Mergers Facilitate Tacit Collusion: An Empirical Investigation of the Miller/Coors Joint Venture*

Nathan H. Miller† Matthew Weinberg‡
Georgetown University Drexel University

First Draft: January 14, 2015

Abstract

We investigate the welfare implications of the Miller/Coors joint venture, which merged the second and third largest brewers of beer in the United States. We show that retail prices are stable about a small downward trend for at least seven years prior to the merger but that, four months after the merger, the prices of MillerCoors and Anheuser-Busch Inbev (ABI) increase abruptly by six percent. The prices of more distant substitutes continue at trend. We estimate a structural model and show that emergent tacit collusion between MillerCoors and ABI best explains the data, under reasonable identifying restrictions. Counterfactual simulations indicate that (i) consumer surplus loss from the merger is due to coordination, as merger-specific marginal cost reductions roughly counter-balance changes in unilateral pricing incentives; and (ii) the merger increases total surplus, despite higher retail prices, due to the magnitude of marginal cost reductions.

*We have benefited from conversations with John Asker, Allan Collard-Wexler, Chris Conlon, J.F. Houde, Aviv Nevo, and Chuck Romeo. We thank Conor Ryan for providing research assistance. All estimates and analyses in this paper based on SymphonyIRI Group, Incorporated data are by the authors and not by SymphonyIRI Group, Incorporated.

†Georgetown University, McDonough School of Business, 37th and O Streets NW, Washington DC 20057. Email: nathan.miller@georgetown.edu.

‡Drexel University, Gerri C. LeBow Hall, 3220 Market Street, Philadelphia PA 19104. Email: mcw325@drexel.edu.
1 Introduction

Among the longest-standing theoretical results of industrial economics is that collusion arises more readily in concentrated markets than in markets with many competitors (e.g., Stigler (1964); Selten (1973)). While the empirical literature has made steady progress in identifying market power in concentrated markets (e.g., Bresnahan (1987); Gasmi, Laffont and Vuong (1992); Nevo (2001); Ciliberto and Williams (2014); Conlon and Rao (2015)), there is little empirical evidence that increases in concentration can facilitate tacit collusion. The value of research along these lines is heightened by the consideration given to the coordinated effects of mergers by antitrust authorities in the United States and elsewhere.¹

We employ reduced-form and structural methodologies to study the market impacts of the joint venture between the Miller and Coors brewing companies, which consolidated the operations of the second and third largest firms in the United States beer industry. We estimate that retail prices of MillerCoors and Anheuser-Busch Inbev (ABI) increased by six percent after the merger. We then estimate a structural model of the industry and demonstrate that emergent tacit collusion rationalizes these price increases, under reasonable identifying restrictions. We use counter-factual simulations to examine the welfare implications of the merger, both overall and isolating specific mechanisms through which the merger affects outcomes (i.e., unilateral effects, coordinated effects, and cost efficiencies). Among other results are (i) consumer surplus loss is due to tacit collusion between MillerCoors and ABI because merger-specific cost reductions roughly counter-balance changes in unilateral pricing incentives; and (ii) the merger increases total surplus, despite higher retail prices, due to the magnitude of marginal cost reductions.

The reduced-form analysis uses supermarket scanner data that span 39 geographic regions over the period 2001-2011. We use program evaluation techniques to quantify how the retail prices of Miller, Coors, and ABI brands change after June 2008 – the month the merger was consummated – both in absolute terms and relative to the retail prices of Corona and Heineken brands. The roughly six percent price increases that we estimate are precisely estimated, occur abruptly after the merger, and persist through the end of the sample. They also are apparent visually in graphs of inflation-adjusted retail prices over the sample period.²

¹The 2010 Horizontal Merger Guidelines promulgated by the U.S. Department of Justice and Federal Trade Commission emphasize that mergers in concentrated markets can lead to tacit collusion, through a variety of mechanisms. Recently, a number of high profile merger challenges have alleged coordinated effects (e.g. AT&T/T-Mobile and American/US Airways)

²Over the seven and a half years preceding the Miller/Coors merger, the inflation-adjusted retail prices of Miller, Coors, and ABI brands are stable about a small downward trend. This trend breaks dramatically after the Miller/Coors merger. The retail prices of Grupo Modelo and Heineken follow a similar downward
We present quantitative and qualitative evidence that the estimated price increases cannot be explained by cost increases or improved demand conditions. It therefore is natural to examine whether emergent tacit collusion can explain the data. 

The reduced-form results motivate the core of our paper: a model of demand and supply-side price competition in which a parameter that governs post-merger coordination is nested inside the first-order conditions of MillerCoors and ABI. This modeling approach follows the proposal of Nevo (1998) for differentiated product markets. The reduced-form results described above, as well as corroborating qualitative evidence, motivate restrictions on the parameter space that solve the curse of dimensionality described in Nevo (1998). Specifically, we estimate only a change in tacit collusion among a subset of firms, rather an unrestricted matrix of collusion parameters. Incorporated in this manner, the collusion parameter is identified provided there is sufficient exogenous variation in market environment variables such as the number of competing firms and demand shifters (Berry and Haile (2014)).

The supply-side of the model incorporates that beer, like many consumer products, is sold by retailers that intermediate between manufacturers and final consumers. This tiered system of distribution introduces the possibility of double-marginalization and has been the focus of empirical research (e.g., Villas-Boas (2007)). Previous articles on the beer industry assign monopoly power to the retail sector (e.g., Hellerstein (2008); Golberg and Hellerstein (2013)). We build on this approach by incorporating a monopolistically competitive retail sector. The magnitudes of retail markups, retail pass-through, and double marginalization are determined by a scaling parameter that can be estimated or normalized. While not our primary focus, the estimation results indicate that retail markups are relatively small, consistent with significant retail competition in the beer category or vertical arrangements that mitigate double marginalization. Our results regarding post-merger tacit collusion between MillerCoors and ABI are robust across different treatments of the retail sector.

3 Our reduced-form results contribute to a growing literature that estimates the price effects of horizontal mergers based on program evaluation techniques (e.g., Allen, Clark and Houde (2014)). See Ashenfelter, Hosken and Weinberg (2014a) for a survey of the broader literature. Articles that use distant substitute brands as a comparison group in differences-in-differences regressions include Ashenfelter and Hosken (2010), McCabe (2002) and Ashenfelter, Hosken and Weinberg (2013).

4 The proposal of Nevo (1998) can be interpreted as synthesizing the conduct parameter literature (e.g., Iwata (1974)) with later research that evaluates how well supply-side models explain the data (e.g., Bresnahan (1987); Gasmi, Laffont and Vuong (1992); Nevo (2001)). The critique of Corts (1999), which pertains to the identification of conduct parameters, does not apply to the methodology of Nevo (1998).

5 This retail scaling parameter is analogous to the double marginalization parameter introduced in Crawford, Lee, Whinston and Yurukoglu (2014).
We employ a number of identifying restrictions in estimation, the most novel of which is the Miller/Coors merger does not coincide with either changes to unobserved consumer preferences for ABI brands relative to Grupo Modelo and Heineken brands (on the demand-side) or changes to unobserved marginal costs of ABI brands relative to Grupo Modelo and Heineken brands (on the supply-side). We summarize qualitative evidence in support of this identifying restriction in the body of the paper. On the supply-side, this identification strategy allows us to make inferences on tacit collusion based on the post-merger changes in ABI prices. Bias could arise if the underlying economic reality features strategic complementarity in prices that exceeds what is predicted given the pricing game and our specification of the random coefficients logit model (RCLM), in which case unilaterally optimal price increases could be misdiagnosed as tacit collusion. However, we are skeptical that such misspecification bias, even if present, could fully explain our result.

The main limitation of our methodology is that the supergame in which tacit collusion arises is not specified. The consequences are twofold. First, our results do not support any specific theoretical framework in which greater tacit collusion becomes profitable after the Miller/Coors merger. Second, because the collusion parameter we estimate is not fully structural, it would be inappropriate to hold the parameter constant when conducting certain counter-factual simulations. Our approach nonetheless has significant value. We believe our paper to be the first to evaluate empirically the impact of consolidation on tacit collusion. Our findings support the relationship between market concentration and collusion that is posited in the theoretical literature and presumed in antitrust investigations. We also are the first to decompose the price effects of a merger into specific mechanisms through which the merger affects firm incentives. Our results underscore how both coordinated effects and marginal cost efficiencies can have meaningful impacts on market outcomes.

The articles closest to our research are Ciliberto and Williams (2014) and Ashenfelter, Hosken and Weinberg (2014b). The former estimates a model of airline competition in which the intensity of competition between any two carriers is allowed to vary with the degree of multimarket contact. Competitive intensity is captured by a parameter that appears inside firms’ first-order pricing conditions, in a manner that is analogous to our approach. To our knowledge, the Ciliberto and Williams article represents the only other application of this methodology. Ashenfelter, Hosken and Weinberg (2014b) provide a reduced-form evaluation of the Miller/Coors merger, with a focus on the conditions under which marginal cost efficiencies offset the internalization of competition. Robust statistical support is found

---

6The counter-factual experiments we conduct, which perturb the collusion parameter itself, are not subject to this critique.
for the conjecture that retail prices decreased in cities for which Coors products could be shipped efficiently from Miller breweries, relative to other cities. The results of our structural model confirm that the marginal cost efficiencies of the MillerCoors merger are large, put downward pressure on retail prices, and are heterogeneous across regions.

The paper is organized into seven sections. Section 2 provides background information on the U.S. beer industry, shows trends in retail prices, and summarizes qualitative evidence of tacit collusion between MillerCoors and ABInbev. Section 3 describes the datasets used in the analysis. Section 4 presents reduced-form estimates of how retail price changed after the Miller/Coors merger. Section 5 outlines the model of competition and the estimation strategy, and discusses identification in detail. Section 6 presents the estimation results and evaluates the welfare implications of the merger. Section 7 concludes.

2 Industry Background and Facts to be Explained

2.1 Market structure

The U.S. beer industry is similar to many other consumer products industries. Manufacturers (i.e., brewers) of branded beer earn relatively high margins and compete in prices, advertising, periodic sales, and through new product introductions. The beer industry differs from typical retail consumer product industries in its vertical structure because of state laws regulating the sales and distribution of alcohol. With few exceptions, brewers are prohibited by law from selling their products directly to retailers, restaurants, bars and final consumers. Instead, they sell their products to state-licensed distributors, who in turn sell to retailers. Payments along the supply-chain are regulated by federal law, and cannot include slotting fees, slotting allowance, or other fixed payments between firms. While retail price maintenance is technically illegal in many states, in practice distributors are often ex-

7 Ashenfelter, Hosken and Weinberg (2014b) correlates retail price changes across cities with (i) the reduction in shipping distances and (ii) the change in market concentration. Cross-city comparisons provide the empirical variation exploited in estimation, which both controls for firm-specific national shocks concurrent with the merger and precludes inferences about coordinated effects (insofar as tacit collusion affects all cities). Our research also differs from Ashenfelter, Hosken and Weinberg (2014b) in that we explicitly model price competition within markets rather than relying on concentration measures.

8 In many states, establishments that serve food now are permitted to brew and sell beer. Tremblay and Tremblay (2005) discuss how regulatory changes have encouraged the entry of small brewers.

9 The relevant statures are the Alcoholic Beverage Control Act and the Federal Alcohol Administration Act, both of which are administered by the Bureau of Alcohol, Tobacco and Firearms (ATF). See the 2002 advisory posted by the ATF: [https://www.abc.ca.gov/trade/Advisory-SlottingFees.htm](https://www.abc.ca.gov/trade/Advisory-SlottingFees.htm) last accessed by the authors on November 4, 2014.
pected to supply at wholesale prices set by brewers (Asker (2005)). This mitigates pricing inefficiencies that otherwise would arise from double marginalization.

The production of beer remains dominated by a handful of large brewers, even with the recent growth of micro-breweries. Table I shows revenue-based market shares at two-year intervals over 2001-2011, based on retail scanner data that we describe later in this section. Over the first half of the sample, the brands of five brewers – ABI, Miller, Coors, Grupo Modelo, and Heineken – account for just over 80 percent of total retail revenue. ABI brands alone account for at least 35 percent of retail revenue in each year. The Miller/Coors joint venture, consummated in June 2008, consolidated the operations of the second and third largest firms into a single merged entity. In the latter years of the sample, the brands of MillerCoors account for 29 percent of retail revenue.

The Miller/Coors joint venture was announced on October 9, 2007, and approved by the DOJ Antitrust Division on June 5, 2008, after a lengthy investigation. The stated rationale of the DOJ was that merger-specific cost reductions, related to transportation cost savings, likely would dominate anticompetitive effects. While Coors beer was sold nationally, it was brewed only in Golden, Colorado and a secondary facility in Elkton, Virginia. Miller, by contrast, operated six plants with a more even distribution across the U.S., enabling the merged entity to relocate the production closer to retail destinations. Both empirical research (e.g., Ashenfelter, Hosken and Weinberg (2014b)) and the company’s subsequent annual reports indicate that the cost reductions have been realized and that now each popular brand owned by the combined firm is brewed in all eight plants.

Consolidation in the industry has continued. In 2013, ABI acquired Grupo Modelo and its popular Corona brands. The DOJ challenged the acquisition and obtained a settlement in which the rights to market and distribute Grupo Modelo brands in the U.S. were divested to Constellation, a leading distributor of imported brands. Even more recently, Heineken

---

10 The U.S. Supreme Court’s decision in *Leegin Creative Leather Products Inc. v. PSKS, Inc.*, 551 U.S. 877 (2007) changed RPM agreements from being per se illegal to judged under a rule-of-reason standard at the federal level, but RPM remains per se illegal in many states because federal law is superseded by state law.

11 Brewing came to be dominated by national, mass-marketed brands in the 1950s and 1960s. A substantial body of literature examines the minimum efficient scale of production (e.g., see Tremblay and Tremblay (2005) for a review). One source of economies-to-scale is television advertising (e.g., George (2009)). Ascher (2012) also cites improvements in the highway system and the introduction of refrigerated trucks.

12 The 2009 acquisition of Anheuser-Busch by Inbev formed the merged entity Anheuser-Busch Inbev (ABI). The merger did not raise substantial competitive concerns because Inbev’s U.S. sales were primarily from its Labatt’s brand, which was divested to obtain DOJ approval. We discuss this how this acquisition affects our identification strategy in Section 5.5.

rejected a takeover proposal from SABMiller in September 2014, and there is speculation in
the popular press that ABI is preparing to acquire SABMiller.\footnote{See The Economist, “Foamy Wars: SABMiller May Be Swallowed up by Its Main Rival, AB Inbev.” September 20, 2014.}

2.2 Facts to be explained

Figure\ref{fig:1} plots the national average log retail price of 12-packs, over 2001-2011, for three of the four best selling brands of beer: Bud Light, Miller Lite, and Coors Light.\footnote{We exclude Budweiser, the second-best selling brand, because its prices largely track those of Bud Light.} Also shown are prices for Corona Extra and Heineken, the leading brands of Grupo Modelo and Heineken, respectively. The vertical axis is the natural log of the price, measured in 2010 dollars. The vertical bar drawn at June 2008 signifies the consummation of the Miller/Coors merger. Horizontal ticks are shown at October of each year, in order to highlight an industry practice in which brewer prices are adjusted each year in early autumn.

The retail prices of these five brands are stable about a downward trend before the Miller/Coors merger, a period spanning more than seven years in the data. The trend is abruptly interrupted in the first autumn after the merger, specifically for Bud Light, Miller Lite and Coors Light. Average prices increase there by about eight percent for each of those brands. Notably, the ABI price increases are nearly equal those of MillerCoors. These increases persist through the end of our sample and well exceed historical price fluctuations in magnitude. The retail prices of Corona Extra and Heineken do not move noticeably with the merger, and instead continue along the initial trend.

Demand-based explanations for the higher ABI and MillerCoors prices are not supported by the available evidence. We show in Section\ref{sec:results} that unit sales decrease in the later years of our sample period, rather than increase, as would be predicted from an outward demand shift. Further, references to weak demand conditions are common in the annual reports of ABI and MillerCoors.\footnote{In stark language, the 2009 ABI Annual Report refers to “an economic environment that was the most difficult our industry has seen in many years” (p. 17).} Cost-based explanations for the higher prices also seem unlikely, given the marginal cost reductions created by the Miller/Coors merger. Thus, it is natural to examine an explanation based on a reduction in competitive intensity.

2.3 Qualitative evidence of tacit collusion

There is substantial qualitative evidence that the ABI and MillerCoors price increases are due to tacit collusion in the wake of the Miller/Coors merger. We draw first on the Complaint...
filed by the DOJ to enjoin the acquisition to enjoin the acquisition of Grupo Modelo by ABI. The Complaint alleges that ABI and MillerCoors announce (nominal) price increases each year in late summer to take effect in early fall. In most geographic areas, ABI is the market share leader and announces its price increase first; in some other markets MillerCoors announces first. These announcements are transparent and generally have been matched. The Complaint quotes from the normal course documents of ABI:

The specifics of ABI’s pricing strategy are governed by its “Conduct Plan,” a strategic plan for pricing in the United States that reads like a how-to manual for successful price coordination. The goals of the Conduct Plan include “yielding the highest level of followership in the short-term” and “improving competitor conduct over the long-term.”

ABI’s Conduct Plan emphasizes the importance of being “Transparent – so competitors can clearly see the plan;” “Simple – so competitors can understand the plan;” “Consistent – so competitors can predict the plan;” and “Targeted – consider competition’s structure.” By pursuing these goals, ABI seeks to “dictate consistent and transparent competitive response.”

As one ABI executive wrote, a “Front Line Driven Plan sends Clear Signal to Competition and Sets up well for potential conduct plan response.” According to ABI, its Conduct Plan “increases the probability of [ABI] sustaining a price increase.”

A similar narrative can be constructed with the annual reports of the companies. SABMiller implemented a “turnaround plan” in 2002 that increased marketing spend especially for the Miller Lite and Miller Genuine Draft brands. In 2005, it described “intensified competition” and an “extremely competitive environment.” The same year, Anheuser-Busch reported that it was “collapsing the price umbrella by reducing our price premium relative to major domestic competitors.” SABMiller characterized price competition as “intense” in 2006 and 2007. The tenor of the annual reports changes markedly after the Miller/Coors merger. In 2009, SABMiller attributed increasing earnings before interest, taxes, and amortization expenses to “robust pricing” and “reduced promotions and discounts.”

The qualitative evidence supports that tacit collusion is limited to ABI and Miller-Coors. The aforementioned DOJ Complaint alleges that Grupo Modelo did not join the

17See the SABMiller Annual Report in 2005 (p. 13), 2006 (p. 5), 2007 (pp. 4 and 8), 2009 (p. 9 and 24), 2010 (pp. 29) and 2011 (p. 28), and the Anheuser-Busch Annual Report in 2005 (p. 5). The ABI annual reports in the post-merger years are more opaque.
price increases and instead adopted a “Momentum Plan” that was designed to “grow Modelo’s market share by shrinking the price gaps between brands owned by Modelo and domestic premium brands.” The practical consequence is that the nominal prices of Grupo Modelo have remained flat even as ABI and MillerCoors prices have increased. The Complaint is silent regarding the pricing practices of Heineken, though in the retail sales data we examine, the price on Heineken brand beer is similar to that of Corona.

3 Data Sources

Our primary data source is retail scanner data from the IRI Academic Database (Bronnenberg, Kruger and Mela (2008)). The data include revenue and unit sales by UPC code, by week and store, for a sample of supermarkets that spans 47 distinct geographic regions over 2001-2011.\textsuperscript{18} We obtain retail prices as the ratio of revenue sales to unit sales. In our empirical analysis, we focus on eleven flagship brands of ABI, Miller, Coors, Grupo Modelo, and Heineken.\textsuperscript{19} These brands account for 51 percent of all unit sales in the data, and are the locus of competition for the major brewers. We further focus on the sales of 12-packs (144 ounces) and 24-packs (288 ounces). In the beer sector, 12-packs produce the greatest number of unit sales and 24-packs account for the greatest sales volume. Together, they account for 63 percent of flagship brand unit sales in the sample.\textsuperscript{20} Throughout, we refer to brand-size combinations as distinct “products.” Following standard practice, we measure price and market share in 144-ounce equivalent units.

We aggregate the IRI scanner data to the product-region-month level to reduce the computational burdens that arise in estimation and in the computation of equilibrium. These aggregations come with little loss of generality. Our identification strategy does not require week-to-week variation, as we detail below, and aggregation to the monthly level may even be helpful insofar as it reduces random measurement error. Further, while the model incorporates heterogeneous marginal costs at the region-level, reflecting transportation costs, we are skeptical that store-specific effects are important and we do not incorporate them into

\textsuperscript{18}Supermarkets account for 20 percent of off-premise beer sales. IRI also sells scanner data on drug stores and mass retailers, which account for three and six percent of off-premise beer sales, respectively. The other major sources of off-premise beer sales are liquor stores (38 percent) and convenience stores (26 percent). (McClain 2012)

\textsuperscript{19}We define the flagship brands to be Bud Light, Budweiser, Miller Lite, Miller Genuine Draft, Miller High Life, Coors Light, Coors, Corona Extra, Corona Extra Light, Heineken, and Heineken Light.

\textsuperscript{20}In some regions, 30-packs (360 ounces) are sold in lieu of 24-packs due to historical purchase patterns. We aggregate across these two package sizes to create a single, larger, package size. The bulk of omitted sales are made as 6-packs. The pricing and market share trends at that package size resemble those of 12-packs.
We restrict attention to 39 of the 47 geographic regions, dropping a handful of regions in which either few supermarkets are licensed to sell beer or supermarkets are restricted to selling low alcohol beer. The 39 regions are listed in Appendix A. Even with these aggregations and exclusions, our regression analysis incorporates 53,543 observations at the product-region-period level.

In order to better model consumer demand, we supplement the IRI scanner data with data on household demographics from the Public Use Microdata Sample (PUMS) of the American Community Survey. The PUMS data are available annually over 2005-2011. Households are identified as residing within specified geographic areas, each of which has at least 100,000 residents based on the 2000 Census. We merge the PUMS data to the IRI scanner data by matching on the counties that compose the IRI regions and the PUMS areas. In estimation, we restrict attention to the 2005-2011 period, based on the intersection of the sample periods. The PUMS data do not include month-level variation in demographics.

Lastly, we obtain the driving miles between each IRI region and the nearest brewery for each product in our sample using Google Maps, in order to model transportation costs. For imported brands, we define the miles traveled based on the nearest port into which the beer is shipped. We construct a notion of “distance” based on the interaction of driving miles and diesel fuel prices, which we obtain from the Energy Information Agency of the Department of Energy. This allows us to capture variation in transportation costs that arises both cross-sectionally, based on the location of regions and breweries, and inter-temporally, based on fluctuations in fuel costs. It also allows us to capture empirically the distributional cost-savings of the Miller/Coors merger. All prices and incomes are deflated using the CPI and are reported in 2010 dollars.

4 Reduced-Form Estimates

Here we build on the empirical patterns shown in Figure 1. We first estimate reduced-form “difference-in-differences” regression equations that allow us to contrast the price changes for ABI and Miller/Coors brands with those for Grupo Modelo and Heineken brands. The baseline regression equation specifies the log retail price of product $j$ in region $r$ during

\[ \log p_{j,r,t} = \beta_j + \beta_r + \beta_t + \delta_{j,r,t} + \epsilon_{j,r,t} \]

\(21\)While aggregating over stores could generate spurious substitution if not all brands are carried by all supermarkets, we do not believe this is a meaningful concern given our focus on flagship brands.
period $t$ according to

$$
\log P_{jrt}^R = \beta_1 \mathbb{I}\{\text{ABI or MillerCoors}\}_{jt} \times \mathbb{I}\{\text{Post-Merger}\}_t \\
+ \ \beta_2 \mathbb{I}\{\text{Post-Merger}\}_t + \phi_{jr} + \tau_t + \epsilon_{jrt}
$$

which features indicator variables for (i) the ABI and MillerCoors brands in the post-merger periods, and (ii) all products in the post-merger periods. We incorporate product fixed effects interacted with region fixed effects, through the parameters $\phi_{jr}$, and either a linear time trend or period fixed effects through the parameters $\tau_t$.

Panel A of Table 2 presents the results. Columns (i)-(iii) incorporate a linear time trend, while columns (iv)-(vi) control for period fixed effects. The sample used in column (i) corresponds exactly to Figure 1 and includes 12-packs of Bud Light, Coors Light, Miller Lite, Heineken and Corona Extra. The regression coefficients indicate that ABI and MillerCoors prices increased by nine percent, relative to Heineken and Corona, after the merger. The absolute increase is roughly six percent. Column (ii) expands the sample to both 12-packs and 24-packs. Both the relative and absolute price increases are estimated around five to six percent. Column (iii) further adds to the sample Budweiser, Miller Genuine Draft, Miller High Life, Corona Extra Light, and Heineken Light. The results are unchanged. With more flexible controls for inter-temporal effects, as shown in columns (iv)-(vi), the relative price increases are essentially identical but absolute price increases are not identified.

Panel B shows analogous results obtained using unit sales as the dependent variable. Across all of the specifications and samples, the unit sales of ABI and MillerCoors decrease after the Miller/Coors merger, both in absolute terms and relative to Grupo Modelo and Heineken. The regression results reject an explanation for the ABI/MillerCoors price increase based on shifting consumer preferences for less expensive beer as macroeconomic conditions weakened. The results also are consistent with the qualitative evidence presented above. Lastly, the regressions results in Panels A and B show the power that indicators for post-merger ABI and MillerCoors observations have in predicting market outcomes.

---

22 We log the dependent variable only for ease of interpretation. This does not affect results.

23 In specifications that include period fixed effects we do not include Post-Merger.

24 There is no statistical evidence that the pre-merger time trends differ between ABI/MillerCoors and Modelo/Heineken. To investigate, we regres log prices on interactions between the BudMillerCoors dummy and dummies for each time period in our data, region/product effects, and dummies for each time period in our data. We project the coefficients on the interaction terms from time periods prior to the merger onto a linear trend and used the delta-method to test the null hypothesis that the coefficient on the trend was zero. The point estimate of the difference in the pre-merger price trends between Miller/Coors/Bud brands and Heineken/Corona brands is approximately zero and the p-value for the test is 0.611.
identification strategy exploits this empirical variation in the data, under the assumption that the unobserved demand and costs of ABI do not change with the Miller/Coors merger, relative to the unobserved demand and costs of Grupo Modelo and Heineken. We return to the identification strategy in Section 5.5.

5 Model and Estimation

5.1 Overview

We estimate a model of price competition among producers of differentiated products. The supply-side features an oligopoly of brewers that sells to consumer through a monopolistically competitive retail sector. Prices are linear, consistent with industry regulations against slotting allowances, and double-marginalization arises in equilibrium. Competition among brewers follows Nash-Bertrand principles. In periods after the Miller/Coors merger, we incorporate a parameter that allows ABI and MillerCoors to internalize the effects of their competition on each other. We also incorporate a scaling parameter that determines the magnitudes of retail market power and pass-through. Distributors are not incorporated into the model explicitly and can be conceptualized as subsumed within the retail sector.

We use the random coefficients logit model (RCLM) of Berry, Levinsohn and Pakes (1995) to model the demand-side. We rely on a specification in which income affects (i) preferences for imported brands of Corona and Heineken, relative to the flagship brands of ABI and MillerCoors; and (ii) preferences for imports and the flagship brands of ABI and MillerCoors, relative to the outside good. This specification is parsimonious yet flexible along the dimensions most important to our application. The RCLM frequently has been applied to the beer industry because it allows for the estimation of reasonable consumer substitution patterns with aggregated data (e.g., Asker (2005), Hellerstein (2008), Romeo (2014), Golberg and Hellerstein (2013)).

25Hellerstein (2008) and Golberg and Hellerstein (2013) employ a similar framework that features Nash-Bertrand competition among brewers and a retail monopolist. Asker (2005) models distributors explicitly but assumes that they are are passive players.

26Other frameworks are viable. Slade (2004) and Pinske and Slade (2004) use both the nested logit model and linear demands together with the Distance Metric approach of Pinkse, Slade and Brett (2002) to study market power and mergers in the U.K. beer industry. Rojas (2008) uses the Distance Metric approach and a linear approximation to the almost ideal demand system (AIDS) of Deaton and Muellbauer (1980).
5.2 Supply

Let there be $m = 1 \ldots M$ distinct markets. These are region-period combinations in our application. The retail sector sets prices to maximize its profit, taking as given its marginal cost and brewers’ prices. The first order conditions in each market are

\[
f(p_m^R) \equiv p_m^R - p_m^B - mc_m^R + \lambda \left( \left( \frac{\partial s_m(p_m^R; \theta^D)}{\partial p_m^R} \right) \right)^T s_m(p_m^R; \theta^D) = 0,
\]

where $p_m^B$ and $p_m^R$ are vectors of retail and brewer prices, respectively, $mc_m^R$ is a vector of retail marginal costs, $s_m(p_m^R; \theta^D)$ is a vector of market shares, and $\lambda$ is a scaling parameter that determines retail market power and pass-through. This nests perfect retail competition ($\lambda = 0$), in which there is no double marginalization and retailers fully pass-through changes in brewer prices, as well as retail monopoly ($\lambda = 1$).

Brewers set their prices with knowledge of equation (2). Assuming the existence of pure-strategy equilibrium in prices, the first order conditions are

\[
p_m^B = mc_m^B - \left[ \Omega_m \circ \left( \frac{\partial p_m^B(p_m^R; mc_m^R, \theta^D)}{\partial p_m^B} \right)^T \left( \frac{\partial s_m(p_m^R; \theta^D)}{\partial p_m^R} \right) \right]^T s_m(p_m^R; \theta_d),
\]

where $mc_m^B$ is the vector of brewer marginal costs, $\Omega_m$ is the ownership matrix, and the operation $\circ$ is element-by-element matrix multiplication. The $(j, k)$ element of the ownership matrix equals one if products $j$ and $k$ are produced by the same firm. We allow for a range of values if $j$ and $k$ are produced by ABI and MillerCoors and the market postdates the Miller/Coors merger. Otherwise it equals zero. Mathematically, our baseline specification is

\[
\Omega_m(j, k; \kappa) = \begin{cases} 
1 & \text{if } j, k \text{ produced by same brewer} \\
\kappa & \text{if } j, k \text{ produced by ABI and MillerCoors after the Miller/Coors merger} \\
0 & \text{otherwise}.
\end{cases}
\]

The specification is motivated by the qualitative evidence in the Department of Justice Complaint filed to enjoin the acquisition of Grupo Modelo by ABI, as well as by the reduced-form evidence about retail prices.\(^{27}\) We discuss interpretation and identification in Section 5.5.

Here we note only that the collusion parameter is best interpreted as summarizing a change

\(^{27}\)The specific timing assumption in this specification is unimportant in estimation because we exclude the months between June 2008 and May 2009 from the sample (i.e., one year of post-merger data).
that arises in the wake of the Miller/Coors merger, because competition is normalized to Nash-Bertrand in the pre-merger periods. Retail pass-through enters the first order conditions directly, and can be calculated in a manner consistent with the underlying demand schedule and the retail scaling parameter. We defer details to Section 5.4.2.

We specify a marginal cost function that incorporates product- and market-level heterogeneity, and captures the cost efficiencies of the Miller/Coors merger. Because the marginal costs of brewers and retailers are not separably identifiable within our framework, we parameterize a joint marginal cost function according to

\[ mc_m(\gamma) = mc_R^m(\gamma) + mc_B^m(\gamma) = W_m \gamma + \sigma_j^S + \mu_c^S + \tau_t^S + \omega_m, \tag{5} \]

where \( W_m \) is a matrix of cost variables, \( \sigma_j^S, \mu_c^S, \) and \( \tau_t^S \) are product, region, and period fixed effects, respectively, and \( \omega_m \) is a vector of unobservable marginal costs. We proxy shipping costs using a distance variable calculated as the miles between the region and brewery, interacted with the price of diesel fuel. This captures the cost savings of the Miller/Coors merger that arise from the production of Coors’ products in the more geographically dispersed Miller breweries. We also include an indicator variable for MillerCoors products in the post-merger periods to account for residual merger synergies unrelated to distribution.

We treat the vector of unobserved marginal costs as a structural error term. Combining equations (2), (3), and (5), the structural error term is

\[ \omega_R^m = p_R^m - W_m \gamma - \left( -\lambda \left[ \frac{\partial S_m}{\partial p_R^m} \right]^T \right)^{-1} s.m - \Omega_m(\kappa) * \left( \frac{\partial p_R^m(\lambda)}{\partial p_B^m} \frac{\partial S_m}{\partial p_R^m} \right)^T \left( \frac{\partial s.m}{\partial p_R^m} \right)^T \right)^{-1} s.m, \tag{6} \]

where we have suppressed selected function arguments for brevity. The supply-side parameters to be estimated are \( \theta^S = (\gamma, \kappa, \lambda) \). The marginal cost parameters enter equation (6) linearly, the brewer collusion parameter enters nonlinearly through the ownership matrix, and the retail scaling parameter enters both linearly through the retail markup and nonlinearly through the retail pass-through matrix.

### 5.3 Demand

We model demand using the random coefficients logit model (RCLM). Consider demand in some market \( m \), again defined in our application as a region-period combination. The
conditional indirect utility that consumer $i$ receives from product $j$ in market $m$ is

$$u_{ijm} = x_j^\beta_i - \alpha p_{jm}^R + \sigma_j^D + \mu_c^R + \tau_t^R + \xi_{jm} + \epsilon_{ijm} = V_{ijm} + \epsilon_{ijm}, \quad (7)$$

where $x_j$ is a vector of observable product characteristics, $p_{jm}^R$ is the retail price, $\sigma_j^S$, $\mu_c^S$, and $\tau_t^S$ are product, region, and period fixed effects, respectively, and $\xi_{jm}$ captures product- and market-specific deviations in the mean consumer valuation. The stochastic term $\epsilon_{ijm}$ is mean zero and has a Type I extreme-value distribution.

We express the individual-specific taste parameters as a function of structural parameters and consumer income:

$$\beta_i^* = \beta + \Pi D_i, \quad (8)$$

where $D_i$ is income. The product characteristics include a constant and an indicator that equals one for Corona and Heineken brands. This specification is parsimonious yet flexible along the dimensions most important to our application. First, it breaks the independence of irrelevant alternatives (IIA) property of logit demand between the imported brands and the flagship domestic brands of ABI and MillerCoors. Second, it allows the consumer demand for beer to shift in a natural way with the onset of recession, which roughly coincides with the MillerCoors merger. The demand-side parameters to be estimated include $(\alpha, \beta, \Pi)$.

We complete the demand system by allowing consumers to forgo purchase of the major beer brands through the grocery channel. The conditional indirect utility that consumer $i$ receives from the outside good in market $m$ is

$$u_{i0m} = \xi_0 + \epsilon_{i0m}, \quad (9)$$

where $\xi_0$ is the mean consumer valuation and $\psi_m$ captures market-specific tastes for the outside good relative to the inside goods. We follow convention and normalize the mean valuation to zero. We define the total potential market size to be ten percent greater than the maximum observed unit sales in each market. This is approach is pragmatic because it is simple and produces reasonable demand elasticities.

In many applications of the RCLM, the individual-specific taste parameters also are allowed to vary with unobserved demographics, simulated numerically. When incorporated here, the corresponding coefficients are small and statistically insignificant, so we opt for the simpler specification. We also find that incorporating other observable demographics, such as age and race, has little impact on the obtained elasticities.

Market size is held constant over time in each region. We experimented with the population-based market size definitions that are featured in the existing literature on beer markets (e.g., Asker (2005), Hellerstein...
We define the vector of demand parameters $\theta^D = (\theta_1^D, \theta_2^D)$ such that $\theta_1^D = (\alpha, \beta)$ includes the parameters that enter the objective function linearly while $\theta_2^D = (\Pi)$ includes the nonlinear parameters. Equations (7) and (8) can be combined such that

$$u_{ijm} = \delta(x_j, p^R_{jm}, \sigma_j^D, \mu_c^D, \tau_t^D, \xi_{jm}; \theta_1^D) + \mu_{ijm}(x_j, p^R_{jt}, D_i; \theta_2^D) + \epsilon_{ijm},$$

$$\delta_{jm} = x_j\beta - \alpha p^R_{jm} + \sigma_j^D + \mu_c^D + \tau_t^D + \xi_{jm}, \quad \mu_{ijt} = [p^R_{jm}, x_j]^\prime (\Pi D_i),$$

where $\delta_{jm}$ is the mean consumer valuation of product $j$ in market $m$ and depends only on the linear parameters, while $\mu_{ijm} + \epsilon_{ijm}$ is the consumer-specific deviation and depends on the nonlinear parameters. The choice probabilities that arise with the RCLM are widely published, and for brevity we refer readers to Nevo (2001).

### 5.4 Estimation

#### 5.4.1 Moments and the objective function

We estimate the demand and supply parameters separately for computational reasons detailed in the next subsection. On the demand-side, we employ the nested fixed point approach of Berry, Levinsohn and Pakes (1995). For each vector of candidate nonlinear demand parameters, a contraction mapping computes the vector of mean utility levels $\delta^*$ that solves the implicit system of equations $s(x, p^R, \delta^*; \theta_2^D) = S$, where $S$ is the vector of observed market shares. We then obtain

$$\xi^*_{jm}(\theta^D) = \delta^*_{jm}(x, p^R_{jm}, \delta^*; \theta_2^D) - (x_j\beta - \alpha p^R_{jm})$$

for each product $j$ and market $m$. Let $\xi = [\xi_1^j, \xi_2^j, \ldots \xi_M^j]^\prime$ stack the market-varying unobserved product characteristics, and let $Z$ be a matrix of instruments. Then under the identifying assumption that $E[\xi | Z] = 0$, the GMM demand estimates are defined by

$$\hat{\theta}^D = \arg \min_{\theta^D} \xi^*(\theta^D)^\prime Z A^{-1} Z^\prime \xi^*(\theta^D),$$

where $A$ is a positive definite weighting matrix. The demand parameters $\theta_1^D = (\alpha, \beta)$ enter the objective function linearly and we concentrate these parameters out of the optimization problem using 2SLS, following standard practice. We estimate demand with the standard two step procedure (e.g., Hansen (1982)), setting $A = Z'Z$ in the first step and

(2008); Romeo (2014); Golberg and Hellerstein (2013)). These produce nearly identical own-price elasticities of demand, but larger diversion to the outside good.
then using estimates of the optimal weight matrix in the second step. The optimal weight matrix was estimated with a Eicker-White-Huber cluster robust covariance estimator that allows for heteroskedasticity, autocorrelation and within-region cross-product correlations (Bhattacharya 2005).³⁰

We estimate the supply-side of the model taking as given the demand estimates. For each vector of candidate supply-side parameters, we calculate the implied brewer markups, retail markups, and observed costs, and obtain the vector \( \omega^*(\theta^S; \hat{\theta}^D) \) based on equation (6).

Let \( \omega = [\omega_1', \omega_2', \ldots, \omega_M']' \) stack the unobserved costs that arise in each market, and let \( Z \) be a matrix of instruments. Then under the identifying assumption that \( E[\omega|Z] = 0 \), the GMM supply estimates are defined by

\[
\hat{\theta}^S = \arg \min_{\theta^S} \omega^*(\theta^S; \hat{\theta}^D)'ZC^{-1}Z^\prime\omega^*(\theta^S; \hat{\theta}^D)
\]

where \( C \) is a positive definite weighting matrix. The cost parameter \( \gamma \) enters the objective function linearly, and we concentrate it out of the optimization problem using 2SLS. We again employ the standard two step procedure and estimate a second step weighting matrix with region-level clustering. In the next draft, we also will adjust the supply-side standard errors to account for the incorporation of demand-side estimates.

### 5.4.2 Retail pass-through

In this section, we derive retail pass-through formally, explain its impact on computational burden, and introduce a methodology that enables supply-side estimation. We start with the observation of Jaffe and Weyl (2013) that the implicit function theorem can be applied to derive the following expression for pass-through:

\[
\frac{\partial p^R_m}{\partial p^S_m} = - \left( \frac{\partial f(p^R_m)}{\partial p^R_m} \right)^{-1}
\]

where the vector \( f(p^R_m) \) is as defined in equation (2). By inspection, the Jacobian matrix on the right-hand-side depends on both the first and second derivatives of demand. For any set of demand parameters, retail pass-through can be calculated by (i) numerically integrating over the consumer draws to obtain the \( J \times J \) matrix of first derivatives and the \( J \times J \times J \) array of second derivatives; (ii) manipulating these to obtain \( \partial f(p^R_m)/\partial p^R_m \); and (iii) obtaining the opposite inverse of the Jacobian. Due to memory constraints, we find that it is fastest to

³⁰We compute the contraction mapping separately for each market, using a tolerance of 1e-14. We describe steps we took to ensure we found the global minimum of the objective function in an appendix.
compute pass-through on a market-by-market basis, so steps (i)-(iii) are repeated for every region-period combination in the data. With joint estimation of supply and demand, all of the above additionally must be repeated for each candidate parameter vector, and the GMM objective function becomes impossible to minimize in a reasonable time.

It is more expedient to estimate the supply-side separately, taken as given the results of the demand-side. With the obtained demand parameters, we first calculate \( \frac{\partial f(p^R)}{\partial p^R} \) for each market, integrating numerically over consumer demographics, under the assumption that the retail scaling parameter (i.e., \( \lambda \)) equals one. It is then simple to adjust the Jacobian term in accordance with any candidate retail scaling parameter under consideration. To clarify this procedure, we provide a closed-form expression for column \( n \) of the Jacobian term. Suppressing market-level subscripts, the column vector is given by

\[
\begin{bmatrix}
0 \\
1 \\
0 \\
\vdots
\end{bmatrix} + \lambda \left[ \frac{\partial s}{\partial p^R} \right]^T \left[ \frac{\partial^2 s}{\partial p^R \partial p_n} \right] \left[ \frac{\partial s}{\partial p^R} \right]^{-1} s - \lambda \left[ \frac{\partial s}{\partial p^R} \right]^T \left[ \frac{\partial s}{\partial p_n} \right],
\]

(15)

where the 1 in the initial vector is in the \( n^{th} \) position. In supply-side estimation, we start with the Jacobian obtained under the assumption \( \lambda = 1 \) and then, for each vector of candidate supply-side parameters, we (i) subtract the identity matrix from the initial Jacobian, (ii) scale the remainder by \( \lambda \), (iii) add back the identity matrix; and (iv) take the opposite inverse to obtain a retail pass-through matrix that is fully consistent with the candidate parameter vector under consideration. This eliminates the need to obtain first and second demand derivatives, via numerical integration, at each candidate parameter vector. Thus, it is possible to estimate the demand and supply parameters (separately) with only a single application of numerical integration to obtain pass-through.

5.5 Identification and instruments

5.5.1 Supply

We make two identifying assumptions to obtain the supply-side parameters. The first is that region-specific changes in consumer income, which affect demand, are orthogonal to unobserved marginal costs. The second is that the unobserved costs of ABI brands do not change, relative to the those of Corona and Heineken, following the Miller/Coors merger.
This latter assumption drives the identification of tacit collusion because it allows us to infer an increase in brewer collusion parameter if the ABI price increases in the wake of the Miller/Coors merger exceed what can be rationalized with Nash-Bertrand competition.

We implement the identifying assumptions by constructing instruments based on (i) median region income; (ii) indicators that equal one for ABI brands after the Miller/Coors merger, separately for 12-packs and 24-packs; (iii) the interactions of median income with these ABI indicators; and (iv) the interaction of median income with an indicator for imported brands. The power of the post-merger ABI indicators in predicting markups is supported by the reduced-form regression results. Identification rests on product-specific changes over time, because the marginal cost specification incorporates region, period, and product fixed effects. Further, the marginal cost specification includes an indicator for MillerCoors brands post-merger, so the ABI indicators enforce that any changes in the unobserved costs of ABI are orthogonal to those of Corona and Heineken, and allow for a natural treatment of merger synergies.

That these assumptions are sufficient for identification can be illustrated by returning to the first order conditions summarized in equation (6). If the retail scaling parameter and the brewer collusion parameter are to be identified separately, what is required is exogenous variation that shifts the retail and brewer markups differentially. Our instruments provide this variation. Consumer income affects both retail and brewer markups, through the demand derivatives. The indicator for ABI brands after the Miller/Coors merger also effects both markups, but it has a substantially larger impact on brewer markups under reasonable retail pass-through conditions. Thus, the two identifying assumptions together provide sources of empirical variation that affect retail and brewer markups differentially, enabling estimation of the supply-side parameters.

Our empirical strategy is best interpreted as summarizing a change in tacit collusion that arises after the MillerCoors merger. In principle, both the pre-merger and post-merger levels of collusion are identified in the presence of a demand-shifter with sufficient variation in the instrument set (Berry and Haile (2014)). While we do include median income as an instrument, its identifying power is insufficient for the estimation of collusion levels. Thus, an additional assumption is required to make progress, and we normalize pre-merger competition to Nash-Bertrand. This identification strategy is analogous to that of Ciliberto.

31 Suppose that the ABI markup increases by $1.00 after the Miller/Coors merger. If retail pass-through is roughly complete, as we estimate it to be, then the retail markup is unaffected because retail prices also increase by $1.00. There is a differential impact on brewer markups unless retail pass-through is well more than complete. Specifically, the retail price must increase by exactly $2.00, in response to the $1.00 increase in the ABI price, if the differential effect is to be eliminated.
and Williams (2014), which makes the implicit assumption of Nash-Bertrand competition among airline carriers without any multi-market contacts. Thus, the brewer collusion parameter represents a change in relative to the pre-merger baseline.

There are two main potential sources of bias. First, we cannot rule out that the acquisition of Anheuser-Busch by Inbev in 2008 generated marginal cost savings on the ABI brands. This could lead to a violation of the identifying assumption that the unobserved costs of ABI brands do not change after 2008, relative to the those of Corona and Heineken. If such cost savings exist, then our estimate of brewer collusion following the MillerCoors merger would be conservative, because it would take even more coordination to achieve the observed price points, given the lower ABI costs. We believe, however, that any cost savings due to the Anheuser-Busch acquisition were small, involving only best practices, because distribution was unaffected for the brands in our sample and there is little indication of realized savings in the ABI annual reports that postdate the acquisition. We conclude that there is little risk of bias due to ABI merger synergies.

Second, bias could arise from the functional form assumptions we have placed on demand. We identify the collusion parameter from the responses of ABI prices to the Miller-Coors merger. If the underlying economic reality features strategic complementarity that exceeds the level captured in the RCLM of demand, then we could misinterpret unilaterally optimal price increases for tacit coordination. This is unlikely to fully explain our result, however. We observe the ABI and MillerCoors prices increase by the same magnitude following the Miller/Coors merger (e.g. see Figure 1). Standard demand systems do not produce anything near that level of strategic complementarity. Further, the prices of Corona and Heineken do not increase after the merger, so if extreme strategic complementarity were to explain the results, it would have to exist for some brands and not others. Lastly, we note that the RCLM is theoretically capable of approximating the curvature of the underlying demand systems, and thus obtaining the correct degree of strategic complementarity, though we are skeptical that this is accomplished in our specification of the model.

---

32More precisely, Ciliberto and Williams impose that airline carriers with infinitely negative multi-market contacts compete ala Nash Bertrand. Of course, negative multi-market contacts are impossible in practice. Given the results reported for the baseline specification, it can be calculated that competition between carriers with no multi-market contact is governed by a collusion parameter of 0.04, which is nearly Nash Bertrand (see Column 3 of Table 5).

33Inbev motivated the acquisition as a source of substantial fixed cost savings. It subsequently revised the pay system, ended pension contributions and life insurance for retirees, and transfered the foreign beer operations of Anheuser Busch to InBev (Ascher (2012)).

34Conversely, our results underestimate the brewer collusion parameter if strategic complementarity in the RCLM exceeds that of the underlying economic reality.
5.5.2 Demand

We make three main identifying assumptions to recover the demand-side parameters. The first is that unobserved preferences are orthogonal to the distance between the region and the brewery. This allows the marginal cost variables related to distance, which capture distribution costs, to serve as instruments. Second, we assume that unobserved preferences for ABI and MillerCoors brands do not change, relative to those for Corona and Heineken, following the Miller/Coors merger. Third, we assume that unobserved preferences are orthogonal to median market income, keeping in mind that how income effects consumer-specific preferences is incorporated directly. This final assumption follows the finding of Romeo (2014) that the employment of mean demographics as instruments improves numerical performance in the estimation of the RCLM.

We implement the identifying assumptions by constructing instruments based on (i) the distance between the region and the relevant brewery, separately for 12-packs and 24-packs, where distance is calculated as the interaction of miles and the price of diesel fuel; (ii) indicators that equal one for ABI and MillerCoors brands after the Miller/Coors merger, separately for 12-packs and 24-packs; (iii) median region income; (iv) median income interacted with the distance instruments; (v) median income interacted with the ABI/MillerCoors indicators; (vi) median income interacted with an indicator that equals one for imported brands. The power of the post-merger ABI indicators in predicting retail prices is demonstrated by the reduced-form regression results. Identification rests on product-specific changes over time, because the specification incorporates region, period, and product fixed effects.

6 Estimation Results

6.1 Demand Estimates

Table 3 presents the results of demand-side estimation. The first two columns show the results of logit demand estimation, conducted with OLS and 2SLS, respectively. The dependent variable in these regressions is $\log(s_{jm}) - \log(s_{0m})$. The third column shows results

\footnote{A slightly weaker identifying assumption is that unobserved preferences for ABI brands do not change, relative to those for Corona and Heineken, following the Miller/Coors merger. This can be implemented by adding an indicator variable to the indirect utility equation that equals one for MillerCoors brands post-merger. Doing do does not affect our elasticity estimates.}

\footnote{While the instruments based on the indicators for ABI and MillerCoors brands in the post-merger periods are novel, they are easily motivated from the supply-side of the model. Validity hinges on the assumption that unobserved quality does not change differentially for ABI and MillerCoors.}
from the RCLM, which we estimate using 200 income draws for each region-period combination. The RCLM specification allows consumer income to affect preferences for the inside goods and preferences for imported brands (i.e., the Corona and Heineken products). All regressions include product, region, and period fixed effects. Estimation is based on 53,543 observations at the product-period-region level. The sample spans 39 regions over 2005-2011, excluding months between June 2008 and May 2009. Standard errors are clustered at the region-level to account for correlations among observations from the same region.

The price coefficient drops as we use instrumental variable techniques relative to OLS, suggesting that beer prices are set by firms with knowledge of preferences not captured by our fixed effects. The instruments are powerful as demonstrated by the first stage $F$-statistic of 26.09 that we obtain from the 2SLS regression. With 2SLS and RCLM, products are never priced on the inelastic portion of the demand curve, and the median demand elasticity in our full RCLM specification is $-4.13$. The RCLM results also indicate that income (i) reduces preferences for the inside goods, and (ii) increases preferences for imported brands. Both effects are statistically significant. The results allow demand for the inside goods to shift with the onset of recession, and break the IIA property of logit demand as it pertains to substitution between imported and domestic brands.

The obtained demand elasticities are consistent with existing literature on beer markets. Appendix Table C.1 shows median own-price and cross-price elasticities of demand for 12-packs of beer. The median elasticities are highest for Corona and Heineken Light, at $-6.27$ and $-6.32$ respectively, and lowest for Miller High Life, at $-3.37$. These elasticities for imported brands are remarkably close to those estimated from supermarket sales in Chicago in Hellerstein (2008), which reports own-price elasticities of $-6.04$ for Corona and $-6.12$ for Heineken, and somewhat lower elasticities for domestic brands. The economic importance of the interaction of income and the import dummy can be seen in the diversion ratios shown in Appendix Table C.2. Consumer substitution is more pronounced among domestic products than it is between domestic and imported brands.

---

37 We calculate the partial $F$-statistic by regression price on the instrumental variables and the fixed effects. The statistic is adjusted using a clustering correction at the region level.

38 Higher income consumers likely are more inclined to purchase wine and expensive beers not included in our sample, or to forgo consumption altogether.

39 The RCLM has eight overidentifying restrictions. Asymptotically, the minimized GMM objective function should follow a Chi-square distribution with eight degrees of freedom under the null hypothesis that each moment is valid. The minimized objective function value of 18.89 just exceed the 0.05 critical value of 16, so there is some basis for rejecting the model. That said, existing Monte Carlo evidence indicates that this tests over-rejects in finite samples (Altonji and Segal (1996)), and rejecting overidentifying restrictions is common in demand estimation.

40 Table C.2 shows diversion among 12-packs only and does not incorporate substitution to 24-packs. The
6.2 Supply Estimates

Table 4 presents the results of supply-side estimation. The four columns differ only in how the retail scaling parameter is treated: in column (i) the retail parameter is estimated, while in columns (ii)-(iv) it is normalized to 0.00, 0.25, and 1.00, respectively. All regressions incorporate product, region, and period fixed effects into the marginal cost function. The results from the RCLM demand-side estimation are taken as given. Again estimation is based on 53,543 observations at the product-period-region level. Standard errors are clustered at the region-level to account for correlations among observations from the same region.

The brewer collusion parameter is positive and statically significant in each specification, ranging from 0.32 to 0.38. The results easily reject Nash-Bertrand pricing in the post-merger periods. Strictly interpreted, the parameter indicates that ABI and MillerCoors internalize roughly a third of the other’s profits when pricing in the post-merger periods. In our view, however, the looser interpretation of increased tacit collusion between ABI and MillerCoors is closer to what can be supported by the data, given the normalization that pre-merger competition is Nash-Bertrand. The inference of increased coordination does not depend on the treatment of the retail scaling parameter, and is robust with a perfectly competitive retail sector (column (ii)), a monopolist retailer (column (iv)), and intermediate levels of retail market power (columns (i) and (iii)).

The retail scaling parameter, when estimated, takes a value of 0.068 that is much closer to perfect competition than retail monopoly. The economic implications are that retail markups on beer are relatively small, and that the retail pass-through matrix is close to the identity matrix. This results could be driven by either by significant retail competition in the beer category, or by vertical arrangements that successfully mitigate double marginalization, such as implicit maximum retail price maintenance. With the estimated retail scaling parameter, nearly 99% of the price observations can be rationalized with nonzero marginal costs. The ability of the model to rationalize prices in this way deteriorates quickly with the magnitude of retail market power, and with retail monopoly less then 30% of the observations yield positive marginal costs.

Turning to the marginal cost shifters, the parameters for MillerCoors products in the post-merger periods are negative, and the distance parameter is positive, consistent with transportation costs. This supports two channels through which the Miller/Coors merger produced marginal cost reductions. First, the merger lowered the level of Miller-

---

A product-specific brewer price change results in nearly complete retail pass-through, and does not affect much other retail prices because cross pass-through is nearly zero.
Coors marginal cost curves by $0.56 for 12-packs and $0.89 for 24-packs. Second, it reduced the shipping distance between breweries and retailers. The latter channel is particularly meaningful from the Coors products. We calculate that the two sources of efficiencies imply an average reduction in the marginal cost of 12-pack Coors products of 0.76 in the year 2011. The comparable average marginal cost during this period would have been $5.55 but for the efficiencies, implying marginal cost savings of 13.6 percent. This number is close to, but slightly higher than, the 11 percent reduction in unit cost predicted in the trade press (e.g., van Brugge et al (2007)).

Table 5 shows the average pre-merger and post-merger markups on ABI, Coors, and Miller 12-packs, separately at the brewer and retail level. Markups are calculated based on equation (6) and the baseline parameter estimates. As shown, the brewer markup on ABI brands increases from $3.97 pre-merger to $4.97 post-merger. This reflects, in part, post-merger tacit collusion. The brewer markup increases are even larger for Coors ($2.97 to $4.89) and Miller ($3.63 to $5.27) due to the combined impact of collusion and cost savings. The retail markup is around $0.80-$0.90 before and after the merger.

Figure 2 provides another way to visualize the impact of the Miller/Coors merger on markups. The four scatterplots have imputed marginal costs on the horizontal axis and retail prices on the vertical axis, separately for Miller Lite, Coors Light, Bud Light, and Budweiser. Observations are calculated as region-specific 12-pack averages. Pre-merger data from 2007 are plotted as blue circles and post-merger data from 2009 are plotted as red plus signs. Corresponding lines of best fit also are plotted. The key empirical pattern is that post-merger prices are above pre-merger prices, for any given level of costs. This cannot be explained by demand changes because, by all accounts, demand for these products decreases over the sample period. Instead, the causes are the internalization of competition between Miller and Coors, and the rise of coordination between MillerCoors and ABI. An empirical pattern of secondary interest is that the relationship between costs and prices appears to damp in the post-merger period (i.e. cost pass-through decreases). In Appendix Table C.3 we explore that possibility with regression analysis based on observations at the product-period-region level, and find statistically significant evidence of reduced cost pass-through with Coors Light, Bud Light and Budweiser. This supports the theoretical result of Scharfstein and Sunderam (2013) that reduced cost pass-through can be taken as evidence of tacit collusion.

Prior to the merger, Coors beer was primarily brewed in Golden, Colorado as well as a much smaller secondary plant in Elkton, Virginia (Heyer and Shapiro (2010)), while Miller was brewed in six plants uniformly distributed across the U.S. This allowed MillerCoors to lower its distribution costs by moving the production of Coors beer into Miller plants.
Figure 3 explores further the marginal cost reductions. Shown are two scatterplots, one each for Coors Light and Miller Lite. Each dot is an average within a region, in the year 2011. The horizontal axis is the magnitude of the merger-induced marginal cost change. The vertical axis is the corresponding change in the retail price. This is not observed explicitly – instead we recompute equilibrium under the counterfactual assumption that the Miller/Coors merger did not generate marginal cost savings, and compare the counterfactual prices to the observed prices. The figures shows that the cost savings on Coors Light range from roughly $0.60 to $1.20, depending on the region in question. The greatest cost savings arise in regions, such as San Diego and Los Angeles, that are distant from the original Coors breweries but near a Miller brewery. The cost savings on Miller Lite have a more limited range, reflecting the more limited scope for reducing costs by moving Miller products nearer to retailers by moving production to the two Coors plants in Golden, CO and Elkton, VA. The figure also shows how these cost savings translate into retail prices, on a region-by-region basis. While these pass-through relationships are driven by the model, the predictions are broadly consistent with the reduced-form results of Ashenfelter, Hosken and Weinberg (2014b).

6.3 Counter-factual simulations

In this section, we explore the effects of the Miller/Coors merger on retail prices, markups, producer and consumer surplus, and welfare. We use counter-factual experiments to isolate the influence of three mechanisms through which the merger changed market outcomes: (i) “unilateral effects” resulting from the internalization of competition between Miller and Coors; (ii) “coordinated effects” resulting from tacit collusion between MillerCoors and ABI; and (iii) marginal cost reductions from the merger efficiencies. What is observed directly, through the data and the model estimates, is the scenario in which the Miller/Coors merger occurs with coordinated effects and cost reductions. To support the analysis, we recompute equilibrium under four counter-factual scenarios:

- The merger does not occur.

---

43 The lower post-merger pass-through rates are driven, at least to a substantial extent, by the functional forms used on the demand-side of the model. This provides an opportunity to conduct a specification check based on reduced-from regressions of prices on marginal cost shifters. We implement using distance between the brewery and region as the cost shifter, but find that the pass-through coefficients are sensitive to the sample and control variables employed.

44 The production of Coors beer for San Diego and Los Angeles moved from Golden Colorado to Irwindale California, reducing shipping distances by 946 and 987 miles, respectively.
• The merger occurs with efficiencies and without coordinated effects.

• The merger occurs without efficiencies and without coordinated effects.

• The merger occurs without efficiencies and with coordinated effects.

We compare outcomes across these scenarios to identify the merger effects and explore the three mechanisms. We begin with price graphs, which provide a transparent representation of the data and the counterfactual simulations.

Figure 4 shows the evolution of average retail prices for Coors Light 12-packs under each of the scenarios. The five data series shown, which correspond to the counterfactual scenarios enumerate above, diverge in the post-merger periods. The series in red, labeled “Coordinated, Unilateral, Efficiencies,” is the raw data. Several conclusions are immediate. First, the Miller/Coors merger increases the prices of Coors Light substantially relative to the baseline of “No Merger” scenario that appears in gold. Second, coordinated effects account for most of this price increase. The net effect of unilateral effects and efficiencies results in prices (shown as the blue “Unilateral, Efficiencies” series) that are close to those of the no merger scenario. Third, the DOJ correctly anticipated the substantial mitigating influence of the cost efficiencies. The series in green, labeled “Unilateral, No Efficiencies,” shows that prices increase substantially under the unilateral effects mechanism, relative to the “No Merger” baseline. The efficiencies eliminate more than half of that price increase. It is the emergence of tacit collusion, likely unanticipated by the DOJ, that is the main driver of the price increases. Lastly, while the observed prices in the post-merger periods well exceed the “No Merger” baseline, they are still higher without efficiencies, as shown in the series in black labeled “Coordinated, Unilateral, No Efficiencies.” Appendix Figure C.1 shows that the same empirical patterns arise for Miller Lite, albeit with a somewhat smaller impact of the marginal cost efficiencies.

Figure 5 shows the evolution of average retail prices for Bud Light 12-packs under the five scenarios. Once again, the observed prices in the post-merger periods exceed substantially the prices that arise in the “No Merger” baseline. The price elevation is due exclusively to coordinated effects. This can be seen by examining the “Unilateral, Efficiencies” scenario,

45 For the counterfactuals without efficiencies, we calculate the marginal costs of the Miller and Coors products as if there were no level-effects of the merger on marginal costs (i.e., $\gamma_1 = \gamma_2 = 0$), and products were brewed at their original breweries. For the counterfactuals without coordinated effects, we set the brewer collusion parameter to zero (i.e., $\kappa = 0$). For the scenario in the merger does not occur, we do both of the above and also adjust the ownership matrix (i.e., $\Omega$) to reflect independent ownership of the Miller and Coors products in the post-merger periods.

46 Each dot represents the average price across the 39 regions in a specific period.
which tracks the “No Merger” baseline nearly exactly. While our evidence indicates that
the unilateral effects of the Miller/Coors merger are substantial (though substantially off-
set by efficiencies), these unilateral effects have a comparatively small impact on Bud Light
prices. Further, the marginal cost efficiencies of the merger, which affect ABI only indirectly,
also have a small impact on Bud Light prices. Appendix Figure C.2 shows that the same
empirical patterns arise for Budweiser.

Table 6 provides the mean retail prices and markups of ABI, Miller, and Coors brands,
across each of the five scenarios. All numbers are for 2011, the final year of the sample.
The mean prices are consistent with the figures discussed above. For instance, comparing
columns (i) to (v) indicates that the Miller/Coors merger caused ABI 12-pack retail prices
to increase from $9.13 to $10.09, Miller 12-pack prices to increase from $7.59 to 8.96, Coors
12-pack prices to increase from $8.61 to $10.20. The increase in the ABI markup reflects
the higher retail price. The increases in the Miller and Coors markups are more pronounced
and also reflect the marginal cost savings of the merger.

Table 7 shows welfare statistics across the five scenarios for the 2011 calendar year.
All numbers shown are percentage differences relative to the “No Merger” counterfactual
in which the Miller/Coors merger does not occur.\footnote{Percentage differences are more
illuminating than level effects because our data reflect a small subsample of
national sales. Appendix Table C.4 shows the level effects – though it is not apparent (to us) how to scale
these level effects in a satisfactory manner.} We begin with producer surplus. A
number of results are noteworthy. The merger increases producer surplus across the board.
If the merger causes unilateral effects, coordinated effects, and efficiencies (as we estimate),
then total producer surplus increases 33.7\% relative to the no merger baseline. More than
half of these gains are due to tacit collusion. For ABI specifically, nearly all the gains are
due to tacit collusion. Marginal costs efficiencies account for a 4%-5\% increase in industry-
wide producer surplus. These efficiencies both raise the surplus of MillerCoors and lower the
surplus of ABI (due to lower MillerCoor prices). The former effect dominates the latter.

We turn now to consumer surplus and total surplus. The merger makes consumers
unambiguously worse in each of the scenarios considered. If the merger causes unilateral
effects, coordinated effects, and efficiencies (as we estimate), then total consumer surplus
decreases 13.6\% relative to the no merger baseline. However, the magnitude of this impact
varies substantially with the roles of tacit collusion and efficiencies. If the merger causes only
unilateral effects then consumer surplus loss is 4.0\%, and layering on marginal cost efficiencies
further reduces this loss to only 1.2\%. This may well have been the scenario deemed most
likely by the DOJ in its decision to clear the merger. Lastly, we observe that even with
tacit collusion, the marginal cost efficiencies are sufficiently large that the producer surplus gains outweigh the consumer surplus losses, such that the merger increases total surplus by 2.1%. Thus, clearance of the merger could be justified on a total welfare standard despite its ramifications for retail prices and consumer surplus. Absent tacit collusion, total surplus increases even more because the smaller increase in retail prices leads to a smaller impact on deadweight loss.

7 Conclusion

This paper explored how the intensity of competition changes with mergers of competing firms. The theoretical potential for mergers of competitors to facilitate tacit collusion is well understood, is described in the FTC/DOJ merger guidelines, and has formed the basis for many important antitrust challenges. However, the empirical academic literature previously has focused primarily on how mergers create market power by allowing the merged entity to internalize pricing externalities. We instead estimate a model of supply that allows for post-merger coordination between the merged entity and its remaining competitors.

The specific context of our research is the Miller/Coors joint venture, which attracted serious scrutiny from antitrust authorities. Our empirical results indicate the presence of tacit collusion between MillerCoors and its closest rival, Anheuser-Busch Inbev (ABI), during post-merger periods. This corroborates a narrative of coordination that has emerged through a Complaint filed by the DOJ in response to a subsequent merger in the industry. Our results also corroborate the expectation of DOJ and others that merger-specific marginal cost reductions are large and have meaningful pro-competitive effects.

The main limitation of our approach provides an agenda for future research. Because we elect not to specify the over-arching supergame, our results do not support any specific theoretical framework in which tacit collusion becomes more profitable (or more feasible) in the post-merger periods. The development of such a framework would be of substantial academic interest, and also could help antitrust authorities assess the likelihood of competitive effects for mergers that resemble the Miller/Coors joint venture.
References


Figure 1: Average Retail Prices of Flagship Brand 12-Packs
Notes: The figure plots the national average price of a 12-pack over 2001-2011, separately for Bud Light, Miller Lite, Coors Light, Corona Extra and Heineken. The vertical axis is the natural log of the price in real 2010 dollars. The vertical bar drawn at June 2008 signifies the consumation of the Miller/Coors merger. Horizontal ticks are shown at October of each year due to an industry practice in which brewer prices are adjusted in early autumn.
Figure 2: Price-Cost Relationships Pre-Merger and Post-Merger
Notes: The figure provides scatterplots of observed prices and imputed marginal costs for Miller Lite (panel A), Coors Light (panel B), Bud Light (panel C), and Budweiser (panel D). Observations are calculated as region-specific 12-pack averages. Observations from 2007, which pre-date the Miller/Coors merger, are plotted as blue circles. Observations from 2009, which post-date the merger, are plotted as red plus signs. Lines of best fit are provided in each case.
Figure 3: Change in Price against Change in Marginal Cost

Notes: The figure plots average regional difference in price against average regional difference in marginal cost for 12-packs of Coors Light (Panel A) and Miller Lite (Panel B).
Figure 4: Counterfactual Price Series for Coors Light

Notes: The figure plots the average retail prices of Coors Light 12-Packs. The red prices labeled “Coordinated, Unilateral, Efficiencies” are the raw data. The gold prices labeled “No Merger” are numerically computed for a counterfactual in which to Miller/Coors merger does not occur. The blue prices labeled “Unilateral, Efficiencies” are the scenario in which the Miller/Coors merger occurs with unilateral effects and efficiencies but no coordinated effects. The green prices labeled “Unilateral, No Efficiencies” are the scenario in which the merger occurs with unilateral effects but without efficiencies or coordinated effects. The black prices labeled “Coordinated, Unilateral, No Efficiencies” are computed assuming the merger occurs with coordinated and unilateral effects but without efficiencies. Straight averages are calculated over the 39 regions in the data.
Figure 5: Counterfactual Price Series for Bud Light
Notes: The figure plots the average retail prices of Bud Light 12-Packs. The red prices labeled “Coordinated, Unilateral, Efficiencies” are the raw data. The gold prices labeled “No Merger” are numerically computed for a counterfactual in which the Miller/Coors merger does not occur. The blue prices labeled “Unilateral, Efficiencies” are the scenario in which the Miller/Coors merger occurs with unilateral effects and efficiencies but no coordinated effects. The green prices labeled “Unilateral, No Efficiencies” are the scenario in which the merger occurs with unilateral effects but without efficiencies or coordinated effects. The black prices labeled “Coordinated, Unilateral, No Efficiencies” are computed assuming the merger occurs with coordinated and unilateral effects but without efficiencies. Straight averages are calculated over the 39 regions in the data.
<table>
<thead>
<tr>
<th>Year</th>
<th>AB/ABI</th>
<th>Miller</th>
<th>Coors</th>
<th>Miller</th>
<th>Coors</th>
<th>Modelo</th>
<th>Heineken</th>
<th>Total</th>
<th>HHI</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>0.37</td>
<td>.</td>
<td>0.20</td>
<td>0.12</td>
<td>0.08</td>
<td>0.04</td>
<td>0.08</td>
<td>0.81</td>
<td>2,043</td>
</tr>
<tr>
<td>2003</td>
<td>0.39</td>
<td>.</td>
<td>0.19</td>
<td>0.11</td>
<td>0.08</td>
<td>0.05</td>
<td>0.05</td>
<td>0.82</td>
<td>2,092</td>
</tr>
<tr>
<td>2005</td>
<td>0.36</td>
<td>.</td>
<td>0.19</td>
<td>0.11</td>
<td>0.09</td>
<td>0.05</td>
<td>0.05</td>
<td>0.79</td>
<td>1,907</td>
</tr>
<tr>
<td>2007</td>
<td>0.35</td>
<td>.</td>
<td>0.18</td>
<td>0.11</td>
<td>0.10</td>
<td>0.06</td>
<td>0.07</td>
<td>0.80</td>
<td>1,853</td>
</tr>
<tr>
<td>2009</td>
<td>0.37</td>
<td>0.29</td>
<td>.</td>
<td>.</td>
<td>0.09</td>
<td>0.05</td>
<td>0.09</td>
<td>0.80</td>
<td>2,350</td>
</tr>
<tr>
<td>2011</td>
<td>0.35</td>
<td>0.28</td>
<td>.</td>
<td>.</td>
<td>0.09</td>
<td>0.07</td>
<td>0.07</td>
<td>0.79</td>
<td>2,162</td>
</tr>
</tbody>
</table>

Notes: The table provides revenue shares and the Herfindahl-Hirschman Index (HHI) over 2001-2011. Firm-specific revenue shares are provided for AB/ABI, Miller, Coors, Modelo, and Heineken. The total across these firms also is provided. The HHI is scaled from 0 to 10,000. The revenue shares incorporate changes in brand ownership during the sample period, including the merger of Anheuser-Busch (AB) and Inbev to form A-B Inbev (ABI), which closed in April 2009, and the acquisition by Heineken of the FEMSA brands in April 2010. All statistics are based on supermarket sales recorded in IRI scanner data.
Table 2: OLS Regression Results for Retail Prices and Sales Volume

<table>
<thead>
<tr>
<th>Panel A: Log Retail Price</th>
<th>(i)</th>
<th>(ii)</th>
<th>(iii)</th>
<th>(iv)</th>
<th>(v)</th>
<th>(vi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1{ABI or MillerCoors}</td>
<td>0.094***</td>
<td>0.057***</td>
<td>0.060***</td>
<td>0.094***</td>
<td>0.057***</td>
<td>0.062***</td>
</tr>
<tr>
<td>× 1{Post Merger}</td>
<td>(0.007)</td>
<td>(0.008)</td>
<td>(0.007)</td>
<td>(0.007)</td>
<td>(0.008)</td>
<td>(0.007)</td>
</tr>
<tr>
<td>1{Post Merger}</td>
<td>-0.031***</td>
<td>-0.006</td>
<td>-0.011</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>(0.005)</td>
<td>(0.008)</td>
<td>(0.007)</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Period Fixed Effects</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Time Trend</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Panel B: Log Unit Sales</th>
<th>(i)</th>
<th>(ii)</th>
<th>(iii)</th>
<th>(iv)</th>
<th>(v)</th>
<th>(vi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1{ABI or MillerCoors}</td>
<td>-0.106**</td>
<td>-0.175**</td>
<td>-0.364***</td>
<td>-0.175**</td>
<td>-0.106**</td>
<td>-0.366***</td>
</tr>
<tr>
<td>× 1{Post Merger}</td>
<td>(0.042)</td>
<td>(0.085)</td>
<td>(0.065)</td>
<td>(0.085)</td>
<td>(0.042)</td>
<td>(0.065)</td>
</tr>
<tr>
<td>1{Post Merger}</td>
<td>-0.054</td>
<td>0.065</td>
<td>0.265***</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>(0.040)</td>
<td>(0.087)</td>
<td>(0.070)</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Period Fixed Effects</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Time Trend</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

| R²                        |         |         |         |         |         |         |
| # Obs.                    | 25,740  | 25,740  | 44,621  | 44,621  | 94,837  | 94,837  |

Notes: All regressions include product fixed effects interacted with region fixed effects. The dependent variable in Panel A is log real retail price and the dependent variable in Panel B is the log of unit sales (in 144-ounce equivalent units). Observations are at the product-region-year level. Columns (i) and (iv) contain 144oz package sizes of Bud Light, Coors Light, Miller Lite, Corona Extra, and Heineken. Columns (ii) and (v) contain 144oz and 288oz package sizes of Bud Light, Coors Light, Miller Lite, Corona Extra, and Heineken. Columns (iii) and (vi) contain 144oz and 288oz package sizes of Budweiser, Bud Light, Coors, Coors Light, Miller Genuine Draft, Miller High Life, Miller Lite, Corona Extra, Corona Light, Heineken and Heineken Premium Light. The estimation sample spans 39 regions from 2001-2011. Not all products appear in all region/time periods. Standard errors are clustered at the region level and reported in parentheses. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.
Table 3: Demand-Side Estimates

<table>
<thead>
<tr>
<th>Regressor</th>
<th>Parameter</th>
<th>OLS</th>
<th>2SLS</th>
<th>RCLM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retail Price</td>
<td>$\alpha$</td>
<td>-0.266***</td>
<td>-0.355***</td>
<td>-0.458***</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.067)</td>
<td>(0.076)</td>
<td>(0.104)</td>
</tr>
<tr>
<td>RCLM Interactions</td>
<td>$\Pi_1$</td>
<td>-0.294***</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.080)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$\Pi_2$</td>
<td>0.281*</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.155)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Derived Statistics</td>
<td>Median Price Elasticity</td>
<td>-2.68</td>
<td>-3.57</td>
<td>-4.13</td>
</tr>
<tr>
<td></td>
<td>Frequency of Inelastic Demand</td>
<td>0.001%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td>1st Stage F-Statistic</td>
<td>26.09</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>GMM J-Statistic</td>
<td>18.89</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: The table shows the results of demand-side estimation. There are 53,543 observations at the product-period-region level. The sample spans 39 regions over 2005-2011, excluding the months between June 2008 and May 2009. All regressions include product, region, and period fixed effects. The logit model is estimated alternatively with OLS and 2SLS. The RCLM is estimated with 200 income draws for each region-period. Standard errors clustered by region and are shown in parentheses. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.
Table 4: Supply Side Estimates

<table>
<thead>
<tr>
<th>Regressor</th>
<th>Parameter</th>
<th>(i)</th>
<th>(ii)</th>
<th>(iii)</th>
<th>(iv)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nonlinear Parameters</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brewer Collusion</td>
<td>$\kappa$</td>
<td>0.330***</td>
<td>0.327***</td>
<td>0.336***</td>
<td>0.381***</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.00003)</td>
<td>(0.00003)</td>
<td>(0.00004)</td>
<td>(0.00004)</td>
</tr>
<tr>
<td>Retail Scaling</td>
<td>$\lambda$</td>
<td>0.068***</td>
<td>0</td>
<td>0.25</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.00006)</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Linear Parameters</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MillerCoors×PostMerger</td>
<td>$\gamma_1$</td>
<td>-0.557**</td>
<td>-0.506***</td>
<td>-0.616***</td>
<td>-0.739***</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.227)</td>
<td>(0.059)</td>
<td>(0.117)</td>
<td>(0.117)</td>
</tr>
<tr>
<td>MillerCoors×PostMerger ×24-Pack</td>
<td>$\gamma_2$</td>
<td>-0.321***</td>
<td>-0.324***</td>
<td>-0.318***</td>
<td>-0.301***</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.062)</td>
<td>(0.059)</td>
<td>(0.093)</td>
<td>(0.093)</td>
</tr>
<tr>
<td>Distance</td>
<td>$\gamma_3$</td>
<td>0.167***</td>
<td>0.170***</td>
<td>0.161***</td>
<td>0.115***</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.057)</td>
<td>(0.053)</td>
<td>(0.170)</td>
<td>(0.170)</td>
</tr>
<tr>
<td>Distance×24-Pack</td>
<td>$\gamma_4$</td>
<td>0.018</td>
<td>0.007</td>
<td>0.029</td>
<td>0.088</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.043)</td>
<td>(0.039)</td>
<td>(0.101)</td>
<td>(0.101)</td>
</tr>
<tr>
<td><strong>Derived Statistics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative Marginal Costs</td>
<td></td>
<td>1.28%</td>
<td>0.54%</td>
<td>11.99%</td>
<td>70.94%</td>
</tr>
<tr>
<td>GMM J-Statistic</td>
<td></td>
<td>29.37</td>
<td>30.03</td>
<td>29.50</td>
<td>29.40</td>
</tr>
</tbody>
</table>

*Notes:* The table shows the results of supply-side GMM estimation. There are 53,543 observations at the product-period-region level. The sample spans 39 regions over 2005-2011, excluding the months between June 2008 and May 2009. Distance is measured as thousands of miles interacted with the retail price of gasoline. All regressions also include product, region, and period fixed effects. The retail scaling parameter is estimated in column (i) and normalized in columns (ii)-(iv). Standard errors are clustered by region and shown in parentheses. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.
### Table 5: Average Markups by Firm

<table>
<thead>
<tr>
<th></th>
<th>ABI</th>
<th>Coors</th>
<th>Miller</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Merger Brewer Markup</td>
<td>3.97</td>
<td>2.97</td>
<td>3.63</td>
</tr>
<tr>
<td>Post-Merger Brewer Markup</td>
<td>4.79</td>
<td>4.89</td>
<td>5.27</td>
</tr>
<tr>
<td>Pre-Merger Retail Markup</td>
<td>0.86</td>
<td>0.85</td>
<td>0.91</td>
</tr>
<tr>
<td>Post-Merger Retail Markup</td>
<td>0.83</td>
<td>0.82</td>
<td>0.91</td>
</tr>
</tbody>
</table>

*Notes:* The table presents volume-weighted average markups for 12-packs of beer, separately for the brands of ABI, Coors, and Miller. Markups are calculated based on the supply-side model. The pre-merger data span January 2005 to May 2008, while the post-merger data span June 2009 to December 2011. ABI brands include Budweiser and Bud Light, the Coors brands include Coors Light and Coors, and the Miller brands include Miller Genuine Draft, Miller High Life, and Miller Lite.
Table 6: Prices and Markups in Counterfactual Scenarios

<table>
<thead>
<tr>
<th>Scenario Description</th>
<th>(i)</th>
<th>(ii)</th>
<th>(iii)</th>
<th>(iv)</th>
<th>(v)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coordinated Effects</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>Unilateral Effects</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Efficiencies</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>no</td>
</tr>
</tbody>
</table>

**Retail Prices**

<table>
<thead>
<tr>
<th></th>
<th>ABI</th>
<th>Miller</th>
<th>Coors</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i)</td>
<td>10.05</td>
<td>8.97</td>
<td>10.20</td>
</tr>
<tr>
<td>(ii)</td>
<td>10.17</td>
<td>9.19</td>
<td>10.67</td>
</tr>
<tr>
<td>(iii)</td>
<td>9.07</td>
<td>7.98</td>
<td>9.29</td>
</tr>
<tr>
<td>(iv)</td>
<td>9.25</td>
<td>8.21</td>
<td>9.75</td>
</tr>
<tr>
<td>(v)</td>
<td>9.13</td>
<td>7.59</td>
<td>8.61</td>
</tr>
</tbody>
</table>

**Brewer Markups**

<table>
<thead>
<tr>
<th></th>
<th>ABI</th>
<th>Miller</th>
<th>Coors</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i)</td>
<td>4.79</td>
<td>5.27</td>
<td>4.90</td>
</tr>
<tr>
<td>(ii)</td>
<td>4.93</td>
<td>5.06</td>
<td>4.66</td>
</tr>
<tr>
<td>(iii)</td>
<td>3.77</td>
<td>4.26</td>
<td>3.89</td>
</tr>
<tr>
<td>(iv)</td>
<td>3.93</td>
<td>3.90</td>
<td>3.63</td>
</tr>
<tr>
<td>(v)</td>
<td>3.74</td>
<td>3.16</td>
<td>2.76</td>
</tr>
</tbody>
</table>

*Notes:* The table provides volume-weighted mean markups, separately for the 12-pack brands of ABI, Miller, and Coors, under five different economic scenarios. The first scenario, that of column (i), is based on the supply-side parameter estimates. Columns (ii)-(v) show results counter-factual scenarios. The numbers in column (ii) are computed assuming the merger occurs with coordinated and unilateral effects but without efficiencies. The numbers in column (iii) are computed assuming the merger occurs with unilateral effects and efficiencies but no coordinated effects. The numbers is column (iv) are computed assuming the merger occurs with unilateral effects but without efficiencies or coordinated effects. Lastly, the numbers in column (v) are computing assuming that the Miller/Coors merger does not occur. All statistics are for 2011, the final year of our sample.
### Table 7: Welfare Effects of Miller/Coors Merger

<table>
<thead>
<tr>
<th>Scenario Description</th>
<th>(i)</th>
<th>(ii)</th>
<th>(iii)</th>
<th>(iv)</th>
<th>(v)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coordinated Effects</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>Unilateral Effects</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Efficiencies</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>no</td>
</tr>
</tbody>
</table>

#### Merger Effect on Producer Surplus

<table>
<thead>
<tr>
<th></th>
<th>ABI</th>
<th>Miller</th>
<th>Coors</th>
<th>Total Industry</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i)</td>
<td>19.4%</td>
<td>53.3%</td>
<td>62.2%</td>
<td>33.7%</td>
</tr>
<tr>
<td>(ii)</td>
<td>32.1%</td>
<td>23.7%</td>
<td>34.5%</td>
<td>28.7%</td>
</tr>
<tr>
<td>(iii)</td>
<td>1.2%</td>
<td>28.9%</td>
<td>38.2%</td>
<td>14.3%</td>
</tr>
<tr>
<td>(iv)</td>
<td>12.9%</td>
<td>12.9%</td>
<td>5.5%</td>
<td>10.6%</td>
</tr>
</tbody>
</table>

#### Merger Effect on Consumer Surplus

<table>
<thead>
<tr>
<th></th>
<th>Total Industry</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i)</td>
<td>-13.6%</td>
</tr>
<tr>
<td>(ii)</td>
<td>-17.8%</td>
</tr>
<tr>
<td>(iii)</td>
<td>-1.2%</td>
</tr>
<tr>
<td>(iv)</td>
<td>-6.1%</td>
</tr>
</tbody>
</table>

#### Merger Effect on Total Surplus

<table>
<thead>
<tr>
<th></th>
<th>Total Industry</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i)</td>
<td>2.1%</td>
</tr>
<tr>
<td>(ii)</td>
<td>-2.3%</td>
</tr>
<tr>
<td>(iii)</td>
<td>4.0%</td>
</tr>
<tr>
<td>(iv)</td>
<td>-0.6%</td>
</tr>
</tbody>
</table>

*Notes: The table provides the effect of the Miller/Coors merger on producer surplus, consumer surplus, and total surplus. All numbers are for reported as the percentage change, relative to the “No Merger” scenario in which the Miller/Coors merger does not occur, and are for the year 2011. Column (i) considers the scenario in which the merger occurs with coordinated effects, unilateral effects, and efficiencies. This best reflects the raw data. Column (ii) considers the counterfactual scenario in which the merger occurs with coordinated and unilateral effects but without efficiencies. Column (iii) considers the counterfactual scenario in which the merger occurs with unilateral effects and efficiencies but no coordinated effects. Column (iv) considers the counterfactual scenario in which the merger occurs with unilateral effects but without efficiencies or coordinated effects. No numbers are shown for column (v), which represents the baseline scenario in which no merger occurs.*
Appendix

A Regions

1. Atlanta
2. Birmingham/Montgomery
3. Boston
4. Buffalo/Rochester
5. Charlotte
6. Chicago
7. Cleveland
8. Dallas
9. Des Moines
10. Detroit
11. Grand Rapids
12. Green Bay
13. Hartford
14. Houston
15. Indianapolis
16. Knoxville
17. Los Angeles
18. Milwaukee
19. Mississippi
20. New Orleans
21. New York
22. Omaha
23. Peoria/Springfield
24. Phoenix
25. Portland, OR
26. Raleigh/Durham
27. Richmond/Norfolk
28. Roanoke
29. Sacramento
30. San Diego
31. San Francisco
32. Seattle/Tacoma
33. South Carolina
34. Spokane
35. St. Louis
36. Syracuse
37. Toledo
38. Washington D.C.
39. West Texas/New Mexico
B Computation of Demand Estimates

Estimates for the parameters governing demand for beer were computed by minimizing a nonlinear GMM objective function. Recent work by Knittel and Metaxoglou (2012) shows that correctly computing random coefficient logit demand models can be challenging because the objective function can be highly non-convex and contain multiple local optima and saddle points. We followed the recommendations in Knittel and Metaxoglou (2012) and the example of Golberg and Hellerstein (2013) and took several steps to ensure that we correctly computed a global minimum of the objective function. First, we used a parsimonious demand specification with only two nonlinear parameters to facilitate computation. Second, we used the Nelder-Mead non-derivative search algorithm. While this algorithm takes longer to converge than derivative-based methods, it is believed to be more robust (Golberg and Hellerstein (2013)). We passed the optimum computed with the simplex method to a gradient-based quasi-Newton algorithm and verified that the optimum did not change. This gives us additional confidence that we did not converge to a saddle point or a ridge. Third, we used a high tolerance criterion for the Berry (1994) contraction mapping of mean utility levels of $1e^{-14}$. This is higher than the tolerance level of $1e^{-9}$ used in Golberg and Hellerstein (2013). Finally, we confirmed second-order conditions by verifying that the Hessian of the objective function at the optimum is positive definite and well-conditioned with eigenvalues equal to 2822 and 257.
C Additional Tables and Figures
Figure C.1: Counterfactual Price Series for Miller Lite

Notes: The figure plots the average retail prices of Miller Lite 12-packs. The red prices labeled “Coordinated, Unilateral, Efficiencies” are the raw data. The gold prices labeled “No Merger” are numerically computed for a counterfactual in which the Miller/Coors merger does not occur. The blue prices labeled “Unilateral, Efficiencies” are the scenario in which the Miller/Coors merger occurs with unilateral effects and efficiencies but no coordinated effects. The green prices labeled “Unilateral, No Efficiencies” are the scenario in which the merger occurs with unilateral effects but without efficiencies or coordinated effects. The black prices labeled “Coordinated, Unilateral, No Efficiencies” are computed assuming the merger occurs with coordinated and unilateral effects but without efficiencies. Straight averages are calculated over the 39 regions in the data.
Figure C.2: Counterfactual Price Series for Budweiser Light

Notes: The figure plots the average retail prices of Budweiser 12-packs. The red prices labeled “Coordinated, Unilateral, Efficiencies” are the raw data. The gold prices labeled “No Merger” are numerically computed for a counterfactual in which the Miller/Coors merger does not occur. The blue prices labeled “Unilateral, Efficiencies” are the scenario in which the Miller/Coors merger occurs with unilateral effects and efficiencies but no coordinated effects. The green prices labeled “Unilateral, No Efficiencies” are the scenario in which the merger occurs with unilateral effects but without efficiencies or coordinated effects. The black prices labeled “Coordinated, Unilateral, No Efficiencies” are computed assuming the merger occurs with coordinated and unilateral effects but without efficiencies. Straight averages are calculated over the 39 regions in the data.
Table C.1: Median Own-Price and Cross-Price Demand Elasticities

<table>
<thead>
<tr>
<th></th>
<th>Bud Light</th>
<th>Budweiser</th>
<th>Coors Light</th>
<th>Coors Extra</th>
<th>Corona Light</th>
<th>Corona Extra</th>
<th>Heineken Light</th>
<th>Miller G. D.</th>
<th>Miller High Life</th>
<th>Miller Lite</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bud Light</td>
<td>-4.06</td>
<td>0.177</td>
<td>0.017</td>
<td>0.187</td>
<td>0.043</td>
<td>0.018</td>
<td>0.029</td>
<td>0.007</td>
<td>0.037</td>
<td>0.068</td>
</tr>
<tr>
<td>Budweiser</td>
<td>0.366</td>
<td>-4.268</td>
<td>0.017</td>
<td>0.187</td>
<td>0.043</td>
<td>0.018</td>
<td>0.029</td>
<td>0.007</td>
<td>0.037</td>
<td>0.068</td>
</tr>
<tr>
<td>Coors</td>
<td>0.366</td>
<td>0.177</td>
<td>-4.455</td>
<td>0.187</td>
<td>0.043</td>
<td>0.018</td>
<td>0.029</td>
<td>0.007</td>
<td>0.037</td>
<td>0.068</td>
</tr>
<tr>
<td>Coors Light</td>
<td>0.366</td>
<td>0.177</td>
<td>0.017</td>
<td>-4.261</td>
<td>0.043</td>
<td>0.018</td>
<td>0.029</td>
<td>0.007</td>
<td>0.037</td>
<td>0.068</td>
</tr>
<tr>
<td>Corona Extra</td>
<td>0.056</td>
<td>0.027</td>
<td>0.003</td>
<td>0.028</td>
<td>-6.114</td>
<td>0.059</td>
<td>0.091</td>
<td>0.023</td>
<td>0.006</td>
<td>0.010</td>
</tr>
<tr>
<td>Corona Light</td>
<td>0.056</td>
<td>0.027</td>
<td>0.003</td>
<td>0.028</td>
<td>0.138</td>
<td>-6.271</td>
<td>0.091</td>
<td>0.023</td>
<td>0.006</td>
<td>0.010</td>
</tr>
<tr>
<td>Heineken</td>
<td>0.056</td>
<td>0.027</td>
<td>0.003</td>
<td>0.028</td>
<td>0.138</td>
<td>0.059</td>
<td>-6.248</td>
<td>0.023</td>
<td>0.006</td>
<td>0.010</td>
</tr>
<tr>
<td>Heineken Light</td>
<td>0.054</td>
<td>0.025</td>
<td>0.002</td>
<td>0.028</td>
<td>0.132</td>
<td>0.059</td>
<td>0.086</td>
<td>-6.323</td>
<td>0.005</td>
<td>0.010</td>
</tr>
<tr>
<td>Miller G.D.</td>
<td>0.366</td>
<td>0.177</td>
<td>0.017</td>
<td>0.187</td>
<td>0.043</td>
<td>0.018</td>
<td>0.029</td>
<td>0.007</td>
<td>-4.447</td>
<td>0.068</td>
</tr>
<tr>
<td>Miller H.L.</td>
<td>0.366</td>
<td>0.177</td>
<td>0.017</td>
<td>0.187</td>
<td>0.043</td>
<td>0.018</td>
<td>0.029</td>
<td>0.007</td>
<td>0.037</td>
<td>-3.372</td>
</tr>
<tr>
<td>Miller Lite</td>
<td>0.366</td>
<td>0.177</td>
<td>0.017</td>
<td>0.187</td>
<td>0.043</td>
<td>0.018</td>
<td>0.029</td>
<td>0.007</td>
<td>0.037</td>
<td>0.068</td>
</tr>
</tbody>
</table>

Notes: The cell entry in row $i$ and column $j$ is the percentage change in the quantity of product $i$ due to a one percent increase in the price of product $j$. All products tabulated here are 12-packs. Elasticities are calculated as the median over the region-period combinations.
Table C.2: Median Diversion Ratios

<table>
<thead>
<tr>
<th></th>
<th>Bud Light</th>
<th>Budweiser</th>
<th>Coors</th>
<th>Coors Light</th>
<th>Corona Extra</th>
<th>Corona Light</th>
<th>Heineken</th>
<th>Heineken Light</th>
<th>Miller G. D.</th>
<th>Miller High Life</th>
<th>Miller Lite</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bud Light</td>
<td>-</td>
<td>0.044</td>
<td>0.004</td>
<td>0.045</td>
<td>0.008</td>
<td>0.003</td>
<td>0.005</td>
<td>0.001</td>
<td>0.009</td>
<td>0.021</td>
<td>0.049</td>
</tr>
<tr>
<td>Budweiser</td>
<td>0.085</td>
<td>-</td>
<td>0.004</td>
<td>0.043</td>
<td>0.007</td>
<td>0.003</td>
<td>0.005</td>
<td>0.001</td>
<td>0.009</td>
<td>0.020</td>
<td>0.047</td>
</tr>
<tr>
<td>Coors</td>
<td>0.081</td>
<td>0.040</td>
<td>-</td>
<td>0.041</td>
<td>0.007</td>
<td>0.003</td>
<td>0.005</td>
<td>0.001</td>
<td>0.008</td>
<td>0.019</td>
<td>0.045</td>
</tr>
<tr>
<td>Coors Light</td>
<td>0.085</td>
<td>0.041</td>
<td>0.004</td>
<td>-</td>
<td>0.007</td>
<td>0.003</td>
<td>0.005</td>
<td>0.001</td>
<td>0.009</td>
<td>0.020</td>
<td>0.047</td>
</tr>
<tr>
<td>Corona Extra</td>
<td>0.013</td>
<td>0.006</td>
<td>0.001</td>
<td>0.006</td>
<td>-</td>
<td>0.010</td>
<td>0.015</td>
<td>0.004</td>
<td>0.001</td>
<td>0.003</td>
<td>0.007</td>
</tr>
<tr>
<td>Corona Light</td>
<td>0.012</td>
<td>0.006</td>
<td>0.001</td>
<td>0.006</td>
<td>0.022</td>
<td>-</td>
<td>0.015</td>
<td>0.004</td>
<td>0.001</td>
<td>0.003</td>
<td>0.007</td>
</tr>
<tr>
<td>Heineken</td>
<td>0.012</td>
<td>0.006</td>
<td>0.001</td>
<td>0.006</td>
<td>0.022</td>
<td>0.010</td>
<td>-</td>
<td>0.004</td>
<td>0.001</td>
<td>0.003</td>
<td>0.007</td>
</tr>
<tr>
<td>Heineken Light</td>
<td>0.012</td>
<td>0.006</td>
<td>0.001</td>
<td>0.006</td>
<td>0.022</td>
<td>0.010</td>
<td>0.014</td>
<td>-</td>
<td>0.001</td>
<td>0.003</td>
<td>0.007</td>
</tr>
<tr>
<td>Miller G.D.</td>
<td>0.082</td>
<td>0.040</td>
<td>0.004</td>
<td>0.041</td>
<td>0.007</td>
<td>0.003</td>
<td>0.005</td>
<td>0.001</td>
<td>-</td>
<td>0.019</td>
<td>0.045</td>
</tr>
<tr>
<td>Miller H.L.</td>
<td>0.083</td>
<td>0.040</td>
<td>0.004</td>
<td>0.042</td>
<td>0.007</td>
<td>0.003</td>
<td>0.005</td>
<td>0.001</td>
<td>0.008</td>
<td>-</td>
<td>0.046</td>
</tr>
<tr>
<td>Miller Lite</td>
<td>0.085</td>
<td>0.041</td>
<td>0.004</td>
<td>0.043</td>
<td>0.007</td>
<td>0.003</td>
<td>0.005</td>
<td>0.001</td>
<td>0.009</td>
<td>0.020</td>
<td>-</td>
</tr>
</tbody>
</table>

Notes: The cell entry in row $i$ and column $j$ is given by the median of $|\frac{\partial s_i}{\partial p_j}|$ over the region-period combinations. All products tabulated here are 12-packs.
Table C.3: Price-Cost Relationships Pre-Merger and Post-Merger

<table>
<thead>
<tr>
<th></th>
<th>Miller Lite</th>
<th></th>
<th>Coors Light</th>
<th></th>
<th>Bud Light</th>
<th></th>
<th>Budweiser</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre</td>
<td>Post</td>
<td>Pre</td>
<td>Post</td>
<td>Pre</td>
<td>Post</td>
<td>Pre</td>
<td>Post</td>
</tr>
<tr>
<td>Constant</td>
<td>7.09</td>
<td>8.20</td>
<td>4.20</td>
<td>8.07</td>
<td>6.67</td>
<td>7.89</td>
<td>6.68</td>
<td>7.83</td>
</tr>
<tr>
<td></td>
<td>(0.08)</td>
<td>(0.06)</td>
<td>(0.27)</td>
<td>(0.38)</td>
<td>(0.40)</td>
<td>(0.28)</td>
<td>(0.41)</td>
<td>(0.35)</td>
</tr>
<tr>
<td>Marginal Cost</td>
<td>0.45</td>
<td>0.42</td>
<td>0.87</td>
<td>0.44</td>
<td>0.58</td>
<td>0.46</td>
<td>0.58</td>
<td>0.47</td>
</tr>
<tr>
<td></td>
<td>(0.08)</td>
<td>(0.06)</td>
<td>(0.28)</td>
<td>(0.07)</td>
<td>(0.07)</td>
<td>(0.07)</td>
<td>(0.07)</td>
<td>(0.06)</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.435</td>
<td>0.619</td>
<td>0.800</td>
<td>0.571</td>
<td>0.490</td>
<td>0.466</td>
<td>0.978</td>
<td>0.965</td>
</tr>
<tr>
<td># Observations</td>
<td>1548</td>
<td>1157</td>
<td>1599</td>
<td>1117</td>
<td>1597</td>
<td>1174</td>
<td>1597</td>
<td>1174</td>
</tr>
</tbody>
</table>

Notes: The table shows the results of univariate OLS regressions. The dependent variable is the retail price and the regressor is the marginal cost imputed from the structural model. Observations are 12-packs at the region-year-month level. Results are reported separately for the pre-merger period (i.e., before June 2008) and the post-merger periods (i.e., after May 2009), and separately for the Miller Lite, Coors Light, Bud Light, and Budweiser Brands. Standard errors are clustered at the region level and reported in parentheses.
Table C.4: Welfare Effects of Miller/Coors Merger in Millions of Dollars

<table>
<thead>
<tr>
<th>Scenario Description</th>
<th>(i)</th>
<th>(ii)</th>
<th>(iii)</th>
<th>(iv)</th>
<th>(v)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coordinated Effects</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>Unilateral Effects</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Efficiencies</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>no</td>
</tr>
</tbody>
</table>

**Merger Effect on Producer Surplus**

<table>
<thead>
<tr>
<th></th>
<th>ABI</th>
<th>Miller</th>
<th>Coors</th>
<th>Total Industry</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABI</td>
<td>4.73</td>
<td>7.04</td>
<td>5.33</td>
<td>17.42</td>
</tr>
<tr>
<td>Miller</td>
<td>7.04</td>
<td>4.55</td>
<td>3.81</td>
<td>14.83</td>
</tr>
<tr>
<td>Coors</td>
<td>5.33</td>
<td>2.03</td>
<td>3.27</td>
<td>7.40</td>
</tr>
<tr>
<td>Total Industry</td>
<td>17.42</td>
<td>14.83</td>
<td>7.40</td>
<td>5.46</td>
</tr>
</tbody>
</table>

**Merger Effect on Consumer Surplus**

<table>
<thead>
<tr>
<th></th>
<th>Total Industry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Industry</td>
<td>-14.12 -18.45 -1.26 -6.32</td>
</tr>
</tbody>
</table>

**Merger Effect on Total Surplus**

<table>
<thead>
<tr>
<th></th>
<th>Total Industry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Industry</td>
<td>3.30 -3.61 6.14 -0.86</td>
</tr>
</tbody>
</table>

*Notes:* The table provides the effect of the Miller/Coors merger on producer surplus, consumer surplus, and total surplus. All numbers are millions of dollars, relative to the “No Merger” scenario in which the Miller/Coors merger does not occur, and are for the year 2011. Column (i) considers the scenario in which the merger occurs with coordinated effects, unilateral effects, and efficiencies. This best reflects the raw data. Column (ii) considers the counterfactual scenario in which the merger occurs with coordinated and unilateral effects but without efficiencies. Column (iii) considers the counterfactual scenario in which the merger occurs with unilateral effects and efficiencies but no coordinated effects. Column (iv) considers the counterfactual scenario in which the merger occurs with unilateral effects but without efficiencies or coordinated effects. No numbers are shown for column (v), which represents the baseline scenario in which no merger occurs.