

Company-Specific Revenues From Underage Drinking

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ABSTRACT. Objective: Alcohol is the most commonly used illegal drug among U.S. high school students. This study aimed to estimate the proportion of drinks and sales revenue accruing to alcoholic beverage companies that were attributable to underage consumption in 2011 and 2016. **Method:** We used national survey data to estimate the number of adult and underage past-30-day drinkers, median volume of alcohol consumed, beverage preferences, and alcohol price by beverage type. We used Impact Databank to determine the total number of alcoholic drinks sold. After adjusting for underreporting, we applied the percentage of alcohol reported to be consumed by underage youth on surveys to the alcohol sales data by beverage type and assigned a beverage-specific cost. **Results:** Underage youth drank 11.73% of the alcoholic drinks sold in the U.S. market in 2011 and 8.6% in 2016. Total sales revenue

attributable to underage consumption was \$20.9 billion (10.0%) out of a total of \$208.0 billion in 2011 and \$17.5 billion (7.4%) out of \$237.1 billion in 2016. Three alcoholic beverage companies represented nearly half (43.5%) of the market share of beverages consumed by underage youth. **Conclusions:** Despite the alcoholic beverage industry's stated commitment to reducing underage drinking, significant revenues appear to accrue from this activity. This presents an opportunity to enact and enforce policies—such as alcohol taxes or required company funding of independently managed youth drinking prevention initiatives—that recover these revenues from the industry and use them to help achieve the goal of preventing youth alcohol consumption. (*J. Stud. Alcohol Drugs*, 82, 368–376, 2021)

ALCOHOL IS THE most commonly used illegal drug Among U.S. high school students (Kann et al., 2018), and its use contributes to significant morbidity and mortality through motor vehicle crashes, physical and sexual assault, unintended pregnancy, sexually transmitted infections, homicide, and suicide (Centers for Disease Control and Prevention [CDC], 2013a). Youth who initiate drinking before age 21 are four times more likely to be diagnosed with an alcohol use disorder at some point in their lifetimes (Grant & Dawson, 1997). There is thus a strong public health interest in delaying initiation of drinking.

Globally, alcohol sales are a big business: Worldwide alcohol sales are worth more than U.S.\$1.5 trillion per year (Euromonitor International, 2018); in the United States alone, consumer expenditures on alcoholic beverages were approximately \$222 billion in the 12 months ending June 30, 2016 (bw166, 2016). According to the industry itself, none of these revenues should come from persons under 21 in the United States: voluntary marketing codes developed by and for the U.S. alcohol industry in the United States repeatedly state that their products are intended for adults of legal pur-

chase age who drink (Distilled Spirits Council of the United States, 2011), whereas the Beer Institute wrote in 2019 that brewers are committed to reducing the level of underage drinking to zero (Beer Institute, 2019).

However, from an economic perspective, there may be much to gain from selling alcohol to youth, given the connection between early initiation and alcohol use disorder. Few studies have attempted to capture the commercial value of underage drinking in the United States, although researchers abroad have quantified the value of alcohol sales attributable to minors based on their markets and minimum legal purchase ages (Doran et al., 2009; Li & Si, 2016; Surasak et al., 2011). Foster et al. (2003) estimated that in 1999, underage drinkers were responsible for nearly 20% of total drinks consumed, and \$22.5 billion out of \$116.2 billion total alcohol sales in the United States in that year. In 2006, Miller and colleagues estimated \$18.1 billion in sales (16.2%) attributable to youth ages 14–20. Before Foster's efforts (2003, 2006), estimates primarily focused on heavy drinkers and did not distinguish between youth and adult consumption (Greenfield & Rogers, 1999). Estimates

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have also been limited to total sales and revenues because the only data available for ascribing revenues to particular beverages were survey data on youth beverage type preferences (beer, spirits, or wine). Studies have since attempted to capture more accurately the type of alcoholic beverages young people prefer (Cremeens, 2009; Siegel et al., 2011), but information on youth consumption by brand would go a step further and allow for attribution of sales and revenues not only by beverage type but also by company.

To address this gap, we estimate the total sales attributable to the alcoholic beverage industry by parent company. We believe this is the first attempt to estimate the sales revenue accruing to the alcoholic beverage industry by parent company from underage drinking.

Method

We used similar methods as those described by Foster et al. (2003) to calculate the relative proportion of standard drinks consumed and sales revenue from underage and adult drinking in the alcoholic beverage market in 2011 and 2016 (the most recent year of data that were available). Unlike Foster et al., however, we used more specific data and applied a series of corrections to avoid potential biases as described below. We also went a step further and assigned sales revenue in the youth market to the parent alcoholic beverage company using estimates of the share of youth drinking taken up by each brand derived from the Alcohol Brand Research Among Underage Youth (ABRAND) survey data (Siegel et al., 2013). We begin by summarizing the available data sets, which provides context for the decisions made about which data sets to use for the calculations.

Summary of the available national data sets

In addition to the ABRAND data, there were four national data sets for determining the number of youth (age 12–20 years) and adults (age ≥ 21) who drank alcohol in the past 30 days in the United States in 2011 and 2016 and their levels of consumption: (a) the National Survey on Drug Use and Health (NSDUH), (b) Monitoring the Future, (c) the Youth Risk Behavior Surveillance Survey (YRBS), and (d) the Behavioral Risk Factor Surveillance System (BRFSS). Of these, Monitoring the Future was eliminated because it only collects data from a subset of grades (8th, 10th, and 12th) and therefore was not representative of youth ages 12–17 years old.

Alcohol Brand Research among Underage Youth. In 2011, Siegel et al. fielded an innovative survey that asked underage participants to describe their consumption of 898 specific brands of alcoholic beverages in the past 30 days (Siegel et al., 2013). Ipsos Public Affairs LLC (at the time GfK Knowledge Networks) used its national Internet panel to recruit 1,031 young people ages 13–20 years in 2011. The

response rates were 43.4% for panelists ages 18 to 20 years and 44.4% for those ages 13 to 17 years.

National Survey on Drug Use and Health. Administered by the Substance Abuse and Mental Health Services Administration, NSDUH uses a household enumeration sampling design that includes youth who do not attend public school. The overall response rate was 64.7% in 2011 and 53.5% for 2016. NSDUH uses an in-person audio computer-assisted survey administration method in which participants listen to survey questions and enter answers directly into the computer; parents may be present during this process (Gfroerer et al., 1997). Of the surveys, NSDUH includes the widest age range (age ≥ 12). In 2011, NSDUH contained 88,536 interviews and it contained 67,942 interviews in 2016. When weighted, NSDUH data are representative of the U.S. civilian, noninstitutionalized population age 12 years and older.

Youth Risk Behavior Survey. Coordinated by the CDC and administered at the state level, YRBS uses a three-stage cluster-based sampling design to obtain a nationally representative sample of students who attend public and private schools in grades 9–12 within the United States and the District of Columbia. It is administered biennially and was not administered in 2016. The overall response rate was 71% in 2011 (Eaton et al., 2012) and 60% in both 2015 (CDC, 2016a) and 2017 (CDC, 2018). Interviewers read survey questions to the students, who record their answers on a computer-scannable form. YRBS data are completely anonymous; students' names and addresses are not recorded.

Behavioral Risk Factor Surveillance Survey. Also coordinated by the CDC, BRFSS uses a dual-frame landline and cell phone-based sampling design. Of the surveys, it has the largest sample size; it contained 506,467 completed interviews in 2011 and 486,303 in 2016. The response rates in 2011 were 54.0% for landlines and 27.9% for cell phones (CDC, 2013b); in 2016, they were 47.7% and 46.4%, respectively (CDC, 2017a). Almost all states and territories administered the survey using computer-assisted interviewing (CDC, 2017b). When weighted, BRFSS data are representative of the U.S. civilian noninstitutionalized population in the states, District of Columbia, Puerto Rico, and Guam.

Step 1: Calculating the number of current underage and adult drinkers

NSDUH, YRBS, and BRFSS all use sophisticated sampling designs that were unlikely to lead to sampling bias, and they used nearly identical question wording for assessing past-30-day (“current”) alcohol consumption. Therefore, across the three surveys, we determined the greatest possibility of a difference in the potential for bias related to issues of confidentiality. When estimating the prevalence of sensitive or illegal behaviors, anonymous data collection methods (e.g., those used in YRBS) obtain higher prevalence levels than confidential methods (e.g., those used in NSDUH)

(Grucza et al., 2007). In addition, although in-person interview methods themselves do not result in different levels of alcohol use reports (Tourangeau et al., 2000), NSDUH's face-to-face interviews with minors only occur when a parent or guardian is at home, which could produce a context effect that further induces social desirability bias and encourages youth to underestimate their drinking (Johnson, 2014).

Based on this assessment, we combined data from YRBS (CDC, 2011b, 2015, 2017c) and BRFSS (CDC, 2011a, 2016b) to calculate the number of current underage and adult drinkers (Box 1). To obtain YRBS data for 2016, we averaged data from 2015 and 2017. YRBS samples through 12th grade rather than targeting a specific age group. This means their highest age category combines 18-year-olds with persons older than 18 years. BRFSS contained a category for 18-year-olds; therefore, we only used YRBS data for 12- to 17-year-olds, and we used BRFSS data for persons ages 18 and older. We used Stata/IC 14.2 (StataCorp LP, College Station, TX) to apply the complex survey sampling weights and used subpopulation commands to obtain estimates of the percentage of underage (12–17 for YRBS and 18–20 for BRFSS) and adult (≥ 21 from BRFSS) drinkers in 2011 and 2016. We then multiplied these percentages against the population size from the American community population estimate for that age range for the respective year to obtain the total number of drinkers in the United States in each age category.

Step 2: Calculating the median volume of alcohol consumed by underage youth and adults

YRBS did not ask any questions about quantity of alcohol consumed, so we only compared NSDUH and BRFSS as potential sources of alcohol frequency (i.e., number of drinking days in past 30 days) or quantity (i.e., number of average drinks per drinking day). As participants who report alcohol frequency and quantities have already reported alcohol use, we determined the most likely source of bias that could differ across the surveys to be recall errors. The NSDUH frequency and quantity questions had more context-specific cues to prompt participants' memory, including a programmer instruction to insert the date 30 days before in the frequency question and another instruction to insert the number of days the participant reported drinking in the past 30 days in the quantity question. These types of prompts can help respondents with some of the cognitive calculations required to answer the question (Fowler, 1995). Therefore, we obtained frequency and quantity from NSDUH for both underage and adult age groups (U.S. Department of Health and Human Services, 2013, 2018).

In exploratory analyses, we determined that the reported mean quantities of alcohol consumed were skewed such that most were low, but there were large outliers. In addition, the quantities for underage youth were more highly skewed than for adults, meaning that the values for under-

Box 1. Summary of analytic process

1. Calculate number of past-30-day drinkers for 12–20 (underage) and for 21 and older (adults) separately.
2. Calculate median volume of alcohol consumed in the past year for each age group.
3. Estimate the proportion of alcohol assumed to be drunk by underage youth.
4. Convert annual alcohol sales data from gallons of beer, spirits, and wine into drinks.
5. Calculate the proportion of alcohol consumption by beverage type for underage youth and adults.
6. Correct beverage-specific consumption for under-reporting by beverage type.
7. Estimate the proportion of alcoholic drinks attributable to underage youth.
8. Calculate the price of alcoholic drinks.
9. Estimate the proportion of alcoholic drink sales revenue attributable to underage youth.
10. Estimate the sales revenue from alcoholic sales accruing to 10 major companies.

age youth had more outliers that pulled the mean up toward those extreme values than the adult values did. Therefore, to avoid overestimating underage youth consumption in our summary measure, we departed from the methods of Foster et al. (2003) and used the median instead of the mean for underage and adult populations. Ideally, one would use a mean for these analyses, but we used a median because there was skew in the data that differed across youth and adults. We provide results of a sensitivity analysis using the mean in the supplemental appendix; the results only increased by 1–2 percentage points (a relative increase of 5%–16%). We also conducted a sensitivity analysis in which we capped the outliers at 50 drinks per day; the results did not change.

Step 3: Estimating the proportion of alcohol assumed to be drunk by underage youth

Similar to Foster et al. (2003), we first converted a summary measure for individual-level past-30-day drinks consumed to an individual-level past-year drinks consumed by multiplying by 12. We next multiplied the number of underage and adult drinkers (separately) by the median number of drinks consumed each year (separately by underage youth and adults) to estimate the total number of drinks consumed by underage youth and adults, respectively. We then added these two products to estimate the total number of drinks consumed each year. Our estimate of the proportion of alcohol assumed to be drunk by underage youth using uncorrected survey data was calculated as the drinks reported by underage youth alone divided by the total number of drinks (i.e., drinks reported by underage youth and adults combined).

Step 4: Converting alcohol sales data from gallons to standard drinks

Impact Databank reported sales in gallons of beer, distilled spirits, and wine (cider and ready-to-drink beverages were included with beer), which were converted from gallons to ounces (133.28 oz. per gallon) and then to total standard drinks of each and summed per year. The number of ounces per standard drink depended on the type of beverage; it was 12 oz. of 5.0% beer, 5 oz. of 12% wine, or 1.5 oz. of 40% distilled spirits (National Institute on Alcohol Abuse and Alcoholism [NIAAA], n.d.).

Step 5: Calculating proportions of alcohol consumption by beverage type for underage youth and adults

Underage and adult drinkers are thought to drink each beverage type in different proportions. Previous estimates of youth beverage-specific consumption that demonstrated this, however, were unable to account for youth who consumed more than one type of beverage or measure quantity (Siegel et al., 2011). Therefore, we used totaled market shares by beverage type from the ABRAND survey. We then multiplied these percentages by the number of standard drinks sold in the U.S. market (Step 4) and the proportion of alcohol assumed to be consumed by underage youth using survey data (Step 3). This was repeated separately for each beverage type.

For adults, total sales of alcohol by beverage type for 2011 and 2016 were extracted from Impact Databank market research reports (Impact Databank, 2012a, 2012b, 2012c, 2017a, 2017b, 2017c). We first subtracted the number of standard drinks of beer, distilled spirits, and wine estimated to be consumed by youth and assigned the remaining standard alcoholic drinks to adults. We then divided each of the remaining beer, distilled spirits, and wine standard drinks by the total remaining standard drinks to determine the beverage-specific proportions for adults in 2011 and 2016.

Step 6: Correcting for underreporting

One of the most notorious problems with self-reported alcohol consumption is underreporting. Some speculate that youth may underreport consumption more than adults (Gfroerer et al., 1997), whereas others hypothesize that youth may overreport in an effort to impress peers (Fendrich, 2005; Swadi, 1990), although this may be more common in school-based settings (Johnson, 2014). In the absence of empirical evidence of underestimation by age, we applied beverage-specific correction factors calculated by Stockwell et al. (2014). By comparing quantity–frequency methods—like those used in NSDUH—to the 24-hour recall diary method, which is considered the “gold standard” for measuring alcohol consumption (Bloomfield et al., 2013), they estimated

that surveys that use quantity–frequency questions capture about 48.8% of beer, 38.3% of wine, and 64.9% of spirits consumption (Stockwell et al., 2014). After calculating the unadjusted number of standard drinks of beer, distilled spirits, and wine estimated to be consumed by underage youth and by adults by combining the Impact Databank sales data and the unadjusted proportion of alcohol consumed from the survey data, we applied the age- and beverage-specific proportions and corrected for underreporting by dividing by these percentages.

Step 7: Calculating the proportion of standard alcoholic drinks consumed by underage youth and adults

We then divided the number of standard drinks estimated to be consumed by underage youth by the total number of standard drinks consumed by both underage youth and adults combined. In other words, we calculated the proportion of total alcohol that underage youth consume (drinks_y) as $\text{drinks}_y = \text{percent}_y \times \text{drinks}_r$ where (percent_y) is the corrected proportion of the alcohol estimated to be consumed by underage youth using the survey data, and (drinks_r) is the total number of standard drinks sold in the United States from Impact Databank.

Step 8: Calculating price of standard alcoholic drinks

Historically, price data for alcoholic beverages have only been available at the beverage type level, not for individual brands. In 2011, DiLoreto et al. (2012) compiled the first known database comprising average cost per ounce and ethanol content of each of 900 brands compiled from online store data. Whereas Foster et al. (2003) estimated price per beverage category by dividing numbers of standard drinks by expenditures, we used DiLoreto’s beverage-specific prices per drink. The estimated cost of a drink was \$1.21 for beer, \$1.43 for spirits, and \$3.83 for wine. We adjusted this to 2016 dollars using a consumer price index (CPI) for all urban consumers and alcoholic beverages of 1.07 ($2016 \text{ CPI} / 2011 \text{ CPI} = 242.53 / 226.69 = 1.07$) (U.S. Bureau of Labor Statistics, 2020).

We also included a sensitivity analysis following the methods of Foster et al. (2003) using the 2011 data, which estimated price per drink by dividing the market sales for each beverage category by the number of standard drinks sold. Market sales data by beverage type were not available for 2016.

Step 9: Calculating total and proportion of total expenditures, underage and adult

The sales revenues from underage consumption (sales_y) were then estimated as: $\text{sales}_y = \text{drinks}_y \times \text{cost}_{BWS} \times \text{percent}_{BWS}$ where (drinks_y) is the number of alcoholic drinks consumed by youth, (cost_{BWS}) is the cost per drink of each

TABLE 1. Number of underage youth and adults who drank alcohol in the past 30 days in the United States (in thousands) in 2011 and 2016

| Year | Underage youth | | | Adults |
|------|-----------------------------------|-----------------------------------|-----------------------------------|---------------------------------|
| | 12–17 years ^a n (%) | 18–20 years ^b n (%) | 12–20 years ^c n (%) | ≥21 years ^b n (%) |
| 2011 | 10,888.0 (42.6) | 5,011.5 (38.2) | 15,899.6 (41.1) | 123,202.6 (56.2) |
| 2016 | 8,518.8 (33.8) | 4,494.3 (34.4) | 13,013.1 (34.0) | 126,611.4 (54.6) |

^aPrevalence from the Youth Risk Behavior Survey and population size from the American Community Survey; ^bprevalence from the Behavioral Risk Factor Surveillance System and population size from the American Community Survey; ^cprevalence is a weighted average of the Youth Risk Behavior Survey and the Behavioral Risk Factor Surveillance System (first two data columns) and population size from the American Community Survey.

beverage type, and (percent_{BWS}) is the share of that specific beverage type consumed by underage youth. Summing the categorical totals for beer, distilled spirits, and wine provided the total sales revenue from alcohol for underage youth. This process was replicated to provide totals for adult consumption, substituting data from Impact Databank to estimate (percent_{BWS}) share of beverage type after removing the standard drinks estimated to be consumed by underage youth.

Sales revenue from beer, distilled spirits, and wine consumed by youth ages 12–20 years were summed and then divided by the total sales revenue to determine the proportion of sales attributable to underage youth for 2011 and 2016.

Step 10: Estimating sales revenue attributable to underage youth consumption by alcoholic beverage company

Each of the 898 brands from the ABRAND survey was categorized by parent company, and the youth market shares were multiplied by brand-specific prices and total number of youth standard drinks to calculate the value of each brand's youth market share; these brand values were then totaled per company and multiplied by the CPI increase to generate 2016 estimates.

Results

Total current drinkers, underage and adult

The prevalence of current (past-30-day) drinking declined for both youth and adults between 2011 and 2016. In 2011, 41.1% of underage youth were current drinkers; this fell to 34.0% in 2016 (Table 1). The adult prevalence was 56.2% in 2011 and 54.6% in 2016. This equaled an estimated 15.9 and 13.0 million underage drinkers and 123.2 and 126.6 million adult drinkers in 2011 and 2016, respectively.

Calculating beverage-specific consumption, underage and adult

The percentages of each beverage type consumed by underage youth in 2011 were 61.9% beer (includes cider, alcoholic energy drinks [3.3% of total alcohol], and flavored malt

beverages [16.1% of total alcohol]), 32.4% distilled spirits, and 5.7% wine (Table 2). After removing the beverage-specific alcohol consumed by underage youth, we estimated that adult beverage-specific consumption percentages were 53.0% beer and malt beverages, 30.8% spirits, and 16.2% wine in 2011, and 50.0% beer and malt beverages, 34.3% spirits, and 15.7% wine in 2016. After applying the beverage-specific correction factors, we found that underage youth consumed 11.7% of the standard alcoholic drinks in 2011 and 8.6% of the standard alcoholic drinks in 2016.

Sales revenue attributable to underage youth consumption

Total sales revenue attributable to underage consumption was \$20.9 billion out of a total of \$208.0 billion, or 10.0% of the total sales revenue in 2011 and \$17.5 billion out of \$237.1 billion or 7.4% in 2016. Our sensitivity analysis showed that following the methods of Foster et al. (2003) for estimating the price per standard drink would increase the percentage of sales attributable to underage youth by 17.1% in 2011 (from \$20.9 billion to \$24.5 billion).

Sales revenue attributable to underage youth by alcoholic beverage company

Three alcoholic beverage companies represented nearly one half (44.7%) of the market share of beverages consumed by underage youth as reported in the ABRAND survey (Table 3). In 2016, AB InBev products accounted for 21.2% of the volume of youth consumption or \$2.2 billion in sales revenue attributable. MillerCoors accounted for 12.3% of the market share or \$1.1 billion in sales revenue. Diageo products held 11.1% of the market share or \$2.0 billion in sales revenue. Together, the other seven leading alcoholic beverage companies totaled \$3.1 billion in sales revenue attributable to underage youth consumption in 2016.

Discussion

According to our analysis, underage youth consumption was responsible for nearly 9% of total alcoholic beverage consumption and just over 7% of total sales revenue in 2016,

TABLE 2. Sales revenue from alcohol consumption in the United States, underage youth and adults, 2011 and 2016

| Beverage | % of drinks ^a A | No. of drinks, thousands ^b B | Cost per drink, \$ ^c C | Sales revenue, thousand \$ B × C |
|---|-------------------------------|---|---|--|
| Underage youth, 12–20 | | | | |
| 2011 | | | | |
| Beer | 61.9 | 9,036,437 | 1.21 | 10,934,088 |
| Distilled spirits | 32.4 | 4,729,896 | 1.43 | 6,763,751 |
| Wine | 5.7 | 832,111 | 3.83 | 3,186,986 |
| Total | | 14,598,444 | | 20,884,825 |
| Percentage attributable to underage youth | | 11.73% | | 10.04% |
| 2016 | | | | |
| Beer | 61.9 | 6,567,340 | 1.29 | 9,136,446 |
| Distilled spirits | 32.4 | 4,379,907 | 1.53 | 5,651,741 |
| Wine | 5.7 | 454,725 | 4.10 | 2,663,022 |
| Total | | 11,401,971 | | 17,451,210 |
| Percentage attributable to underage youth | | 8.61% | | 7.36% |
| Adults, ≥21 years | | | | |
| 2011 | | | | |
| Beer | 53.9 | 58,216,938 | 1.21 | 70,442,496 |
| Distilled spirits | 30.8 | 33,847,828 | 1.43 | 48,402,394 |
| Wine | 16.2 | 17,842,390 | 3.83 | 68,336,355 |
| Total | | 109,907,156 | | 187,181,244 |
| 2016 | | | | |
| Beer | 50.0 | 57,367,167 | 1.29 | 78,368,553 |
| Distilled spirits | 34.3 | 50,051,926 | 1.53 | 63,391,184 |
| Wine | 15.7 | 13,569,549 | 4.10 | 77,925,849 |
| Total | | 120,988,642 | | 219,685,587 |
| Total, underage youths and adults combined | | | | |
| 2011 | | 124,505,600 | | 208,066,069 |
| 2016 | | 132,390,613 | | 237,136,797 |

Notes: No. = number. ^aUnderage youth percentage of market from ABRAND and adult percentage of market from Impact Databank after subtracting drinks reported to be consumed by underage youth; ^bcalculated as the total number of drinks sold in the United States (from Impact Databank) × % of market adult/underage youth (from the Youth Risk Behavior Survey, Behavioral Risk Factor Surveillance System, National Survey on Drug Use and Health) × % of market (from Impact Databank and ABRAND) and corrected for underreporting by beverage type; ^cfrom DiLoreto et al. 2012, cost per drink updated using a consumer price index for all urban consumers alcoholic drinks of (2016 CPI / 2011 CPI = 242.53 / 226.69 = 1.07).

accounting for \$17.5 billion in sales revenue. To validate our estimates, we compared our calculated total sales figures with actual sales figures. Our estimated 2011 sales were \$10.4 billion higher than the actual sales (\$197.6 billion actual vs. \$208.0 billion estimated), and in 2016 our figure was \$2.0 billion lower than the actual sales (\$235.1 billion vs. \$237.1 billion) (Impact Databank, 2017b). We further compared our 2011 figure with Foster et al.'s (2003) estimate, and it was lower (10.0% vs. 17.5%). BRFSS data show that prevalence of alcohol use among youth declined considerably over this period (from 44.9% of high school students in 2003 to 38.7% in 2011, and 32.8% by 2015) (CDC, 2020), accounting for some of the difference; the remainder is likely attributable to methodological decisions we made in a more conservative direction.

Three alcoholic beverage parent companies—AB InBev, Miller Coors, and Diageo—accounted for 44.7% of the volume of alcohol sales attributable to underage youth. This reflects the high degree of concentration in the U.S. beer

market: AB InBev and Miller Coors together account for two thirds of both market volume and advertising expenditure. Diageo is the largest seller of spirits, with 49% of volume and 12% of ad spending among spirits companies. The dominance of these companies in terms of volume makes their advertising cost per unit sold lower than their competitors, helping their products to dominate consumption in both youth and adult markets (Jernigan & Ross, 2020).

This study is subject to several limitations. The main limitation is that our final estimates hinge on our analytic decisions. We have endeavored to minimize bias, be conservative, and remain transparent about the consequences of these decisions by providing a supplemental appendix, although it was not logistically feasible to provide results for every possible permutation of calculation. Of our adjustments, using the median instead of the mean had the largest consequence for our estimates and it was conservative, reducing the size of the estimated proportion of alcohol and commercial sales attributable to underage youth.

TABLE 3. Youth market share and sales revenue from sales to underage youth ages 12–20 by alcoholic beverage company, 2011 and 2016

| Parent company | Youth market share, % ^a | | | Sales revenue from alcoholic beverages consumed by youth, thousand \$ | | | Total |
|--------------------------|------------------------------------|-------------------|-------|---|-------------------|---------|-----------|
| | Beer | Distilled spirits | Wine | Beer | Distilled spirits | Wine | |
| 2011 | | | | | | | |
| AB InBev | 20.38 | 0.87 | 0.00 | 2,689,333 | 111,356 | 0 | 2,800,690 |
| MillerCoors | 12.34 | 0.00 | 0.00 | 1,466,808 | 0 | 0 | 1,466,808 |
| Diageo | 5.35 | 5.62 | 0.09 | 1,356,878 | 1,159,905 | 32,074 | 2,548,858 |
| Bacardi | 0.00 | 3.92 | 0.00 | 196,519 | 561,296 | 0 | 757,815 |
| Pernod Ricard | 0.71 | 3.23 | <0.01 | 158,337 | 514,314 | 1,193 | 673,845 |
| Brown-Forman | 1.19 | 2.12 | 0.33 | 319,386 | 332,601 | 109,001 | 760,989 |
| E&J Gallo | 0.87 | 0.54 | 1.86 | 170,657 | 59,621 | 341,869 | 572,148 |
| Heineken | 2.89 | 0.00 | 0.00 | 522,754 | 0 | 0 | 522,754 |
| Beam, Inc. | 0.00 | 2.61 | 0.00 | 0 | 326,097 | 0 | 326,097 |
| Mike's Hard Lemonade Co. | 1.92 | 0.00 | 0.00 | 418,063 | 0 | 0 | 418,063 |
| 2016 | | | | | | | |
| AB InBev | | | | 2,100,420 | 86,971 | 0 | 2,187,392 |
| MillerCoors | | | | 1,145,605 | 0 | 0 | 1,145,605 |
| Diageo | | | | 1,059,747 | 905,907 | 25,050 | 1,990,706 |
| Bacardi | | | | 153,485 | 438,382 | 0 | 591,868 |
| Pernod Ricard | | | | 123,664 | 401,689 | 931 | 526,286 |
| Brown-Forman | | | | 249,447 | 259,768 | 85,132 | 594,347 |
| E&J Gallo | | | | 133,286 | 46,565 | 267,006 | 446,859 |
| Heineken | | | | 408,280 | 0 | 0 | 408,280 |
| Beam, Inc. | | | | 0 | 254,687 | 0 | 254,687 |
| Mike's Hard Lemonade Co. | | | | 326,515 | 0 | 0 | |

^aData from the Alcohol Branding among Underage Youth (ABRAND) Survey.

In addition, the ABRAND survey was fielded in 2011 and was the most recent source of data for youth beverage-specific consumption of which we were aware. On this basis, we performed the analyses for 2011 and 2016, but it is possible that the beverage choices for youth changed during this time, which could lead to an over- or underestimate of expenditures in the 2016 data. A shift toward greater consumption of beer would imply an overestimate, whereas a shift toward distilled spirits would imply an underestimate. It is also possible that brands shifted among the parent companies between 2011 and 2016; because of the high level of overall stability in brand ownership, we did not attempt to adjust for that.

The key implication of our findings is that, despite their stated commitment to reducing underage drinking, alcoholic beverage companies benefit from significant revenues as a result of this activity. The landmark 2003 report *Reducing Underage Drinking: A Collective Responsibility* (National Research Council and Institute of Medicine, 2004) included among its recommendations (Recommendation 7-1): "All segments of the alcohol industry that profit from underage drinking, inadvertently or otherwise, should join with other private and public partners to establish and fund an independent nonprofit foundation with the sole mission of reducing and preventing underage drinking." The report recommended a contribution of 0.5% of gross industry revenues; applying this to the individual companies' 2015 North American figures from annual reports results in \$78 million from AB InBev and \$26 million from Diageo (Anheuser-Busch InBev, 2016; Diageo plc, 2016).

There are other possible ways of redirecting this revenue from alcoholic beverage producers. Given that alcohol taxes have been demonstrated to reduce underage drinking (Elder et al., 2010; Wagenaar et al., 2009), an "unwanted revenues" tax on alcohol producers with funds dedicated to the funding of underage drinking prevention activities could serve the dual purpose of fulfilling the National Research Council and Institute of Medicine recommendation and acting as a prevention mechanism in and of itself.

Identifying the brands of alcoholic beverages underage youth choose, the level of consumption of each brand, and the prices of those brands has allowed us to estimate the revenues attributable to alcohol companies from alcohol consumption by underage youth. Our findings point to the importance of continually monitoring youth alcohol consumption by brand, calling attention to policies that recover these revenues from the industry, and using them to achieve the goal of preventing youth alcohol consumption.

Conflict-of-Interest Statement

The authors declare no conflicts of interest.

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