and estimates that this reduces advertising substantially. However, a direct consequence of the positive spillover effect is that firms should advertise less in more competitive markets, i.e., that the extent of advertising should depend on market structure.

<sup>6</sup>See Ashenfelter et al. (2014) for a survey.

<sup>7</sup>The MillerCoors merger, which we study in this paper, has been analyzed by prior work, but again with an emphasis either on how the merger changed price competition—as in Miller and Weinberg (2017)—or on the possibility that the merger may have lowered costs—as in Ashenfelter et al. (2015).

<sup>8</sup>Some more recent papers acknowledge that firms can change more than just prices in response to increased market power, and some work now exists that endogenizes product choice or variety. See Draganska et al. (2009), Mazzeo et al. (2014), Fan (2013), and Wollmann (2018) for examples and also for a discussion of related papers.

<sup>9</sup>As we will describe, our data cover a subset of media markets. Total beer advertising in this period exceeded \$1 billion annually, according to various industry estimates; see, for example, Center for Science in the Public Interest (2008).

<sup>10</sup>This is despite the recent increase in sales of domestic craft and imported beers. These beers have grown rapidly in some parts of the country, especially the West and the Northeast, but remain relatively small in comparison to the big three brewers. See Tremblay et al. (2011) for details.

<sup>11</sup>Their union is described as a joint venture, rather than a merger, because it only applied to the U.S. market. Miller and Coors remain separate companies outside of the United States. For our purposes, the joint venture is identical to a merger, since the two firms combined production, advertising, and all other operations within the United States. The Justice Department routinely referred to the joint venture as a merger.

<sup>12</sup>We initially used data from Information Resources Incorporated (IRI). The data collection methods used by Nielsen and IRI differ,

based on sales channels and the use of proprietary weights. Nevertheless, the results presented in this paper are similar to those obtained using IRI data. Information on availability and access to the scanner data are available at <http://research.chicagobooth.edu/nielsen/>.

<sup>13</sup>Hartmann and Klapper (2018) use a similar method—examining beer advertising by the top four brands and combining the remaining brands into a composite category—in their study of Super Bowl advertising.

<sup>14</sup>The results are similar if we focus only on the top four firms, or even drop Heineken and restrict the sample to the three largest firms.

<sup>15</sup>These states are Pennsylvania, Colorado, Minnesota, Rhode Island, Kansas, Utah, and Oklahoma. For DMAs that cross state lines we use the portion of the DMA that does not fall in any of these states, since the Nielsen data are separated by DMA-state.

<sup>16</sup>The Herfindahl–Hirschmann Index is the sum of the firms' squared revenue shares. Here, we measure it on a scale from zero to 10,000.

<sup>17</sup>See Figure 5 in the online appendix for a plot of aggregate advertising in the year 2008, summed across all manufacturers, against market population.

<sup>18</sup>The general argument is that, if there is an S-shaped response of sales to advertising, and if advertising has long-run effects on demand, it will be optimal for firms to bunch advertising into a few periods. For more details, see Dubé et al. (2005), Doganoglu and Klapper (2006), and Freimer and Horsky (2012).

<sup>19</sup>For studies of the link between advertising and the business cycle, see Heerde et al. (2013) and Steenkamp and Fang (2011).

<sup>20</sup>We attempted to add a separate time trend for each local media market in our data, but there was not enough remaining independent variation in our variables of interest to obtain precise estimates.

<sup>21</sup>We calculate premerger shares using sales data for the five months immediately preceding the merger's approval date.

<sup>22</sup>To see this, consider the two-period model, and notice that the results will be identical if we were to either estimate Equation (2) using  $\text{sim}\Delta\text{HHI}_m$  as the instrument, or else estimate Equation (1) using  $\text{sim}\Delta\text{HHI}_m \times \text{Post}_t$  as the instrument.

<sup>23</sup>The standard error accounts for the fact that the dependent variable in this regression is itself an estimate. We calculated the standard error by applying the delta method to the OLS estimate of the slope parameter from the regression of the event dummies on the time trend.

<sup>24</sup>Even though our main regressors vary only by markets and time, we estimated Equation (3) on firm/market/monthly data so that constrained versions of it can be interpreted as a first stage for our IV regressions that estimate the effect of concentration on advertising.

<sup>25</sup>See Picard (2001), Molinari and Turino (2009), and Hall (2013) for evidence on the procyclicality of advertising and some evidence that advertising is in fact more volatile than the business cycle.

<sup>26</sup>Figure 6 in the online appendix plots annual advertising expenditures for beer and soda. Soda advertising fell sharply between 2007 and 2010, while aggregate beer advertising rose slightly, suggesting that the recession may have caused a drop in advertising, which, in the case of beer, may have been outweighed by the effects of the merger.

<sup>27</sup>As the Department of Justice approved the merger on June 30 2008, we code the indicator for the postmerger period as zero for all months prior to, and including, June 2008, and as one afterward. All results in the paper were robust to dropping a window of data spanning two months before and two months after the month the merger was approved.

<sup>28</sup>We note that other studies of the relationship between structure and conduct parameters have also found that OLS estimates are

downward biased. Evans et al. (1993) discuss reasons for this in their analysis of OLS studies of prices on concentration.

<sup>29</sup>This refers to the conventional 0 to 10,000 point scale used by antitrust agencies. We obtain these figures by noting that a one percentage point increase in the HHI raises advertising by \$0.24 per thousand capita using the monthly specification or \$0.29 using the two-period specification, which are about 4.4% and 5.3%, respectively, of the average premerger advertising spending for a manufacturer-month of \$5.5 per thousand capita.

<sup>30</sup>See Aghion et al. (2005), Goettler and Gordon (2011, and 2014) for results suggesting an inverted-U relationship between competition and investment in R&D.

<sup>31</sup>See Tremblay and Tremblay (2005) and Tremblay et al. (2011) for a review of craft beer trends.

<sup>32</sup>Changing the definition to exclude these types of beers does not change the results presented below. For example, we defined craft beers as the share of all brewers, in each city, excluding the 10 highest selling brewers in that city, and obtained very similar results.

<sup>33</sup>We attempted to add a separate time trend for each market but encountered power issues that made this difficult. Note that there is no equivalent to the census region  $\times$  time trends specification using just pre- and postmerger data since a time trend cannot be estimated with just two time periods.

<sup>34</sup>Specifically, Table 15 in the online appendix shows that the coefficient on the interaction of predicted HHI with an indicator for the announcement period is small and insignificant, while on the interaction with the postmerger period is similar in magnitude to the coefficient reported in Table 5, and significant in most specifications.

<sup>35</sup>The first-stage regression does not change, of course.

<sup>36</sup>Sinkinson and Starc (2015) estimate that a given brand's advertising creates a small positive spillover for nonadvertised brands, but also find a much larger business stealing effect for other advertised brands.

<sup>37</sup>Positive spillovers may depend on the specific definition of product categories. Sahni (2016) shows that spillovers only exist for close substitutes, and Shapiro (2018) uses a set of narrowly defined drugs that are likely to be good substitutes for each other. In the brewing industry, the majority of sales are for light beer brands, which are also likely to be close substitutes for one another. It is less likely that positive spillovers exist between light beers and more expensive products such as imported or domestic craft beers.

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