Tax Design, Efficiency, and Incidence in Sports Betting*

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Abstract

Most U.S. states with legal sports betting tax sportsbook revenue. We show that this ad valorem tax behaves like a profits tax because sportsbooks' costs per dollar wagered are small. Sportsbooks do not raise the price of betting in high-tax states. Instead, they spend less on local TV advertising. We estimate the effects of these advertising reductions on sportsbook deposits. We compare the ad valorem tax to a specific tax, accounting for tax-induced advertising reductions and gambling internalities. The specific tax would increase prices and discourage more betting, but its corrective benefits do not outweigh its conventional efficiency costs.

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1 Introduction

As of 2025, 39 states have legalized sports betting, and Americans wager over $165 billion on sports per year, more than on state-run lotteries (North American Association of State and Provincial Lotteries, 2025; American Gaming Association, 2026). State governors often cite tax revenue as a justification for legalization; Kentucky governor Andy Beshear pitched it as a way to raise revenue "without raising taxes on working families" (Beshear, 2020). Most tax revenue from sports betting is raised by a tax on sportsbooks' revenue. These taxes raised over $3B in 2025 at tax rates ranging from Iowa's 6.75% to New York's 51%. In New York's 2026 fiscal year, sports betting tax revenue exceeded combined state alcohol and tobacco tax revenues (New York State Gaming Commission, 2026; Office of the New York State Comptroller, 2026).

But legal sports betting also imposes unpriced harms. Past work has shown that household balance sheets deteriorate when states legalize sports betting (Baker et al., 2024; Hollenbeck, Larsen and Proserpio, 2025). Some bettors exhibit signs of compulsive consumption or addiction, and many bettors underestimate the financial costs of betting (Potenza et al., 2019; Brown, Grasley and Guido, 2025). These harms are a corrective rationale for taxing sports betting.

Corrective and revenue-raising motives for taxation are generally in tension. A corrective tax only benefits society to the extent that it reduces the harmful activity, but tax-induced consumption reductions erode the tax base and limit the revenue raised. In this paper, we combine simple theory and new data to study how ad valorem taxes on sports betting affect consumers and sportsbooks. We then evaluate the tax's welfare consequences relative to a specific tax on dollars wagered.

We first define prices, quantities, and revenues in the sports betting industry.[1] Sportsbooks post odds for sporting events and take wagers at those odds. These odds are not actuarially fair. Instead, sportsbooks set odds so that a bettor wagering a dollar on each side of a bet is guaranteed to lose money. In the U.S., a dollar wagered results in an average loss of about 9.5 cents; this average loss is the price (p). Quantities (Q) are defined as total dollars wagered. Revenue (pQ) is the product of price and dollars wagered. The distinction between Q and pQ is worth emphasizing because, unlike in most industries, both are denominated in dollars. Suits (1979) captures this distinction: "the total volume of wagers handled is no more 'revenue' to a betting establishment than the total value of houses traded constitutes 'revenue' to a real estate agent."

[1] Prediction markets such as Polymarket and Kalshi, which began listing sports contracts in 2025 and claim exemption from state betting taxes, are outside this paper's scope.

We begin by presenting a model of taxation in an imperfectly competitive market with advertising that guides our empirics. With zero marginal cost, an ad valorem tax leaves the optimal price unchanged but lowers optimal advertising. The optimal price is unchanged because an ad valorem tax behaves like a profits tax — a result that holds in any standard model with zero marginal cost. We think this implication is underappreciated, despite being known since at least Cournot (1838) in the monopoly case.[2] Advertising is different: the tax reduces after-tax marginal revenue per unit of advertising but not its cost, so optimal advertising falls. This mechanism mirrors classic results showing ad valorem taxes distort product quality more than specific taxes (Barzel, 1976). A specific tax should still pass through to prices, as is standard, because it simply acts as a marginal cost increase. To evaluate welfare, we develop sufficient statistics for efficiency and incidence. Welfare effects depend on whether tax-induced quantity reductions arise because of price increases or ad reductions. Price increases eliminate marginal units with positive producer surplus. Ad reductions, by contrast, eliminate units with zero producer surplus, since the marginal dollar of ad spending yields zero profit for an optimizing firm.

Our first contribution is to show empirically that ad valorem taxes on sports betting do not affect prices. For a given event, sportsbooks set the same odds in every state, regardless of the tax rate. But conditional on these uniform odds, sportsbooks could still raise average prices in high-tax states through two channels. First, they could tilt the menu of wagers offered in high-tax states toward worse-odds bets. Even though everyone would see the same price for the same wager, the dollar-weighted average price faced by a high-tax state's bettors would rise. Second, sportsbooks could raise their single national price in response to a higher national average tax. We find that sportsbooks did not raise prices in response to ad valorem taxes through either channel. As a contrast, a per-wager tax in Illinois shows that sportsbooks passed the tax through as an add-on fee, qualitatively consistent with the model.

Our second contribution is to show causally that a tax increase reduces advertising expenditure by sportsbooks. We show that after a 14 percentage-point increase in the ad valorem tax rate in Illinois, local TV advertising in Chicago fell by 32% compared to a synthetic control. In a separate cross-sectional analysis across states, a one-percentage-point increase in the ad valorem tax rate is associated with a decline of roughly 2.0% of the cross-state mean. Several sportsbook CEOs have discussed lowering marketing spend in high-tax states during earnings calls, including in response to the Illinois tax change we study. We collect

[2] *In this case, if the commodity were produced and delivered without appreciable cost between producer and consumers, the price being determined by the condition that the producer shall derive the greatest possible profit... the presence of the constant factor* $(1-n)$ *will not alter the value of* p *in the least; the tax will fall wholly on the producer, and might go so far as to absorb all his net income.* (Cournot, 1838)

new data on sportsbooks' promotional sign-up offers and show that these are also lower in high-tax states. The findings are consistent with our model's prediction that ad valorem taxes reduce the incentive to advertise, and they highlight that the effect of ad valorem taxes on quantities depends on how sensitive demand is to advertising.

Our third contribution is to provide the first causal estimate of the effect of local TV advertising on demand for sports betting. We exploit plausibly exogenous variation in exposure to ads, an identification strategy pioneered by Shapiro (2018). We use microdata on credit card transactions to measure deposits to sportsbooks. We find an ad semi-elasticity for sports betting deposits similar to his estimate for pharmaceuticals and to estimates for consumer packaged goods (Shapiro, Hitsch and Tuchman, 2021). We also show sports betting ads operate primarily on the extensive margin (getting people to deposit at all) rather than the intensive margin (raising deposits per customer).

Our fourth contribution is to quantify the welfare effects of the ad valorem tax on sports betting compared to a specific tax on dollars wagered, the standard corrective tool for goods with unpriced harms. To our knowledge, existing evaluations of sin taxes generally exclude the corrective role of tax-induced reductions in advertising, with Abi-Rafeh et al. (2025)'s study of the soda industry being one notable exception. We use our empirical evidence to discipline sufficient statistics related to advertising and calibrate others from the literature. We calibrate the internality to Brown, Grasley and Guido (2025)'s estimate of 4.97 cents per dollar wagered, i.e., bettors act as if the price of wagering \$1 was less than half of the true average price (9.46 cents 2023–2025).

On conventional efficiency grounds (ignoring the internality) the ad valorem tax is superior to the specific tax, because it barely distorts quantity. But this also means it has minimal corrective benefits. For a marginal dollar of revenue raised, the specific tax causes a reduction in dollars wagered 7.4 times as large as the ad valorem tax. Despite the larger corrective benefits of the specific tax, the ad valorem tax is more efficient. Markups are large in this industry, and specific taxes have higher efficiency costs in the presence of such market power (Delipalla and Keen, 1992). Furthermore, most of the incidence of the ad valorem tax is on firms, which is desirable if a planner places a higher welfare weight on consumer surplus than firm profits. If internalities were more than 1.9 times our calibrated value, the specific tax would be more efficient.

Relationship to Literature

Our most direct contributions are to the literature on the regulation of gambling. Many papers have documented the consequences of legalized gambling, including a growing literature focused on online sports betting.[3] But conditional on legalization, much less is known

[3]Recent evaluations of the consequences of legalized sports betting in the U.S. include Baker et al. (2024);

about how other public policies shape betting markets. We document the effects of tax policies and conduct a quantitative welfare analysis of those policies.[4] We also provide the first causal estimates of the effects of sports betting advertisements on sports betting, at a time when regulators are debating restrictions on those advertisements.[5]

We provide novel evidence that commodity taxes influence the incentive to advertise. Though this prediction follows naturally from many models of advertising, it has received surprisingly little empirical attention. A public health literature has examined the effects of taxes on sugary beverage marketing and reached mixed conclusions.[6] Sports betting is an ideal context to test for such effects, because advertising is a large component of firm spending and tax rates vary widely across states. Our analysis therefore provides some of the cleanest evidence to date of advertising responses to taxes, complementing other work on non-price margins of adjustment to commodity taxes.[7]

Our analysis of tax design, efficiency, and incidence extends an old public finance literature comparing ad valorem and specific taxes.[8] There are two distinctive features of our paper. First, we allow for endogenous advertising responses to product taxes. To our knowledge, Abi-Rafeh et al. (2025) is the only other paper to incorporate this channel in a quantitative welfare analysis.[9] Second, we study a context where the differences between ad

Hollenbeck, Larsen and Proserpio (2025); Goss and Mangrum (2026); McCarthy, Taylor and Wilbur (2026) and Matsuzawa and Arnesen (2024).

[4]In an evaluation of U.K. gambling taxes, Paton, Siegel and Vaughan Williams (2002) anticipate our point that the consequences of taxes on wagers will differ from the consequences of taxes on revenues. We are also aware of two recent empirical papers about taxation of sports betting. Larsen, Vijayaraghavan and Ananthakrishnan (2025) shows that sports betting revenues partially cannibalize revenues from state-run lotteries. Kasinger (2026) studies the pass-through of a specific excise tax in Germany, focusing on differences between firms that choose to pass the fee on as an add-on price vs. those that increase posted odds. Neither paper focuses on the implications of tax design, nor do they conduct quantitative welfare analysis.

[5]For example, in 2025, the SAFE Bet Act was introduced in Congress. This bill would impose a federal prohibition on sports betting TV ads from the hours of 8:00 AM to 10:00 PM and during live sports event broadcasts (Tonko, 2025).

[6]This literature is summarized in Abi-Rafeh et al. (2025). Work suggesting that taxes reduce marketing includes Lee et al. (2024) and Forde et al. (2022), while work finding null effects includes Hua et al. (2024); Asa et al. (2023); Zenk et al. (2020), and Zenk et al. (2021). Keller, Guyt and Grewal (2024) also find that the introduction of a sugary beverage tax reduces short-term promotional discounts for sugary beverages.

[7]Empirical studies have documented non-price adjustments through channels including changes in quality (Barzel, 1976; Sobel and Garrett, 1997), product reformulation (Dickson, Gehrsitz and Kemp, 2025), and product variety (Cawley et al., 2020; Kroft et al., 2024).

[8]Seminal papers include Suits and Musgrave (1953), who show that ad valorem and specific taxes are equivalent under perfect competition but ad valorem taxes are preferred under monopoly, and Delipalla and Keen (1992), who extend this comparison to oligopoly and show that ad valorem taxation is generally preferred under imperfect competition.

[9]Unlike our paper, Abi-Rafeh et al. (2025) does not provide reduced-form evidence on the effects of taxes on advertising. Instead, they estimate demand and ad elasticities for various groups, which they embed in a structural model to conduct counterfactual simulations in which firms' advertising responds endogenously to taxes.

valorem and specific taxes are unusually stark, since sports betting prices primarily consist of markups rather than marginal costs.

The rest of the paper proceeds as follows. Section 2 provides institutional context. Section 3 presents a model of sportsbook taxation. Section 4 describes our data. Section 5 presents results on how firms respond to taxes. Section 6 studies how marketing influences demand. Section 7 calibrates the efficiency of prevailing sports betting taxes and compares to a hypothetical specific tax on dollars wagered. Section 8 concludes.

2 Market Structure and Unit Economics of the Sports Betting Industry

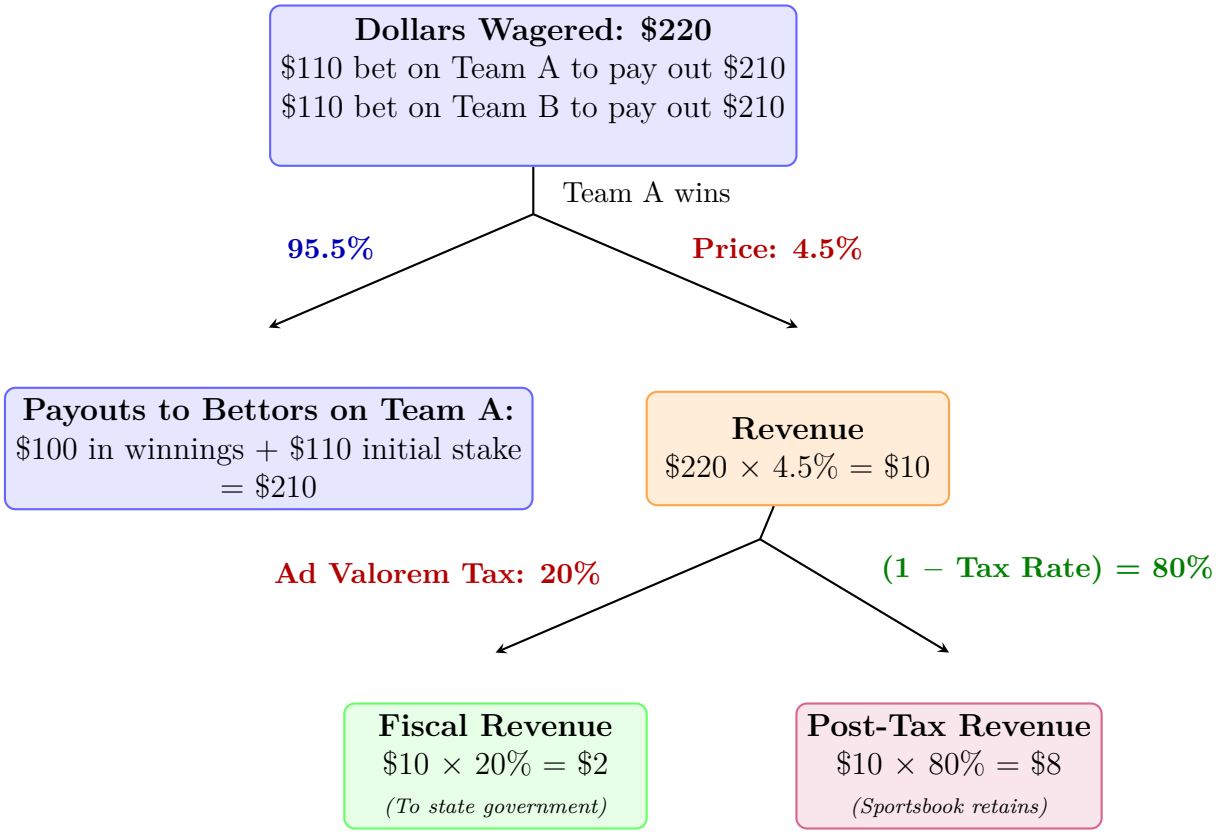
The sports betting market is dominated by a few national firms. As of August 2025, 65% of dollars were wagered at two firms: FanDuel and DraftKings, as Table A.1 shows. 97% of dollars were wagered at one of eight firms. This concentration is bolstered by entry regulation; for example, Oregon, New Hampshire, and Rhode Island allow only one sportsbook to operate.

To trace through how a sportsbook makes money, we consider a stylized example in Figure 1. \$220 is wagered on a contest between evenly matched teams, with \$110 bet on each side. The \$220 wagered is the quantity. The odds offered determine the price. A common odds offer by sportsbooks would pay out \$210 (the \$110 stake plus \$100 in winnings) to the winning bettor while the losing bettor loses their stake. Regardless of who wins, the sportsbook's revenue ($p \cdot Q$) is \$10, so the price to wager a dollar is 4.5% (p =\$10/\$220). In almost every state, sportsbook revenue is the tax base. In Figure 1, the ad valorem tax rate is 20%; the sportsbook pays \$2 in taxes and retains \$8 to cover expenses such as advertising, promotional credits, salaries, and technology costs.

While ad valorem taxes are the dominant form of taxation of sportsbooks, two states assess other types of taxes.[10] Illinois has both an ad valorem tax and a per-wager tax. Tennessee assesses a specific tax of 1.85 cents per dollar wagered. States also differ in whether promotional credits are deductible from the ad valorem tax base. This deductibility can cause appreciable effects on the *effective* tax rate firms pay, because as Table A.2 shows, these promotional credits are large. For example, Pennsylvania and Michigan allow full deductibility of promotional credits, but New York does not allow any deduction. In addition to state taxes, all sportsbooks, online and retail, pay a federal excise tax of 0.25% on dollars wagered, equivalent to 25 cents per \$100 bet.

[10] Figure A.1 lists each state's ad valorem tax rate.

Figure 1. Example Sports Betting Revenue Flow



Notes: The scenario simulates a 20% ad valorem tax. This diagram excludes all sportsbook expenses other than payouts, such as advertising, promotional credits, salaries, and technology costs.

We can distinguish two types of marginal costs for sportsbooks. For a customer who already has an account, there is a *production cost* to provide one unit of quantity (a dollar wagered). There is also a cost to acquire that customer; we call this cost *marketing*. More than 96% of dollars wagered nationwide in 2025 were placed online (Gouker, 2026).

Because sports betting is mostly done online, production costs are small. Of the large sportsbooks, DraftKings offers the most detailed cost breakdown in its 10-K. Its gross margin, before state ad valorem taxes, was at least 80 cents per dollar of revenue.[11] The remaining 20 cents includes expenses like payment processing fees and chargebacks (when a customer disputes a credit card charge after wagering or withdrawing the money). The 80 cent figure is a lower bound: DraftKings records revenue-sharing payments to certain states as costs, but these function economically as taxes.

Sportsbook marketing costs are large; they consist of advertising and promotional credits. In 2025, DraftKings spent 18.6% of revenue on advertising and Flutter (FanDuel's parent company) spent 12.5%. The average large firm spends only 2.4% of revenue on paid media (Gartner, 2025). Even these figures understate how advertising-intensive sports betting is because accounting revenue overstates the revenue available to sportsbooks, as they must also pay state gaming taxes. DraftKings, the only sportsbook that breaks out state taxes in its financial filings, spends 28.5% of (revenue minus state gaming taxes) on advertising.[12] Even looking at sales and marketing—a broader category that includes advertising—only six NAICS industries average more than 12.5% of revenue (He, Mostrom and Sufi, 2025).[13]

Promotional credits grant money to the bettor, or in some cases, increase the payout for a given bet. Examples include bonus bets (a free stake where the user keeps the winnings if the bet wins), deposit matches (the sportsbook matches a user's cash deposit), no-risk bets (the user is refunded if their bet loses), and odds boosts (an increased payout on a specified wager). Promotional credits fall into two categories: large sign-up offers for first-time bettors, worth over $500 at several sportsbooks, and smaller ongoing bonuses to retain customers. We estimate that DraftKings spent between $727M and $1.19B on promotional credits in 2024, and FanDuel spent between $726M and $1.33B. These figures imply sportsbooks' spending on promotional credits ranges from 36.9% to 113.5% of their advertising spend. We outline

[11] We compute this by (i) taking DraftKings' GAAP gross margin of 41%, which treats state gaming taxes as a cost, (ii) adding back state gaming taxes (35% of revenue), and (iii) adding back depreciation, amortization, and stock compensation (4% of revenue, combined), which we view as fixed costs.

[12] Source: 2025 10Ks. DraftKings spent $1.125B on advertising (18.6% of $6,054.5M revenue; 28.5% of $3,943.9M revenue net of $2,110.6M gaming taxes); Flutter Entertainment (FanDuel's parent company) spent $2B globally across all brands.

[13] These industries are: medical equipment manufacturing (339); ground passenger transit (485); educational services (611); information services (519); publishing industries (513); and computing infrastructure providers, data processing, web hosting, and related services (518).

the assumptions going into this calculation in Table A.2.

3 Model

We now develop a model of a market with differentiated products, advertising, and biased consumers. Our model extends the sufficient statistic approach to sin taxes (Allcott and Taubinsky, 2015; Allcott, Lockwood and Taubinsky, 2019) to a setting with market power and advertising. We discuss how this model connects to sports betting markets and review three standard points about the effects of ad valorem and specific taxes in our context. Then, we show that the effects of tax-induced advertising reductions on demand are central to tax incidence and efficiency, which motivates our empirical analysis.

3.1 Setup

We study an industry with N symmetric, but differentiated, firms. Each firm produces a single product, so we index firms and their products by i. Each firm chooses a price $p_i \geq 0$ and level of advertising $A_i \geq 0$. A representative consumer makes a static consumption decision, choosing quantities $(Q_1, \ldots, Q_N)$ of the N products and a numeraire good x, given firm decisions and an exogenous income y. We assume quasilinear utility and normalize the price of the numeraire to one. Doing so lets us define money-metric utility from non-numeraire consumption as $V(Q_1, \ldots, Q_N; A_1, \ldots, A_N)$. We assume this V is concave in each product ($V_{Q_iQ_i} < 0$) and that advertising for product i makes people choose as if product i is more valuable ($V_{Q_iA_i} > 0$). We do not make any assumptions on $V_{Q_iA_{-i}}$; advertising of product i could have positive or negative spillovers to the demand for other products. Putting everything together, the consumer chooses to maximize the following function:

$$U(Q_1, \ldots, Q_N; A_1, \ldots, A_N) = V(Q_1, \ldots, Q_N; A_1, \ldots, A_N) + y - \sum_i^N p_i Q_i \tag{1}$$

We restrict attention throughout to symmetric equilibria, so we write demand for product i as a function of own and rival prices and advertising, $Q_i(p_i, p_{-i}, A_i, A_{-i})$. Our assumptions on V imply that the demand for product i slopes downward in own price and shifts outward in own advertising.

We refer to the consumer's maximand as the *decision utility function*.

Each firm faces constant marginal production cost $\kappa \geq 0$. Advertising costs are $c(A_i)$ with $c'(0) = 0$ and $c''(A_i) > 0$, reflecting an upward-sloping supply curve in the ads market.

Pre-tax profits for firm i are thus:

$$\pi_i = (p_i - \kappa)\, Q_i(p_i, p_{-i}, A_i, A_{-i}) - c(A_i).$$

To remain relatively agnostic on market structure, we parameterize firms' symmetric markup by an exogenous conduct parameter $\theta \geq 0$ (following Bresnahan (1989)). The conduct parameter is characterized by an elasticity-adjusted markup condition, where $\theta = 0$ yields the perfect competition price and $\theta = 1$ yields the monopoly price. We define the market demand elasticity with respect to the symmetric price p (the common price when all firms set $p_i = p$) as $\varepsilon_Q(p) \equiv -pQ'(p)/Q(p)$ and characterize θ as:

$$\frac{p^* - \kappa}{p^*}\, \varepsilon_Q(p^*) = \theta$$

We assume throughout that θ is constant, although this rules out certain models of pricing, including those derived from discrete choice with an outside option, such as standard differentiated-products Bertrand (Weyl and Fabinger, 2013).

We make three regularity assumptions to ensure a unique optimum exists: (i) $\varepsilon_Q(p)$ is strictly increasing in p (Marshall's Second Law, Marshall (1920)) with $\varepsilon_Q(p) \to 0$ as $p \to 0$ and $\varepsilon_Q(p) \to \infty$ as $p \to \infty$; (ii) a firm's marginal return to advertising is weakly decreasing in total industry advertising, $\sum_j \partial^2 Q_i / \partial A_j \partial A_i \leq 0$; and (iii) Q_i is twice continuously differentiable in p_i.

3.2 Effects of taxes in sports betting markets

We now explore how sportsbooks are likely to respond to each type of tax. In the sports betting industry, firms have minimal variable production costs, likely no more than 20% of revenue. The important costs for sportsbooks are either advertising costs or fixed costs that do not scale with dollars wagered. To make the implications of this cost structure stark, we assume the limiting case of zero marginal cost.

Assumption 1: Zero marginal costs. $\kappa = 0$

We also assume that demand is multiplicatively separable in prices and advertising.

Assumption 2: Multiplicative separability of demand. *For each firm i,* $Q_i = f(p_i, p_{-i}) \cdot g(A_i, A_{-i})$

This is the minimal restriction that ensures a firm's optimal price does not depend on the level of advertising. It implies that advertising does not affect the price elasticity of demand.[14]

[14] Dubois, Griffith and O'Connell (2018) is one of the few studies with data rich enough to quantify how

Multiplicative separability follows from some simple models of informative advertising, along the lines of Butters (1977). Consider the following microfoundation. We focus on the single-product world for exposition ($N = 1$). There is a unit mass of consumers, each of whom may be aware or unaware of the product. If a consumer is aware of the product, they consume according to an individual demand curve $f(p)$ and derive individual decision utility $v(f(p))$. If they are unaware, they do not consume. The share of aware consumers $g(A)$ depends on advertising. In this model, aggregate demand is multiplicatively separable, $Q(p, A) = f(p) \cdot g(A)$. Assumption 2 concerns only observed demand and decision utility. For now, we remain agnostic about the welfare effects of advertisements.

We now show how taxes affect firm choices. The government can choose to levy either an ad valorem tax or a specific tax. With an ad valorem tax, revenue is taxed at an exogenous rate $\tau \in [0, 1)$. We assume that advertising costs are not tax deductible, consistent with the tax treatment of sportsbook TV advertising in all U.S. states. After-tax profits are therefore

$$\pi_i = (1 - \tau)\, p_i\, Q_i(p_i, p_{-i}, A_i, A_{-i}) - c(A_i)$$

With a specific tax, the firm is charged t per dollar wagered, so after-tax profits are

$$\pi_i = (p_i - t)\, Q_i(p_i, p_{-i}, A_i, A_{-i}) - c(A_i)$$

The following proposition characterizes how these different kinds of taxes affect equilibrium prices and advertising.

Proposition 1. *Given Assumptions 1 and 2, firms respond to taxes as follows.*

(i) For an ad valorem tax, the symmetric equilibrium price p^* is independent of the tax rate τ.

(ii) For a specific tax, the symmetric equilibrium price p^* increases with the tax rate t.

(iii) For the ad valorem tax, the symmetric equilibrium advertising A^* is strictly decreasing in the tax rate.

We provide a proof in Appendix D.1. To understand the logic, begin with ad valorem

advertising shifts price elasticities. Their study of the potato chips market finds that setting a brand's advertising to zero would raise the absolute value of that brand's price elasticity by only 1–3%, or 0.01–0.07 in elasticity units.

taxes and consider symmetric first-order conditions for prices and advertising.

$$\text{Price FOC:} \quad (1-\tau)\Big[\theta\, Q(p^*) + p^*\, Q'(p^*)\Big] = 0 \iff 1 - \frac{\theta}{\varepsilon_Q(p^*)} = 0 \tag{2}$$

$$\text{Ads FOC:} \quad (1-\tau)\, p^*\, \frac{\partial Q_i}{\partial A_i}(p^*, A^*) = c'(A^*). \tag{3}$$

In condition (2), which pins down the firm's optimal price, the tax rate τ drops out as it is a scalar multiplier on the FOC. The tax also does not influence prices indirectly through advertising under Assumption 2. So prices do not depend on τ. Condition (3) sets the marginal benefits of advertising equal to the marginal costs. An increase in τ reduces the marginal benefit of advertising, because the firm keeps less of the revenue that it "buys" with ads. As such, firms advertise less.

Assumption 1 is important for these results. To see why, suppose that the firm had positive marginal costs $\kappa > 0$. After-tax profits can be rearranged as:

$$\pi_i = (1-\tau)\left[p_i - \frac{\kappa}{1-\tau}\right] Q_i(p_i, p_{-i}, A_i, A_{-i}) - c(A_i).$$

The symmetric pricing FOC under conduct θ becomes

$$\frac{p^* - \kappa/(1-\tau)}{p^*}\, \varepsilon_Q(p^*) = \theta. \tag{4}$$

So, implication (i) of Proposition 1 does not hold in industries with non-trivial production costs. The firm prices at a mark-up over its *effective* marginal cost, $\kappa/(1-\tau)$, which is increasing in τ. For example, Hollenbeck and Uetake (2021) find positive pass-through of an ad valorem tax on cannabis revenue. Appendix D.2 shows price is strictly increasing in the ad valorem tax rate whenever marginal cost is positive.

Unlike ad valorem taxes, specific taxes do affect prices even with zero marginal costs. A specific tax t per dollar wagered enters the profit function in exactly the same way as a marginal cost of t. For a firm with zero marginal costs, the firm problem under a specific tax is therefore identical to its problem with no ad valorem tax and marginal cost $\kappa = t$ in equation (4). Effective marginal cost rises one-for-one with t, and p^* is a markup over it. This implication is consistent with the introduction of a specific tax on sports betting in Germany, which passed through via add-on fees at a rate of 76% (Kasinger, 2026).

3.3 Incidence and efficiency

We now turn to the welfare effects of taxes. For sports betting, decision utility may not capture all welfare effects of consumption. There may be externalities (like harms borne by nonbetting members of the household) or internalities (like misperceptions of financial costs). We incorporate externalities and internalities simultaneously by defining an *uninternalized damage function* $\Gamma(Q)$, where $Q = \sum_i Q_i$ denotes aggregate industry consumption. The damage function Γ measures uninternalized harms from consumption in dollar units. For a good with no externalities where consumers have behavioral biases, Γ can be interpreted as the wedge between the decision utility function (1) and the *normative utility function*, which the consumer would maximize if they did not have any biases (Allcott, Lockwood and Taubinsky, 2019). If the normative utility function is $W(Q_1, \ldots, Q_N; A_1, \ldots, A_N)$, then $\Gamma = V - W$. This expression assumes that externalities and internalities depend only on aggregate consumption Q, not on how consumption is distributed across firms.

To compare tax designs, we develop formulas for the impacts of raising a marginal dollar of tax revenue on consumers, firms, and uninternalized harms. Unlike our predictions of firm responses in sports betting markets (Proposition 1), these formulas do not depend on Assumptions 1 and 2. We are interested both in *efficiency*, which we measure with the total burden across consumers and firms per dollar of revenue raised, and *incidence*, which we measure with the relative burden on consumers vs. sportsbooks.

The first set of sufficient statistics are reduced-form "tax semi-elasticities." We define η_j^{Tot} as the total semi-elasticity of quantity with respect to tax j – that is, when tax instrument j rises by one unit, gambling consumption falls by $\eta_j^{Tot}\%$.[15] The index j indicates either the specific tax t or the ad valorem tax τ. We decompose η_j^{Tot} into an advertising channel and a price channel: $\eta_j^{Tot} = \eta_j^A + \eta_j^P$, where $\eta_j^A = -\frac{1}{Q}\frac{\partial Q}{\partial A}\frac{dA}{dj}$ allows ads to change while prices are fixed, and $\eta_j^P = -\frac{1}{Q}\frac{\partial Q}{\partial p}\frac{dp}{dj}$ allows prices to change while ads are fixed.

We now define a few more bits of notation. We define the revenue raised per unit of quantity at the existing tax regime, z_j, and producer surplus on a marginal unit, net of taxes, $m_j = p - \kappa - z_j$. Let $\omega_j \equiv \frac{\partial z_j}{\partial j}$ denote the "mechanical" impact of a tax on revenues, ignoring behavioral responses ($\omega_\tau = p$, $\omega_t = 1$). A tax-induced price change can also move per-unit revenue, so the total marginal revenue per unit is $\frac{dz_j}{dj} = \omega_j + \frac{\partial z_j}{\partial p}\frac{dp}{dj}$. The marginal uninternalized damages from consumption in dollar units are $\Gamma_Q(Q)$.

We must take a stand on the welfare effects of advertising. There is no standard approach to this issue in the literature. In some models, advertising benefits consumers by informing them (Stigler, 1961) or by entering utility as a complement to the product (Becker and

[15] Our sign convention is that all semi-elasticities are positive, even though consumption falls in response to tax increases.

Murphy, 1993). In others, advertising modifies the utility function, so has ambiguous welfare effects (Dixit and Norman, 1978). We are not aware of empirical evidence that settles the normative interpretation of advertising, nor do we provide such evidence. We assume advertising has no direct effect on decision consumer surplus; it influences welfare only through consumption it induces.

Assumption 3: Advertising does not benefit consumers. *$dU/dA_i = 0$ for all A_i.*

Assumption 3 is pessimistic about the welfare effects of ads, so both tax instruments will look more efficient than under alternatives in which advertising benefits consumers. Proposition 2 states our formulas for marginal tax burdens in terms of measurable sufficient statistics.

Proposition 2. *Given Assumption 3, the following expressions report the ratios of surplus effects to revenue raised from a marginal increase in tax instrument j. The first three expressions give changes in disaggregated surplus components; the final expression gives the marginal excess burden, for which the numerator is the change in total surplus.*

1. *Decision consumer surplus:*

$$\frac{-\frac{dp}{dj}}{\frac{dz_j}{dj} - z_j \cdot \eta_j^{Tot}} \tag{5}$$

2. *Producer surplus:*

$$\frac{(\frac{dp}{dj} - \frac{dz_j}{dj}) - m_j \cdot \eta_j^{P}}{\frac{dz_j}{dj} - z_j \cdot \eta_j^{Tot}} \tag{6}$$

3. *Externalities and internalities:*

$$\frac{\Gamma_Q(Q) \cdot \eta_j^{Tot}}{\frac{dz_j}{dj} - z_j \cdot \eta_j^{Tot}} \tag{7}$$

4. *Marginal excess burden*

$$\frac{-z_j \cdot \eta_j^{Tot} - m_j \cdot \eta_j^{P} + \Gamma_Q(Q) \cdot \eta_j^{Tot}}{\frac{dz_j}{dj} - z_j \cdot \eta_j^{Tot}} \tag{8}$$

We provide a proof in Appendix D.3.

The formula for marginal excess burden (MEB) in equation (8) nests canonical expressions for MEB with pre-existing taxes and markups. In perfect competition with no ex-

ternalities, the typical Harberger calculation gives an MEB of $\frac{-z_j \cdot \eta_j^{Tot}}{\frac{dz_j}{dj} - z_j \cdot \eta_j^{Tot}}$. The tax creates deadweight loss to the extent that it reduces quantities, through any channel. When firms charge markups, tax-induced price increases are more socially costly because they push price further above marginal cost. The $-m_j \cdot \eta_j^P$ term in the numerator of equation (8) captures this effect. Since only the price-channel elasticity appears in this term, the total quantity response is not a sufficient statistic for the welfare cost of a tax: two taxes with the same η_j^{Tot} impose different costs depending on whether the quantity reduction comes from the price or the advertising channel. Reductions through the price channel are costly, since each forgone unit destroys the net-of-tax margin m_j. Units forgone through reduced advertising are offset by saved advertising expenditure.

The standard result that the incidence of a tax depends on its impact on prices also carries through in our setting for both taxes, as $\frac{dp}{dj}$ appears negatively in the decision consumer surplus equation (5) and positively in the producer surplus equation (6). As usual, these price effects do not appear in the MEB equation because they represent transfers that cancel when summing surplus components.

Our MEB expression (8) accounts for a tax's corrective benefits. A marginal unit of quantity reduction, through either the price or the advertising channel, reduces uninternalized damages by $\Gamma_Q(Q)$. The magnitude of these corrective benefits will be larger when taxes affect consumption more.

Quantitative comparisons of taxes depend on the magnitudes of key sufficient statistics, some of which are unique to our setting. The extent to which taxes affect ads and ads affect demand do not typically appear in tax burden formulas, but in our setting they determine η_j^A and therefore η_j^{Tot}. Our empirical analysis provides evidence on the statistics in Proposition 2, so we can quantify the efficiency and incidence of sports betting taxes.

4 Data

Tax rates. We get state ad valorem tax rates for each state from the Tax Foundation. For states with graduated tax rates, we use the average tax rate, calculated as total tax revenue divided by total sportsbook revenue.

State aggregate quantities and revenues. For aggregated dollars wagered, tax revenue, and sportsbook revenue by state, we use data from Legal Sports Report (Ramsey, 2025). State-level data reflects total regulated sports betting, combining online and retail channels; most states report only aggregated figures. Nationwide, more than 96% of dollars were wagered online in 2025 (Gouker, 2026). Because betting is overwhelmingly online, we focus on the 31 states and Washington, DC, where online sports betting is legal as of 2025. We exclude

Florida, Tennessee, Arkansas, and Rhode Island from our cross-state analyses. Florida does not report state-level revenue, likely because its only online book is tribal (Hard Rock), and Tennessee taxes dollars wagered rather than revenue; Arkansas and Rhode Island have no national operators. This leaves at most 27 states and DC for our analyses.

Prices. We use two price measures: realized state-level prices from regulator filings, computed as revenue divided by dollars wagered, and posted event-level NBA moneyline odds from the Odds API, a provider of odds data for professional sports bettors. We use odds from the 2021–2022 season. For each game, the data contains the odds offered by each major sportsbook, observed at approximately 11:00 AM Eastern on game day. We use NBA moneylines because they are a simple bet on the winner of a game, and because the NBA was the only major sport in season for at least two months before and after the tax increase we study in Section 5.1.

Marketing. We measure two types of marketing expenditure: television advertising and promotional sign-up offers.

Television advertising. For television advertising, we use Nielsen Ad Intel from 2018–2024. Nielsen Ad Intel provides this data by firm for each Designated Market Area (DMA). DMAs are media markets constructed by Nielsen which correspond to a set of counties that receive the same local TV broadcasts. Many papers in economics use this data to study exposure to advertising (Shapiro, Hitsch and Tuchman, 2021; Gentzkow et al., 2024; Bordalo et al., 2025). To our knowledge, this data has not previously been used in academic research on sports betting. For our sample, we focus on seven of the largest sportsbooks by market share: DraftKings, FanDuel, BetMGM, Caesars, BetRivers, Fanatics, and bet365, which together represent over 90% of dollars wagered (Table A.1). Figure 5c excludes Fanatics and BetMGM due to data limitations, and the ads semi-elasticity analysis in Section 6 applies additional sample restrictions described in Appendix C.1.1. We exclude ESPN Bet because it was rebranded to theScore Bet in late 2025.

Promotional offers. We build two new datasets of promotional offers. The first has cross-state variation, but no time variation. We scraped screenshots from sportsbooks' websites from January 23, 2026. These provide sign-up offers for each sportsbook by state. This data is a cross-sectional snapshot; to our knowledge, this is the first dataset of sportsbook promotional offers by state. The second is panel data, but does not contain cross-state variation. We constructed a panel of sportsbooks' new customer promotional sign-up offers from archival data. We scraped the Internet Archive's snapshots of Action Network, a promotional offer aggregator. For each sportsbook, we extract the offer displayed at the top of Action Network's page for that sportsbook. We have good coverage from July 2023 through November 2025 for three major sportsbooks: DraftKings, BetMGM, and FanDuel.

Promotional offers are not directly comparable in dollars: a $1,000 bonus bet cannot be converted to $1,000 USD with certainty because bonus bets pay out winnings but do not return the stake. To convert promotional offers to dollar values, we used conversion rates from DarkHorse Odds, a service which helps people take advantage of promotional offers. It has been covered in the Wall Street Journal (DarkHorse Odds, 2025; The Wall Street Journal, 2024). DarkHorse Odds converts promotional offers into their expected value in dollars: bonus bets are valued at $0.70 on the dollar and risk-free bets at $0.50 on the dollar. Table A.3 details each sportsbook's promotional offers and expected values in each state.

Deposits (quantity micro-data). In Section 6, we measure deposits to sports betting accounts using Consumer Edge, a panel of debit and credit card transactions with more than 93 million cards. This lets us see inflows into sports betting accounts, but not betting behavior. Consumer Edge's finest geography is the first 3 digits of the cardholder's billing zip-code (ZIP3), i.e., a collection of ZIP codes, so for most analyses we aggregate transactions to the sportsbook-ZIP3-month level. We benchmark Consumer Edge against state gaming commission data in Appendix C.2. We find that Consumer Edge deposits track state-level sportsbook revenues closely both over time (quarterly log correlation 0.97) and across states (cross-state log correlation 0.85), and that the New York legalization event is clearly visible in the Consumer Edge data. Larsen, Vijayaraghavan and Ananthakrishnan (2025) use state-month aggregates and validate that the budget share spent on gambling increased in a state when sports betting was legalized. McCarthy, Taylor and Wilbur (2026) also use Consumer Edge data to measure sports betting demand.

5 Firm Responses to Taxes

5.1 Effects of Ad Valorem Taxes on Prices

The price of wagering a dollar is not associated with local ad valorem tax rates because, for a given betting product, prices are set uniformly across states. Figure A.2 shows an example of what we mean by a betting product: DraftKings posts identical odds in Illinois and Michigan despite sportsbooks paying very different ad valorem tax rates. FanDuel and BetMGM confirmed their uniform pricing practice to us via email, and a news article confirms DraftKings prices uniformly; we document these quotes in Table A.4. Together these firms account for 79% of dollars wagered. Uniform pricing suggests the incidence of ad valorem taxes is primarily on firms, given the wide variation in ad valorem tax rates across states.

Even with uniform pricing, ad valorem taxes could still lead to higher prices in high-tax states in more subtle ways. We consider two possibilities. First, since sportsbooks offer

a variety of wagers and the demand for wagers varies across locations, sportsbooks could increase prices in high-tax states by offering worse odds for wagers popular among residents of those states. A concrete example would be to offer worse odds on wagers popular among New York residents, like bets on the New York Yankees. In Figure 2a, we reject this hypothesis, finding no relationship between ad valorem tax rates and the average price to bet across states. Second, sportsbooks could adjust their national prices over time when their national tax exposure changes. When New York legalized sports betting, the dollar-weighted average tax rate on U.S. wagers rose by 8.8 percentage points for DraftKings and 8.6 for FanDuel. A sportsbook could have increased national prices in response to this event while still pricing uniformly across states. Figures 2b and 2c reject this hypothesis, showing that FanDuel and DraftKings did not raise prices immediately after launching in New York.

5.2 Case Study: Effect of a Per-wager Tax on Prices

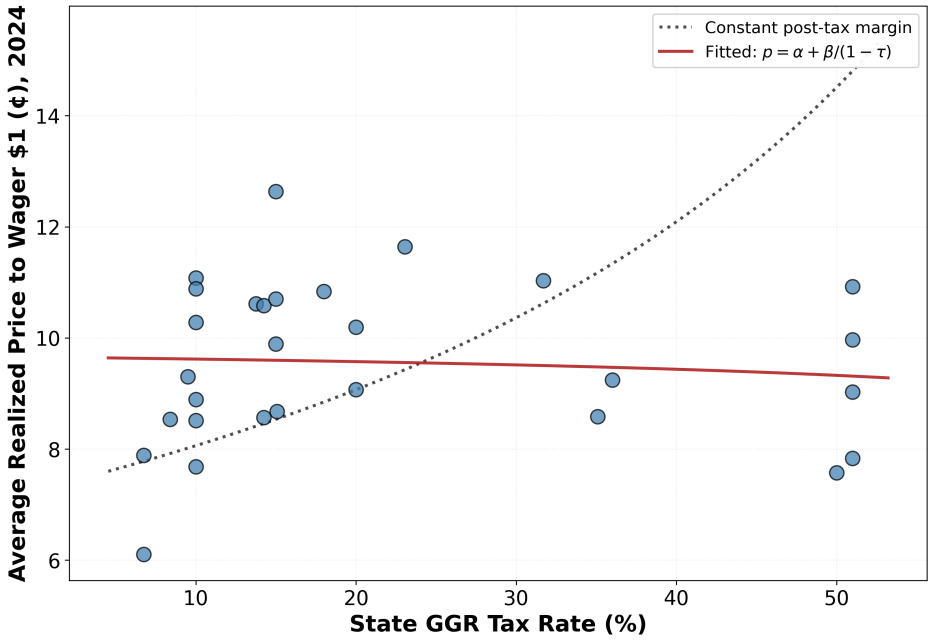
Uniform pricing is consistent with our model, but also with an unmodeled technical constraint that forces sportsbooks to price uniformly. We now consider a test to distinguish these explanations. In our model, sportsbooks would pass through a specific tax on dollars wagered, whereas under uniform pricing, they would not.

We consider a case study of firm responses to a per-wager tax in Illinois. The tax, introduced on July 1, 2025, was \$0.25 on each of an operator's first 20 million online wagers within a fiscal year, and \$0.50 on all remaining online wagers (Illinois Gaming Board, 2025). This tax is not a specific tax, because it is assessed per transaction rather than per dollar wagered. But like a specific tax, and unlike an ad valorem tax, this tax raises marginal cost per dollar wagered, so our model predicts it should pass through to price. The average tax paid from July 2025 through March 2026 was 0.81¢ per dollar wagered.[16]

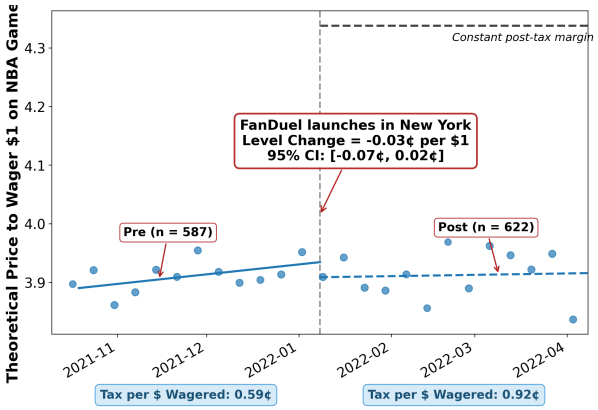
Every major sportsbook responded to the tax by either increasing consumer fees or limiting small bets (Table A.5). FanDuel, Caesars, and Fanatics pass through the full fee on every online wager. DraftKings and bet365 pass through the fee only on smaller wagers. BetMGM and BetRivers raised minimum bet sizes instead of passing through a fee, i.e., an infinite tax on small bets. Figure 3 shows how DraftKings and FanDuel described their fees to consumers. Both firms emphasize in their messaging that these price increases are the direct result of the Illinois tax. These facts demonstrate that firms are technically capable of setting state-specific fees, but they choose not to do so in response to ad valorem tax rates. Positive pass-through of the per-wager tax is qualitatively consistent with Section 3's model.

[16] We compute this by dividing the tax revenue raised, \$94.5 million divided by dollars wagered online, \$11.68 billion.

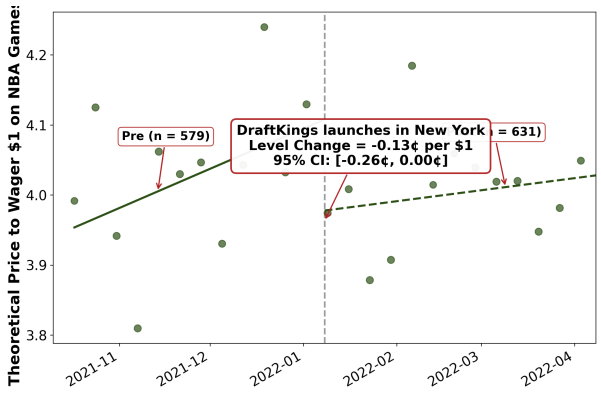
Figure 2. Associations between average price to bet and ad valorem tax rates across space and time



(a) Across states: 2024 average prices



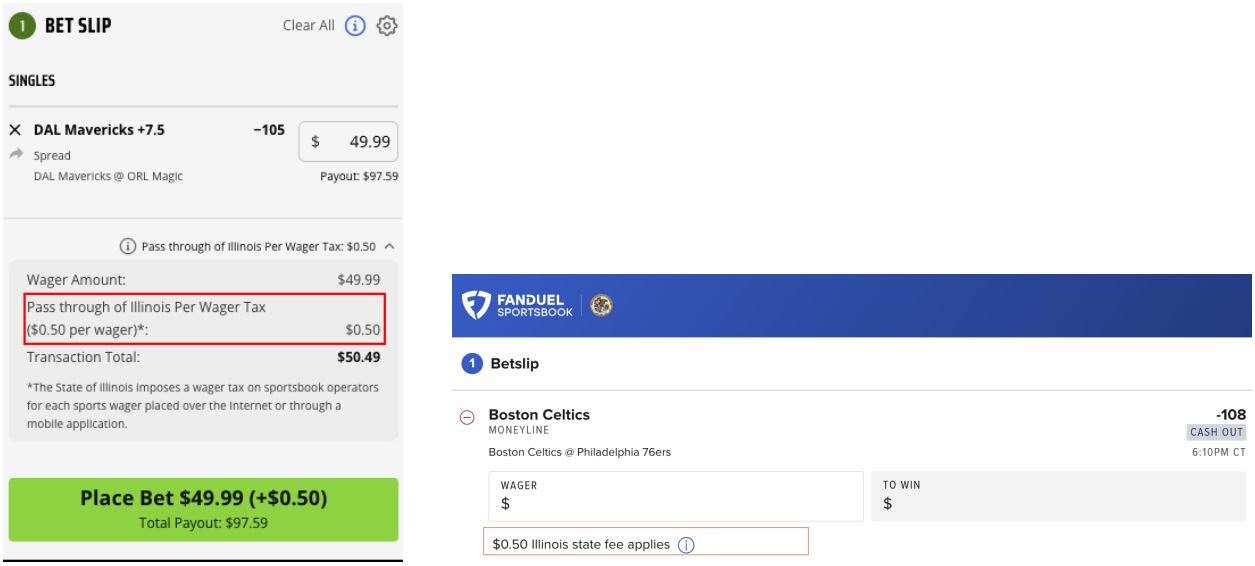
(b) Over time: FanDuel



(c) Over time: DraftKings

Notes: Panel (a): average price to wager a dollar across 28 states and Washington, DC in 2024; Florida excluded (tribal-only, no state reporting); Tennessee excluded (taxes dollars wagered, not revenue). The dotted curve shows what prices would look like if sportsbooks had the same post-tax margin in each state, anchored to Massachusetts. The y-axis varies across states because the state-level price aggregates over event mix (e.g., parlays vs. straight bets) and sportsbook market shares, both of which vary by state. Panels (b) and (c): theoretical price per dollar wagered around New York's January 2022 launch for FanDuel and DraftKings. Each point is the weekly mean across NBA games, with point size proportional to the number of games. Solid lines show pre- and post-launch interrupted time series (ITS) fits; the dashed black line shows what prices would be if sportsbooks raised prices enough so that they would have the same post-tax margin as before i.e. if the entire incidence were on consumers. The ITS model is $p_t = \beta_0 + \beta_1 t + \beta_2 \,\mathrm{Post}_t + \beta_3 (t \times \mathrm{Post}_t) + \epsilon_t$, where $\mathrm{Post}_t = 1$ after January 8, 2022. β_2 is the level change at the cutoff. Standard errors use the Newey-West estimator with 7 lags.

Figure 3. Pass-Through of a Local Per-Wager Tax



(a) DraftKings ($49.99 wager) **(b)** FanDuel

Notes: Panel (a) shows DraftKings adding a $0.50 Illinois state fee to a $49.99 wager. Panel (b) shows FanDuel displaying the Illinois fee on the bet slip. The DraftKings screenshot file was captured March 6, 2026, and the FanDuel screenshot file was captured December 18, 2025. Both screenshots reflect the Illinois per-wager tax after the surcharges were rolled out on September 1, 2025. For DraftKings, the per-wager fee applies only to straight bets of $50 or less and parlays under $10.

Besides Illinois, Tennessee is the only state with a tax base other than sportsbook revenue. Tennessee assesses a 1.85 cent specific tax per dollar wagered, but no sportsbook posts different odds or fees there. This contradicts the model's prediction that a specific tax is passed through. The Tennessee specific tax represented a net cut from an earlier tax regime, which resulted in an effective rate of at least 2 cents per dollar wagered.[17] Legibility and fairness, both outside our stylized model, may explain why firms responded differently in Tennessee versus Illinois. The Illinois tax is very clear to explain to bettors: a flat per-bet fee that firms can show and attribute to the state. The Illinois tax was an *increase*, so passing it through may be perceived as fair. The Tennessee tax was a net cut, so raising prices might have invited regulatory retaliation.

Discussion

Consistent with our model, sportsbooks do not vary prices in response to ad valorem taxes. This finding does not distinguish between sportsbooks profit-maximizing as in our stylized model versus a uniform pricing constraint. But the pass-through of a per-wager tax in Illinois at least rules out that firms face infinite costs of deviating from uniform pricing.

Figure 4 shows that the sports betting ad valorem tax is an anomaly among taxes on consumer products with unpriced harms. Full pass-through or even overshifting of the tax is common (Butters, Sacks and Seo, 2023). Sports betting ad valorem taxes thus do not create deadweight loss from price changes, but also cannot have corrective effects by increasing prices. In the next subsection, we explore whether they distort advertising.

5.3 Effects on Local Marketing Expenditures

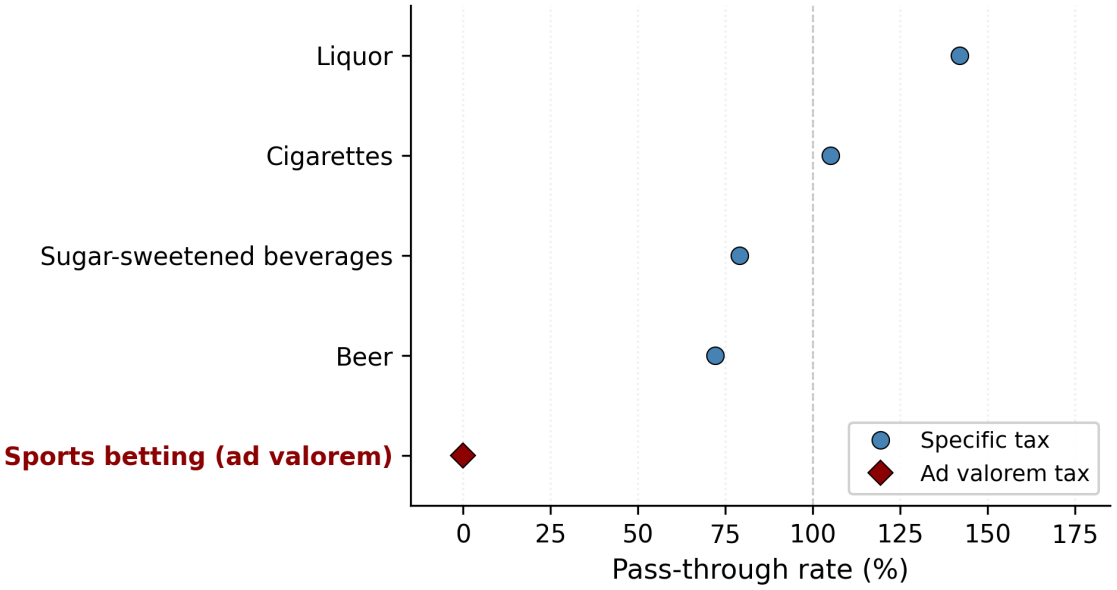
We begin by documenting narrative evidence that firms reduced marketing expenditure in response to high tax rates. In a 2022 investor day, BetMGM's parent company described a strategy of diverting its marketing budget towards states with low ad valorem taxes (Entain Group, 2022):

> During Q1 [2022], BetMGM made a concerted decision to pull back in our pursuit of players in New York due to its unfavourable tax environment. This reduced revenue slightly. However, marketing budget was diverted from New York to states with better economic returns. And this helped drive acquisition overperformance in those states.

BetMGM's statement is representative of statements from other sportsbooks about tax rates and marketing across jurisdictions. We collect several examples in Table 1.

[17] It replaced a 20% ad valorem tax which was paired with a 10% minimum price.

Figure 4. Pass-through rates of specific taxes and the ad valorem tax on sports betting



Notes: Specific excise tax pass-through estimates are from Butters, Sacks and Seo (2023), Table 5. For the sportsbook ad valorem tax, we define pass-through as $\rho_\tau = d\log p / d\log(1+\tau)$, as is common in the literature (see, e.g. (Kroft et al., 2024)).

Table 1. Industry statements on marketing responses to tax rates

Sportsbook	Quote	Source
Penn	"We've been very disciplined on the promo side. The tax rate is extremely high [in NY] at over 50%, and you don't have any promo deduction opportunity before you pay taxes."	Q3 2024 earnings call (Penn Entertainment, 2024)
FanDuel	"During Q2, the Illinois Gaming Board announced an increase in gaming taxes which became effective from July 1, 2024. We expect to directly mitigate 50% of the cost in 2025 through locally optimized promotional and marketing spend."	Q2 2024 earnings release (Flutter Entertainment, 2024)
BetMGM	"During Q1 [2022], BetMGM made a concerted decision to pull back in our pursuit of players in New York due to its unfavourable tax environment. This reduced revenue slightly. However, marketing budget was diverted from New York to states with better economic returns. And this helped drive acquisition overperformance in those states."	May 2022 investor day (Entain Group, 2022)
DraftKings	"We have made significant progress identifying customers with lower lifetime values, especially in high tax states. A high tax state is defined as a state that has multiple sports betting operators and a tax rate above 20%."	Q3 2024 investor relations (DraftKings, 2024*b*)

Illinois' 2024 ad valorem tax increase is a natural experiment that lets us quantify the degree to which a tax rate increase reduces sportsbook advertising. Illinois is the only state with an ad valorem tax rate change that both (a) occurred before our data ends in 2024, and (b) is not confounded with other regulatory changes to sports betting.[18] Illinois switched from a 15% flat rate, in place since it legalized in 2020, to a graduated tax with a top marginal rate of 40%. The average effective tax rate on sportsbook revenue rose from 16.1% (Jan 2023-June 2024) to 30.0% (July-December 2024).[19]

With one treated unit, we use the synthetic control method to construct our counterfactual (Abadie, Diamond and Hainmueller, 2010). Our outcome, Y_{mq} is quarterly local TV ad spend per sportsbook per 100 residents. Let A_{jmq} be sportsbook j's local TV ad spend in DMA m and quarter q, Pop_m DMA m's 2023 population in hundreds of residents, and $\mathcal{B}_m$ the set of sportsbooks operating in DMA m.[20] We include advertising by four major sportsbooks: DraftKings, FanDuel, BetRivers, and Caesars. The outcome is defined as follows:

$$Y_{mq} = \frac{1}{|\mathcal{B}_m|} \sum_{j \in \mathcal{B}_m} \frac{A_{jmq}}{\text{Pop}_m}$$

The treated unit is the Chicago DMA. The Chicago DMA is mostly in Illinois: 91% of its 2024 population lived in Illinois. The Illinois TV market is also mostly Chicago: 98% of sportsbooks' local TV ad spending in Illinois was in the Chicago DMA.

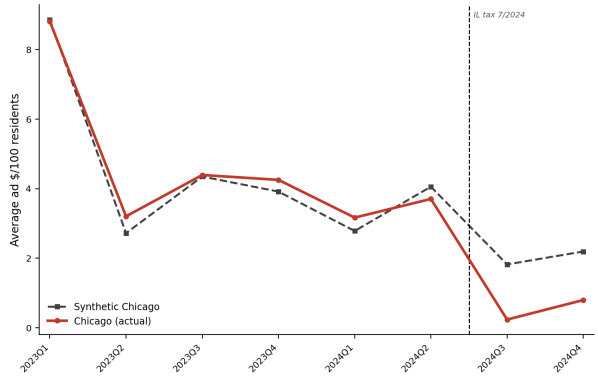
We construct the donor pool as follows. We assign each DMA to the state where a plurality of its population lives, and exclude DMAs whose state legalized in 2023 or later, since sportsbook advertising is especially high immediately after legalization. We also exclude DMAs in Illinois outside Chicago, since they are also subject to treatment. Recent work in synthetic control recommends trimming the donor pool to only include donors similar to the treated unit, to avoid overfitting (Abadie and Vives-i Bastida, 2026). We keep only donors with positive advertising by at least one sportsbook in every pre-treatment quarter, like Chicago. This means the donor pool disproportionately consists of other large metro areas: 9 of the 10 most populous DMAs in legal states are in the donor pool. We then select donor weights to match Chicago's advertising levels in each of the six pre-period quarters. See Appendix C.1.2 for further details on the sample construction and donor pool.

[18] Ohio raised its ad valorem tax rate in 2023, but did so only six months after it legalized sports betting. Washington DC modified its tax structure in 2024, but simultaneously increased the number of sportsbook licenses. Table A.6 lists every post-launch ad valorem tax change and why each is unusable for within-state identification.

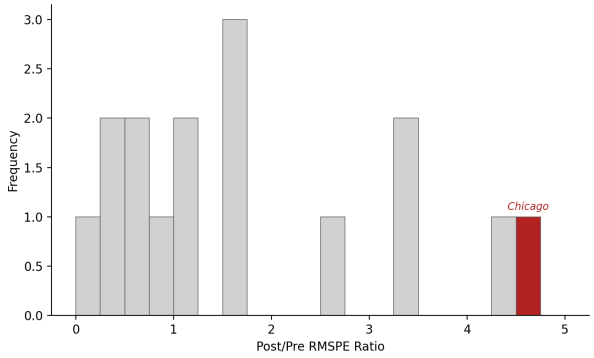
[19] The primary reason the pre-period tax rate is above 15% is that Cook County imposed a 2% ad valorem tax on sportsbook revenues over this period, which sportsbooks paid in addition to the state tax.

[20] Table A.7 lists each book's launch month by state.

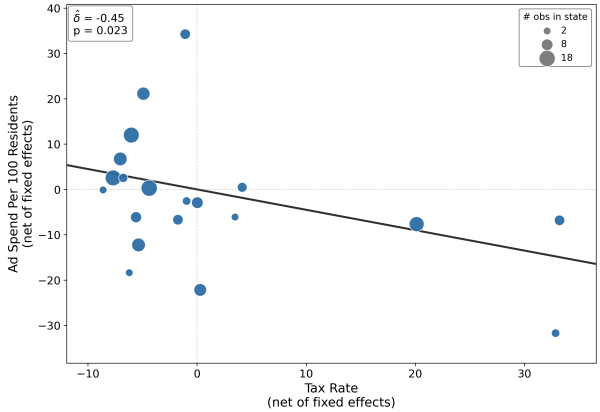
Figure 5. State taxes and local marketing activity



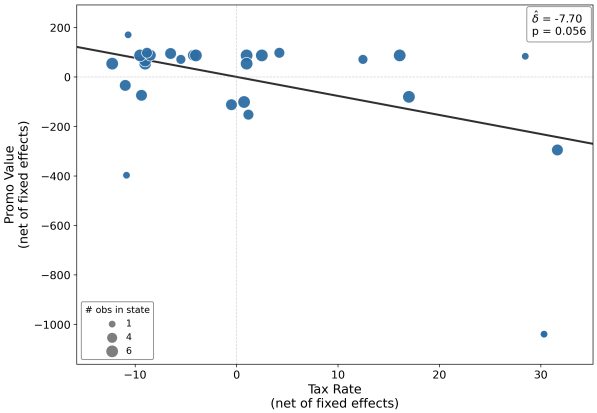
(a) Trends in local TV ad spending: Chicago vs. synthetic Chicago



(b) Ratio of post-tax RMSPE and pre-tax RMSPE: Chicago and 15 control DMAs



(c) Cross-sectional association: local TV ad spending



(d) Cross-sectional association: promotional generosity

Notes: Panel a plots quarterly local TV ad spending per 100 residents per sportsbook for Chicago and synthetic Chicago; the dashed vertical line marks the July 1, 2024 tax increase. Panel b compares Chicago's post/pre RMSPE ratio with the ratios from 15 donor placebos. In Panels c and d, each dot is a state, with size proportional to the number of underlying observations; both axes are residualized on the regression's fixed effects, and red points are New York. Panel c plots local TV ad spending per 100 residents against ad valorem tax rates, averaged across sportsbook-years and residualized on sportsbook × year fixed effects. Local TV ad spending covers 2019–2024 from 5 large sportsbooks. N = 163 state-sportsbook-year observations across 20 states. Panel d plots promotional generosity against ad valorem tax rates, averaged across sportsbooks and residualized on sportsbook fixed effects. This analysis uses 6 sportsbooks: Bet365, BetMGM, BetRivers, DraftKings, FanDuel, Fanatics, which collectively represent 86.4% of national dollars wagered. Caesars offers uniform promos across all states and is excluded. N = 124 state-sportsbook pairs across 27 states and DC. *p*-values in Panels c and d use the wild cluster bootstrap, clustered by state. Appendix C.1.3 contains sample selection details.

Synthetic Chicago consists of a convex combination of other DMAs: Phoenix (62%), Philadelphia (19%), Pittsburgh (11%), and Baltimore (7%). Panel 5a shows local TV advertising was declining across most DMAs over 2023–2024, as sportsbooks shifted to national advertising (Novy-Williams, 2025). The synthetic control nets out this common trend. Advertising in Chicago still fell far below synthetic Chicago immediately after the tax rate was increased. Over the two post-tax quarters (July–December 2024), advertising in Chicago was 32.5% lower than synthetic Chicago. This implies that a 1 p.p. increase in the tax rate lowers quarterly local TV ad spending by \$0.10 per 100 residents per sportsbook.[21]

For inference, we follow standard practice in the synthetic control literature and conduct a placebo test that assigns treatment to each control DMA and re-estimates the synthetic control (Abadie, Diamond and Hainmueller, 2010). We compare Chicago's ratio of post-period vs pre-period root mean squared prediction error (RMSPE), which accounts for the quality of pre-period fit (Figure 5b). This comparison yields $p = 0.062$, the lowest value possible with only 15 donors.

Appendix Figure A.3 shows the point estimate is unchanged if we instead keep all 68 DMAs with positive pre-period advertising in *any quarter*. The RMSPE ratio p-value rises to 0.551. This is because small DMAs barely advertise, so their synthetic control fits almost perfectly in the pre-period. Even a small amount of post-period advertising by them or any donor thus yields a large RMSPE ratio.[22] In a placebo test that compares the absolute value of the post-period gap between a DMA and its synthetic control, Chicago is the third largest value, ($p = 0.043$).

The synthetic control relies on just one tax rate increase in Illinois. As a broader descriptive exercise, we explore cross-sectional associations across more states and years. We collect two forms of local marketing expenditure at the state-sportsbook level, TV advertising and the generosity of promotional offers, and regress each on state tax rates and sportsbook fixed effects.

Our estimating equation for local TV advertisements is

$$\text{AdSpend}_{sjt} = \lambda_{jt} + \delta^{Ads} \cdot \tau_s + \nu_{sjt} \tag{9}$$

where $AdSpend_{sjt}$ is local TV ad spending per 100 residents for sportsbook j in state s in

[21] We calculate this by dividing the average post-tax gap between Chicago and synthetic Chicago in quarterly local TV ad spending (\$1.49 per 100 residents per sportsbook) by the increase in the four books' effective tax rate from the pre-period (January 2023–June 2024) to the post-period (July–December 2024), 15.1 p.p. We compute the effective tax rate by dividing the total taxes the four books paid by their total revenue. This is slightly larger than the change in the statewide effective rate because these four firms are large and the tax is progressive.

[22] Among donors with a higher RMSPE ratio than Chicago, their median pre-period advertising is 0.164 per 100 residents, versus 4.588 for Chicago, and 2.690 for the donor pool in the main specification.

year t. We have multiple years of local advertising data, so we include sportsbook-year fixed effects in Equation (9). Local advertising is measured at the DMA level. We drop DMAs crossing state borders, which represent 64.4% of legal states' population; Table A.8 includes further detail on these dropped DMAs. We population-weight each DMA when aggregating to the state level.

The estimating equation for promotional offers is similar:

$$\text{Promo}_{sj} = \alpha_j + \delta^{Promo} \cdot \tau_s + \epsilon_{sj}$$

where Promo_{sj} is the expected value of the sign-up offer from sportsbook j in state s and τ_s is the ad valorem tax in state s. We compute these expected values using the DarkHorse Odds conventions described in Section 4. The expected values of sign-up offers range from the low hundreds to over a thousand dollars, as shown in Table A.3. In both regressions, the coefficient δ captures the association between local ad valorem taxes and local marketing, within a sportsbook across states.

Figure 5 illustrates our results by plotting residualized marketing expenditures against residualized taxes. A 1 p.p. increase in the ad valorem tax rate is associated with a \$0.45 reduction in annual local TV ads per 100 residents ($p = 0.0227$). This is about 2.0% of the mean across state-sportsbooks. Dividing by four to get the corresponding magnitude for quarterly ads yields \$0.11, quite similar to the causal effect of \$0.10 we estimate in the synthetic control.

For promos, a 1 p.p. increase is associated with a \$7.70 (1.3% of the mean across state-sportsbooks) decrease in the expected value of sign-up offers ($p = 0.06$).

One obvious source of omitted variable bias would be if state legislatures wary of sports betting both set high tax rates and banned advertising. No state has a blanket ban on sports-betting advertising. The main restrictions that exist limit advertising of bets as "risk-free" and targeting of minors (National Council on Problem Gambling and Vixio Regulatory Intelligence, 2024; American Gaming Association, 2025). These restrictions are present among low and high-tax states. Both correlations remain significant when controlling for the number of large sportsbooks in the state, and years since the state legalized sports betting (Table A.9). We include the latter control because states tend to have a large ad surge immediately after legalizing. We are not powered to detect effects with more controls: in the ads association, the coefficient on tax rate loses significance once we control for income and Democratic vote share, though it remains negative. As another robustness check, Figure A.4 contains a leave-one-state-out exercise, dropping the three highest-tax states one-by-one. The result is qualitatively similar in each.

Ad valorem taxes reduce advertising. The efficiency and incidence of ad valorem taxes thus depend on how advertising affects sports betting demand. The next section estimates this effect.

6 The Effect of Sportsbook Advertising on Demand

6.1 Empirical Strategy

A simple regression of sports betting consumption on advertising would suffer from standard endogeneity problems: firms likely target advertising to where demand is high. To isolate quasi-random variation in advertising, we implement a border design in the spirit of Shapiro (2018). Nielsen divides the U.S. into 210 Designated Market Areas (DMAs), and a household's DMA determines which local TV ads it sees. As an example, we illustrate the border between New York City's DMA and the Philadelphia DMA, which bisects New Jersey, in Figure A.5. We estimate the impact of advertising on demand by measuring how deposits and advertising co-vary over time on each side of a DMA "border experiment."

We implement this design using the exact specification from Shapiro (2018):

$$\begin{aligned}\ln Y_{jmt} = \lambda \ln Y_{jm,t-1} + \gamma_1 a_{jmt}^{\text{own}} + \gamma_2 a_{jmt}^{\text{rival}} + \gamma_3 (a_{jmt}^{\text{own}})^2 \\ + \gamma_4 (a_{jmt}^{\text{rival}})^2 + \gamma_5 a_{jmt}^{\text{own}} a_{jmt}^{\text{rival}} + \alpha_{jbm} + \alpha_{jbq} + \varepsilon_{jmt}\end{aligned} \tag{10}$$

where j indexes sportsbooks, m indexes DMAs, t indexes months, and b indexes border experiments. For most of our specifications, the outcome Y_{jmt} will be deposits at a sportsbook in a DMA-month. a_{jmt}^{own} is sportsbook j's own advertising (\$/100 capita in the DMA), and a_{jmt}^{rival} is the sum of all other sportsbooks' ("rival") advertising. Quadratic and interaction effects allow for the possibility that advertising has diminishing marginal returns. The lagged term, $Y_{jm,t-1}$, controls for persistence in sports betting demand.[23] The sportsbook × border × DMA fixed effects and sportsbook × border × quarter fixed effects absorb permanent differences between sides of a border and time-varying shocks common to both sides of a border respectively.

Because of the fixed effects, our estimates are identified from within-border experiment, within-quarter variation: one side of the border receives more advertising than the other in

[23] The lagged dependent variable with fixed effects induces downward bias in $\hat{\lambda}$ in a finite panel (Nickell, 1981). The asymptotic ($N \to \infty$) bias is $\text{plim}\,(\hat{\lambda} - \lambda) = \left\{ \frac{2\lambda}{1-\lambda^2} - \left[\frac{1+\lambda}{T-1} \left(1 - \frac{1}{T} \frac{1-\lambda^T}{1-\lambda} \right) \right]^{-1} \right\}^{-1} \approx \frac{-(1+\lambda)}{T-1}$. With $T = 75$ months and $\hat{\lambda} = 0.38$, the exact bias is -0.0186, or 4.8% of $\hat{\lambda}$. Re-estimating column (1) on the same sample without the lagged outcome gives $\hat{\gamma}_1 = 0.0204$ (SE 0.0047) and $\hat{\gamma}_2 = 0.0193$ (SE 0.0033), statistically indistinguishable from the with-lag estimates of 0.0181 and 0.0170.

a given month, relative to the border-quarter average. To interpret our estimates causally, we assume that households on either side of the border would have behaved similarly absent such an advertising shock. Two institutional details of the local TV advertising market minimize threats to this assumption, as discussed in Shapiro, Hitsch and Tuchman (2021). First, local TV ads are usually bought several months ahead of airing, making it difficult to *time* advertisements to coincide with local demand shocks. Second, local TV ads are often bought in bulk, making it difficult to *locate* advertisements in specific markets.

Estimates from specification (10) represent contemporaneous responses to advertisements. To the extent that advertisements have impacts on consumption beyond a one-month time horizon, our estimates will understate the overall effect of advertisements on consumption. The advertising literature generally concludes that long-run elasticities exceed short-run elasticities (Sethuraman, Tellis and Briesch, 2011; Shapiro, Hitsch and Tuchman, 2021); habit formation may make long-run impacts particularly important in the gambling context (Guryan and Kearney, 2010). A related concern is that advertisements may merely retime demand instead of increasing it. To test for retiming, we run specifications that include one-month lags of own and rival advertising. Retiming would imply that lagged advertising has a negative effect on today's deposits. The coefficients on lagged advertising are either positive or not statistically significant, suggesting retiming is not a major concern (Table A.10).

We impose two sample restrictions when taking this design to the data. First, to avoid confounds from changes in state-specific regulations over time, such as tax rates, we restrict all border experiments to be within-state.[24] Second, we restrict to households that we can confidently locate within a given DMA, because the underlying household geography variable is at the ZIP3 level, and ZIP3s do not perfectly align with DMA boundaries. In our preferred specification, we assign each ZIP3 to the DMA containing at least 80% of its area, and drop ZIP3s that do not have 80% of their area in any DMA. After applying these restrictions, our preferred specification uses 150 border experiments. We show in Figure A.6 that results are stable as we vary this 80% threshold. We provide further details on sample construction in Appendix C.1.1.

Our outcome is logged; we also include a lag of this outcome on the right-hand side. We drop observations where either the outcome or its lag is zero. Methods designed to accommodate zeros in the outcome, such as Poisson pseudo-maximum likelihood (Santos Silva and Tenreyro, 2006), do not accommodate zeros on the right-hand side, and would thus require dropping nearly the same observations as the ones we drop. We do not apply a log-like transformation such as $\log(1+Y)$, since these transformations depend on how units of the outcome are defined and cannot be interpreted as percentage effects (Chen and Roth, 2024).

[24] Results are qualitatively robust to allowing cross-state border experiments (Table A.11).

Dropping zeros removes 34.5% of observations in our main specification. Two heuristic tests suggest that dropping zeros does not upwardly bias our estimates. First, Table A.12 restricts the sample to the two largest sportsbooks, DraftKings and FanDuel, where zeros are much less prevalent: only 7.3% of observations are dropped. If the method we used to drop zeros was biasing our results, that bias should be smaller in a sample with fewer zeros. All coefficients are similar in magnitude when we restrict to this sample. Second, the dropped observations have significantly lower advertising than the observations in our sample, conditional on the fixed effects in our regression ($p < 0.001$). We find a positive effect of advertising on deposits despite dropping observations with both low ads and zero deposits, suggesting that, if anything, our estimates are attenuated.

6.2 Contemporaneous Effects of Advertising

We find that advertising increases sportsbook deposits. Column (1) of Table 2 reports the relevant estimates. The coefficient on own advertising indicates that a \$1 per 100 residents increase in monthly local TV advertising increases deposits by approximately 1.8%. The coefficient on rivals' advertising is similar in magnitude to that on own advertising, suggesting that local TV advertising primarily impacts demand through market expansion, rather than business stealing. These magnitudes are similar to those found in Shapiro (2018) for antidepressant prescriptions and to those in Shapiro, Hitsch and Tuchman (2021) for consumer-packaged goods.

The effect of taxes on deposits through the advertising channel suggests a reduced-form relationship: dollars wagered should be lower in high-tax states. In a bivariate correlation, the sign and magnitude are similar to what we find by chaining our estimates above. A 1 p.p. higher ad valorem tax rate is associated with \$7.92 lower 2024 dollars wagered per capita (1.08% of the cross-state mean), $p = 0.154$. We plot this association in Figure A.7.

6.3 Mechanisms of Sports Betting Ads

We next turn to the mechanisms by which advertising impacts deposits. In columns (2) through (5) of Table 2, we decompose the effect of advertising into the extensive margin (the chance of a household making any deposit) and the intensive margin (the amount deposited, conditional on making at least one deposit). To understand whether ads attract new customers versus increase deposits by existing ones, we also split cards according to whether they have ever made a deposit at the sportsbook in the past, and estimate (10) for each sub-sample.

We find that advertising primarily works through the extensive margin. We estimate a

Table 2. Effects of Advertising on Sports Betting Deposits

		Customers		Dep./Customer	
	Deposits	New	Existing	New	Existing
	(1)	(2)	(3)	(4)	(5)
$\ln Y_{j,m,t-1}$	0.38428***	0.18277***	0.44749***	−0.13668***	0.26083***
	(0.01907)	(0.02114)	(0.02206)	(0.01424)	(0.02043)
Own	0.01812***	0.04958***	0.02234***	−0.00847	−0.00123
	(0.00408)	(0.00647)	(0.00294)	(0.00664)	(0.00347)
Rival	0.01703***	0.02684***	0.01602***	−0.00489	0.00300
	(0.00285)	(0.00318)	(0.00288)	(0.00344)	(0.00278)
Own^2	−0.00030**	−0.00100***	−0.00037***	0.00025	0.00012
	(0.00012)	(0.00018)	(0.00007)	(0.00015)	(0.00009)
Rival^2	−0.00018***	−0.00026***	−0.00022***	0.00011**	−0.00000
	(0.00006)	(0.00006)	(0.00006)	(0.00006)	(0.00005)
Own × Rival	0.00000	−0.00001	0.00000	−0.00003	−0.00013
	(0.00016)	(0.00016)	(0.00013)	(0.00018)	(0.00014)
SB × Border × DMA FE	Yes	Yes	Yes	Yes	Yes
SB × Border × Quarter FE	Yes	Yes	Yes	Yes	Yes
Observations	21,026	21,026	21,026	21,026	21,026
R^2	0.937	0.866	0.970	0.484	0.779

Notes: Sportsbook × DMA clustered standard errors in parentheses. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$. Column (1) pools all depositors. Columns (2)–(5): "New" = first deposit at that sportsbook in that calendar month. Border experiments restricted to quarters in which sports betting is legal and to ZIP3s where a majority of the population resides in one state. This table uses Consumer Edge data.

precise null on the intensive margin (dollars per customer) and can rule out an intensive margin semi-elasticity larger than 0.6%, much smaller than the total effect of 1.8%. The effects of advertising are proportionally larger for new customers: the own-ads extensive margin coefficient is more than twice as large for new customers as for existing customers. These findings are broadly consistent with other results in the advertising literature. On the extensive vs. intensive margin, Bertrand et al. (2010) find that advertising influences take-up but not the amount of consumer loans. On new vs. existing consumers, Blake, Nosko and Tadelis (2015) find that new and infrequent users are positively influenced by ads, but that most advertising is spent on frequent users, for whom advertising is not effective. In Appendix A.2 we examine the dynamics of deposits after sign-up and the characteristics of bettors marginal to advertising, and find suggestive evidence that people who make their initial deposit to sportsbooks in high-advertising periods are less likely to make a deposit in the sixth month after their initial deposit, and deposit less over their first seven months.

While the analysis above exclusively studies the impact of TV advertisements, in Appendix A.1, we conduct a similar analysis to measure the impacts of promotional sign-up offers on sports betting demand. Our point estimates indicate that promotional offers increase the chance of a deposit, especially for new customers, but these estimates are imprecise (Figure A.8).

7 Quantitative Comparison of Tax Designs

We now connect our empirical evidence on the positive consequences of sports betting taxes to our quantitative tax burden formulas from Proposition 2 to study the welfare consequences of tax design.

7.1 Calibration

Our calibration narrows the advertising channel to only local TV advertising, for which we have the cleanest variation. When possible, we use estimates from our own analysis, otherwise we draw upon the literature. We summarize calibrated primitives and key derived parameters in Table 3.

Table 3. Baseline Scenario Parameters

#	Parameter	Description	Units	Value	Source
		Panel A: Estimated and Observed Primitives			
1	$-dA/d\tau$	Ad valorem effect on per-firm advertising (dollar level)	(firm monthly ad \$/100 capita) per p.p.	0.033	Illinois synthetic control (§5.3, Fig. 5a)
2	$\frac{dQ/dA}{Q}$	Market semi-elasticity of dollars wagered w.r.t. a \$1 per 100-capita increase in advertising, by all firms	% industry \$ wagered per (\$1 ad/100 capita per month increase by all firms)	5.26	Border design (§6); full calc. App. B.2 (Table A.14)
3	p	Consumer price	¢/\$ wagered	9.46	Average U.S. price, 2023–2025
4	τ^{Baseline}	Baseline ad valorem tax rate	% of revenue	21	Cumulative gov't revenue / firm revenue, U.S. 2023–2025
		Panel B: Calibrated Primitives			
5	$-\frac{dQ/dp}{Q}$	Market semi-elasticity of demand w.r.t. price	% \$ wagered per 1¢ price	11.2	Calibrated to Brown, Grasley and Guido (2025)
6	Γ_Q	Marginal uninternalized damages	¢/\$ wagered	4.97	Calibrated to Brown, Grasley and Guido (2025)
7	κ	Marginal cost	¢/\$ wagered	0	Calibrated (digital good)
8	dp/dt	Specific tax effect on price	unitless	1	Consistent with upper end of firm responses to Illinois per-wager tax (Fig. 3)
		Panel C: Derived Parameters			
	Ad valorem tax				
9	η_τ^P	Ad valorem semi-elasticity, price channel	% \$ wagered per p.p.	0	Zero price effect (Prop. 1)
10	η_τ^A	Ad valorem semi-elasticity, advertising channel	% \$ wagered per p.p.	0.17	Row 1 × 2
11	η_τ^{Tot}	Ad valorem total semi-elasticity	% \$ wagered per p.p.	0.17	Sum of rows 9 and 10
	Specific tax				
12	η_t^P	Specific semi-elasticity, price channel	% \$ wagered per 1¢ tax	11.2	Row 8 × 5
13	$-dA/dt$	Specific tax effect on per-firm advertising	(firm monthly ad \$/100 capita) per 1¢ tax	0.37	Row 5 × 1 (Lemma 1, App. D.4)
14	η_t^A	Specific semi-elasticity, advertising channel	% \$ wagered per 1¢ tax	1.9	Row 13 × 2
15	η_t^{Tot}	Specific total semi-elasticity	% \$ wagered per 1¢ tax	13.1	Sum of rows 12 and 14
16	t^{Baseline}	Baseline specific tax rate	¢/\$ wagered	0	Status quo in most U.S. states

Notes: All semi-elasticities apply to market-level quantities, not firm-specific quantities.

We make four assumptions to bring our empirical estimates into the tax burden formulas from Proposition 2. The first is that demand is multiplicatively separable in prices and advertising (Assumption 2). Our variation does not identify whether advertising affects the price-sensitivity of demand, so we assume it does not. The second assumption is that advertising responds linearly to the ad valorem tax rate. Section 5 identifies the advertising response from a large tax increase in Illinois and linearity lets us apply it to a marginal tax change. Third, we assume that the ad semi-elasticity estimated in the border design applies to marginal advertising changes, even though it is identified from finite changes in advertising. Fourth, we assume that dollars wagered are proportional to deposits. The dependent variable in the border design from Section 6 is the percent change in *dollars deposited* from a dollar of ad spending, while quantities in the model are *dollars wagered*. We make this assumption so we can directly import our estimate in percent terms without a conversion factor.

Panel A of Table 3 reports estimated and observed primitives. We take the effects of ad valorem taxes on advertising and the semi-elasticity of demand with respect to ads from the evidence in Sections 5 and 6 of this paper respectively. Baseline consumer prices and ad valorem tax rates are average values in the U.S. from 2023 to 2025 (Ramsey, 2025).

Panel B of Table 3 lists terms that we calibrate from the literature. Brown, Grasley and Guido (2025) find that a 2¢ rise in the price per dollar wagered would reduce self-reported dollars wagered by 20%. This implies a semi-elasticity of 11.2.[25] We interpret this price-sensitivity as being valid near existing tax rates and prices. Two other papers estimate price sensitivity in gambling markets and find similar values. Suits (1979) uses cross-state variation in parimutuel prices, implying a semi-elasticity of 11.1; Paton, Siegel and Vaughan Williams (2004) uses the United Kingdom's 2001 reform, implying a semi-elasticity of 7.6. Brown, Grasley and Guido (2025)'s uninternalized damages parameter captures internalities from misperceived losses and self-control problems but not how they scale with quantity. Absent a way to discipline the curvature of $\Gamma_Q(Q)$, we assume the internality per dollar wagered is constant. As discussed in Section 3, our baseline calibration assumes zero marginal costs because sports betting is a digital good. We also assume that a specific tax would pass through fully to prices, which is qualitatively consistent with firms' responses to the per-wager tax in Illinois and the pass-through of other specific sin taxes (Figures 3 and 4).

In Panel C, we report derived sufficient statistics that appear in Proposition 2 or help clarify the mechanics of our calibration. We have imposed both of Proposition 1's required assumptions, so ad valorem taxes leave prices unchanged and the tax only influences quan-

[25] To use this estimate, we fit a constant-semi-elasticity demand function through these points: $Q \propto e^{-bp}$: $e^{-0.02\,b} = 0.8$, so $b = -\frac{dQ/dp}{Q} = -\ln(0.8)/0.02 = 11.2$.

tities through lower advertising. For a specific tax, both channels are relevant. Comparing Row 13 to Row 1, we see a 1 cent increase in the tax on dollars wagered would reduce advertising by about as much as an 11 percentage point increase in the ad valorem tax. To calibrate the specific-tax advertising channel, we use the firm's profit maximization condition to map the observed advertising response to ad valorem taxes into an advertising response to a specific tax, which our variation does not identify directly. We discuss how we calibrate the advertising channel for specific taxes and other details in Appendix D.4.

Finally, we evaluate both taxes at the existing ad valorem rate and a zero specific tax rate ($\tau^{\text{Baseline}} = 21\%$, $t^{\text{Baseline}} = 0$). A positive ad valorem rate and no specific tax is the status quo in most states. We compare the marginal dollar of revenue raised by each instrument, holding total revenue equal.

7.2 Baseline Scenario Results

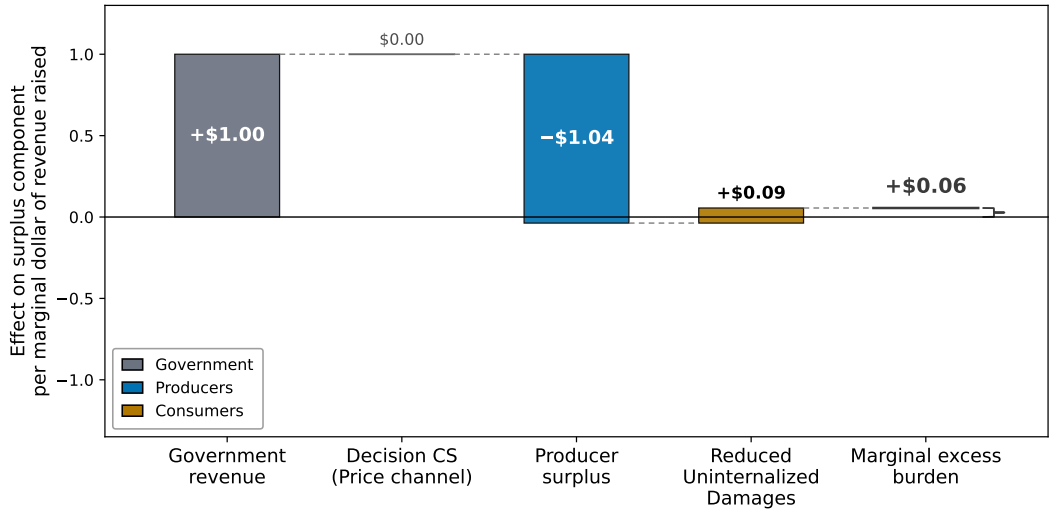
In Figure 6, we decompose the welfare effects of raising one marginal dollar of revenue from ad valorem and specific taxes into effects on decision consumer surplus, producer surplus, and internalities, as specified in Proposition 2. The first three bars in Figure 6 represent standard tax burdens in the presence of market power. From this perspective, the ad valorem tax is close to a nondistortionary profits tax. Consumers are unharmed because prices do not change, and the only source of deadweight loss is the small base erosion term from advertising reductions.[26] By contrast, the specific tax imposes large costs on both firms and consumers. Consumers bear the full burden of the tax's impact on prices, and firms are also harmed because the tax reduces quantities for a marked up product. In the language of Weyl and Fabinger (2013), market power means that consumers and firms "more than fully share" the burdens of the tax. For this reason, the total burdens of the specific tax on decision consumer surplus and producer surplus are larger than those of the ad valorem tax.

Accounting for uninternalized damages narrows this efficiency gap but does not close it. Since the specific tax affects prices, it reduces betting by much more than the ad valorem tax. Therefore, the corrective benefits of the specific tax are larger. Still, at our calibrated internality of $\Gamma_Q = 4.97$ cents per dollar wagered, the corrective benefits are not large enough to make the specific tax more efficient. The reason is that the pre-tax markup (9.46 cents per dollar wagered) already exceeds the internality. Because of the markup (and the existing baseline taxes), the price of betting is already above the socially efficient price, and taxes that raise prices even more only exacerbate this distortion.

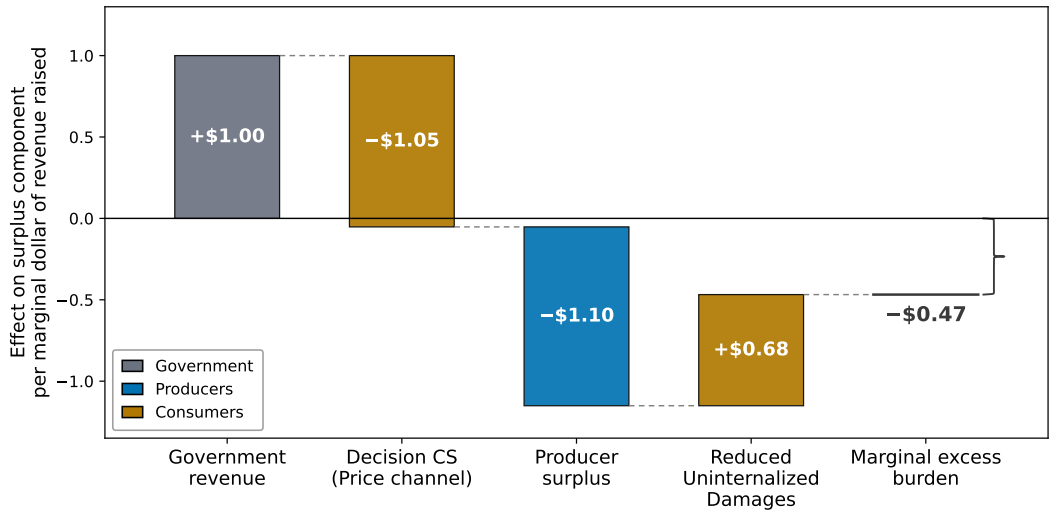
Marginal tax revenue from the ad valorem instrument *increases* total surplus because the

[26] The elasticity of the tax base with respect to τ is $\varepsilon_{base} = \tau \cdot \eta^A_\tau = 21 \times 0.17\% = 3.6\%$. The standard Harberger formula gives MEB $= -\varepsilon_{base}/(1 - \varepsilon_{base}) \approx -0.04$ per dollar raised.

Figure 6. Incidence and efficiency of ad valorem and specific taxes



(a) Ad valorem tax



(b) Specific tax

Notes: Both panels study the impact of a marginal tax increase that raises $1 of revenue, beginning from the prevailing ad valorem rate and no specific tax ($\tau^{\text{baseline}} = 21\%$, $t^{\text{baseline}} = 0$). We use the calibrated parameters in Table 3 to conduct the calibration. Formulas for effects on surplus components per dollar of revenue raised are given in Proposition 2.

corrective benefits exceed the conventional efficiency costs. In fact, the benefits of higher ad valorem taxes exceed the costs until the tax rate exceeds 52%. This rate is similar to the ad valorem tax rate in high-tax U.S. states like New York.[27] Further, most of the incidence falls on sportsbooks, which may make the tax attractive on distributional grounds. Specific taxes have much larger corrective benefits, but under our calibration this is not enough to overcome their larger burdens on consumers and firms. We next probe the robustness of these conclusions to alternative parameterizations.

7.3 Sensitivity

Table 4 reports on the quantity effects (change in dollars wagered per dollar of revenue raised), incidence (share of marginal burdens borne by firms), and efficiency (MEB) of ad valorem and specific taxes. The first row reports results from our main parameterization; the following rows consider alternatives.

Table 4. Quantity effect, incidence, and efficiency under alternative calibrations

		Quantity effect		**Incidence on firms**		**Efficiency**		
		$\Delta\$$ wagered$/\Delta G$		$\Delta PS\,/\,(\Delta CS+\Delta PS)$		MEB $=\Delta TS/\Delta G$		
		τ	t	τ	t	τ	t	Diff
1.	Baseline	-1.9	-13.7	110%	75%	0.06	-0.47	-0.52
2.	Taxes do not affect ads	-0.0	-11.3	100%	70%	0.00	-0.51	-0.51
3.	Ad-sensitivity of demand doubled	-3.9	-16.4	122%	80%	0.12	-0.43	-0.54
4.	Consumers benefit from informative ads	-1.9	-13.7	93%	67%	-0.11	-0.65	-0.54
5.	Zero internality	-1.9	-13.7	100%	51%	-0.04	-1.15	-1.11
6.	Double internality	-1.9	-13.7	122%	140%	0.15	0.21	0.07
7.	Specific tax: 76% pass-through	-1.9	-10.9	110%	81%	0.06	-0.34	-0.40
8.	Markup: 80% of price (DraftKings' 10-K)	-5.6	-13.1	95%	69%	-0.04	-0.26	-0.22
9.	Markup: 38% of price (De Loecker, Eeckhout and Unger, 2020)	-13.6	-11.8	52%	48%	0.22	0.17	-0.05
10.	Price-sensitivity of demand halved	-1.9	-6.0	110%	48%	0.06	-0.21	-0.26

Notes: Each row applies a one-parameter deviation from the baseline calibration. All rows evaluated at the U.S. revenue-weighted ad valorem rate and the specific tax at its first dollar ($\tau = 21\%$, $t = 0$), levied on top of that ad valorem rate. *Quantity effect* ($\Delta\$$ wagered$/\Delta G$): dollars of wagering eliminated per marginal dollar of government revenue raised; negative because taxes reduce wagering. *Efficiency* (MEB $= \Delta TS/\Delta G$): marginal excess burden per dollar of revenue raised; more negative is worse, positive means the tax is net welfare-improving. *Incidence* ($\Delta PS/(\Delta CS+\Delta PS)$): firm share of the total private welfare burden, with ΔCS net of the internality correction $\Gamma_Q(Q)$; values outside $[0, 100]\%$ arise when the internality benefit to consumers exceeds their gross surplus loss.

We next consider sensitivity to the alternative assumptions about the advertising channel. Row 2 shows that if we failed to account for the advertising channel, the ad valorem tax would look like a nondistortionary profit tax with no effect on quantities, no incidence on consumers, and no deadweight loss or corrective benefits. The estimated ad-sensitivity of demand and the normative interpretation of advertising both play a role in determining the welfare effects of the advertising channel. Row 3 shows that a larger ad-sensitivity of demand preserves our qualitative conclusions. In Row 4, we interpret advertising as

[27] To see this, note that the numerator of the MEB equation (8) reduces to $\eta^A(\Gamma_Q(Q)-\tau\cdot p)$, which implies that MEB $= 0$ when $\tau p = \Gamma_Q$. In our parameterization, $\Gamma_Q/p \approx 52\%$.

normatively valuable information provision to consumers. For this row only, we assume a constant semi-elasticity of demand functional form so that we can quantify these information provision benefits (see Appendix D.4 for details). When consumers benefit from advertising, both taxes look worse, because both taxes reduce advertising. But, since both taxes reduce advertising by a similar amount per revenue raised, this interpretation does not change the conclusion that the ad valorem tax is more efficient.

Rows 5 and 6 set internalities per dollar wagered Γ_Q to zero and double the baseline estimate respectively. These rows retain the positive consequences of our base parameterization, but taxes are much more beneficial for consumers when internalities are larger. Since specific taxes pass through to prices, doubling the internality reverses our efficiency ranking.

Row 7 illustrates a scenario where the specific tax has a lower pass-through rate of 76%, in line with Kasinger (2026) and pass-through rates of specific taxes on beer and sugar-sweetened beverages from (Butters, Sacks and Seo, 2023) (Figure 4). Lower pass-through reduces the specific tax's marginal excess burden, since it reduces the tax-induced price distortion.

Rows 8 and 9 vary our assumption about markups; these rows simultaneously modify marginal costs and the implied level of market power. In row 8, markups are 80% of price, the lower bound we calculate from DraftKings' 10-K (Section 2). In row 9, markups are 38% of price, the average markup in the U.S. economy in 2016 reported in De Loecker, Eeckhout and Unger (2020). In both calibrations, the ad valorem tax is still more efficient than the specific tax.

Row 10 shows that if the semi-elasticity were half what we calibrate, the price change from the specific tax would move quantities less, narrowing the efficiency gap between the two taxes.

8 Conclusion

We show that the main taxes on sports betting in the U.S., state-level ad valorem taxes, do not affect the price of sports betting. Instead, they reduce sportsbook marketing, which in turn reduces deposits to sportsbooks. We estimate the ad-sensitivity of sportsbook deposits, and combine this estimate with others from the literature to compare the prevailing ad valorem tax to a specific tax. Because sports wager markups are likely high, specific taxes impose large burdens on both consumers and firms and the specific tax is less efficient than the ad valorem tax in our baseline calibration. The specific tax does reduce betting by more than the ad valorem tax, so if the uninternalized harms of sports betting were sufficiently large, the specific tax would be more efficient.

Since 2018, legal sports betting in the U.S. has grown from essentially nonexistent to

an industry that attracts $165 billion dollars wagered per year. Though every state with legal sports betting taxes it, relatively little attention has been paid to how these taxes are designed. We show that tax design influences both how much the tax affects betting consumption and who ultimately bears the tax's burden. Beyond taxes, policymakers are also considering direct regulations of sports betting television advertising (Tonko, 2025). Our reduced-form estimates of the effectiveness of sports betting advertising can help predict the effects of such restrictions.

More broadly, our analysis highlights an empirical context where tax design is especially consequential. It is well-known that ad valorem taxes shift prices less than specific taxes in imperfectly competitive markets, and that firms can respond to taxes through non-price margins. Sports betting is an extreme case: because wagers are digital goods with negligible marginal costs, ad valorem taxes do not affect prices at all and reduce consumption only by reducing advertising. Ad valorem and specific taxes therefore differ sharply both in their incidence and in their impacts on consumption. These considerations may apply in other markets where prices reflect markups rather than marginal costs and customer acquisition costs are large. In such markets, ad valorem taxes will operate as an implicit tax on marketing.

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A Additional Marketing Analyses Appendix

A.1 Promotional Sign-Up Offers

Unlike television advertising, promotional offers are specifically targeted at new customers. So, when estimating the effects of sign-up offers, we focus on this population. Since we do not anticipate effects of sign-up offers on existing customers, we use this population as a placebo check.

To do this exercise, we require time variation within sportsbooks' promos. This required scraping archival data from the Internet Archive, and we are limited to what was archived historically; sportsbooks themselves do not list historical promotional offers.

Our historical promotional offer data is visible in Figure A.9. The Internet Archive data restricts our analysis in three ways. First, we do not have state-level variation; the data we scrape is only the offer which Action Network lists as the headline offer for that sportsbook. It also means that not every person living in a legal state was able to use this offer in every period. Second, we only have reliable scraping for the three largest sportsbooks: FanDuel, DraftKings, and BetMGM. Third, the sample only goes back to July 2023. To get more power, we assume that if promo data is missing, a promo stayed in place for 30 days from the last time we observe it offered; after that, we treat that sportsbook's promo as missing.

We estimate a week-level extensive margin elasticity with sportsbook and month fixed effects:

$$\ln(\text{Depositors}_{bw}) = \varepsilon \ln(\text{Promo}_{bw}) + \alpha_b + \delta_m + u_{bw}$$

Depositors is the number of Consumer Edge cards which make a deposit to that sportsbook in that week. Our specification is at the sportsbook $\times$ week level. b indexes sportsbook (DraftKings, FanDuel, BetMGM), w indexes week, and m indexes month. α_b are sportsbook fixed effects. δ_m are month fixed effects.

Within a month, we compare weeks when cross-book promo differences are large vs small. When a sportsbook's promo is higher relative to the other books, do its deposits rise relative to the others?

Book fixed effects absorb the fact that sportsbooks differ in size and promotional offer generosity. Month fixed effects absorb seasonal patterns common across books like the Super Bowl, March Madness, etc.

There are two threats to this analysis. First, we do not have sportsbook-month fixed effects, so if only DraftKings does a non-promo marketing push in a month, and that push is correlated with a bump in DraftKings' promos, the elasticity is upwardly biased. Second, we do not have week fixed effects. The elasticity is identified from cross-sportsbook changes in

promos, so within-month unobserved demand shocks, common to all sportsbooks, bias our estimates if books differentially adjust promos in response to those shocks. For example, if all sportsbooks increase their promos a similar amount in the week of the Super Bowl, those promo changes do not contribute identifying variation to our elasticity estimate.

Sign-up offers are only available to customers who have never deposited at that sportsbook, so we split depositors into two mutually exclusive groups: new-to-book customers, who have no prior deposit at that sportsbook, and existing customers, who have deposited before. We present results in Figure A.8.

We find a positive but noisy point estimate on the elasticity of new depositors to sign-up offers.

We test the effect on existing customers as a placebo. If sign-up offers show a positive effect on this group, that finding must be spurious: this group is ineligible to use sign-up promos. Any positive effect would have to be from unobserved demand shifters correlated with sign-up offers. The estimated elasticity for existing customers is a precise zero, consistent with our identifying assumption that cross-sportsbook promo variation within months is uncorrelated with other unobserved demand shifters.

A.2 Dynamics of sports betting and characteristics of marginal bettors

Our estimates in Section 6 look only at the contemporaneous effects of advertisements. Now we explore the dynamics of sports betting over time for people who were exposed to higher levels of plausibly exogenous variation in advertising at sign-up. Understanding who these consumers are is important because the welfare effects of a reduction in ads, either through taxes or regulation, depend on whether marginal bettors are casual bettors or bettors with self-control or misperception problems.

We examine two types of outcomes for depositors: (i) the share of depositors who make a deposit at $t = 1 \dots 6$ months after their first deposit and (ii) average monthly dollars deposited, including those who make no deposits.

Before exploring heterogeneity, we see that most people do not keep depositing after making their initial deposit. Figure A.10a shows that only 36% of new depositors to a sportsbook make a deposit in the next month, and only 13% make a deposit in each of the six subsequent months. Figure A.10c shows this drop-off in dollar terms, combining the intensive and extensive margin. A depositor's first month tends to be their highest deposit-month. Average monthly deposits decline from \$450 to \$156 six months after the month of their deposit. Of all dollars deposited over a depositor's first 7 months, 30% comes in month

one.

To get at the characteristics of marginal bettors, we compare people who first deposited in high vs. low advertising months. The difference is informative about the characteristics of bettors marginal to advertising.

To ensure our measure of advertising is plausibly exogenous, we residualize using the same fixed effects and sample as Equation (10). We residualize out sportsbook × border × side ($\hat{\alpha}_{jbm(z)}$) and sportsbook × border × quarter fixed effects ($\hat{\alpha}_{jbq}$), leaving a residual $\tilde{a}^{\text{own}}_{jzbt}$ that is defined separately for each border experiment b:

$$\tilde{a}^{\text{own}}_{jzbt} = a^{\text{own}}_{jm(z)t} - \hat{\alpha}_{jbm(z)} - \hat{\alpha}_{jbq}$$

where $m(z)$ is the DMA containing ZIP3 z. The residual $\tilde{a}^{\text{own}}_{jzbt}$ is plausibly exogenous by the same argument as the identifying variation in Equation (10). Because a ZIP3 can belong to multiple border experiments, we average these residuals across border experiments, to give each sportsbook–ZIP3–month a single value, $\tilde{a}^{\text{own}}_{jzt}$.

Since a person can deposit at multiple sportsbooks, the unit of analysis is the depositor-sportsbook pair. We split the entire sample of depositor-sportsbooks in half based on the level of $\tilde{a}^{\text{own}}_{jzt}$ in that depositor's ZIP3 (z) in the month (t) of their first deposit to that sportsbook (j). We call these *the high-ad and low-ad groups*.

New depositor-sportsbook pairs in the high-ad group made their first deposit in periods when that sportsbook's ads were, on average, 3.4 times higher than for new depositors to that sportsbook in the low-ad group. Figure A.10 compares outcomes for the high-ad and low-ad groups. The two groups are similar in sportsbook composition and cohort-year composition (when they first deposited). Table A.13 provides more detail on the groups' composition.

We find no evidence that high-$\tilde{a}^{\text{own}}$ periods bring in customers who go on to deposit at disproportionately high levels. In fact, comparing means, they deposit \$206 less per depositor-sportsbook over their first seven months, though this is only marginally significant ($p = 0.050$). The high-ad group is significantly less likely to remain active: in the sixth month after their first deposit, 19.0% make a deposit, compared to 20.8% for the low-ad group ($p = 0.004$ for difference in means).

These results have implications for the design of sports betting policy. We show in Section 5 that the main consequence of ad valorem taxes is to reduce sportsbook marketing. The SAFE Bet Act, a federal bill introduced in 2025, but not yet passed, would regulate sports betting advertising, with an explicit goal to mitigate harms from problem gambling (Tonko, 2025). Our results suggest that policies restricting advertising would be an effective but blunt tool to accomplish this goal: we do not find evidence that advertising dispropor-

tionately brings high-deposit customers into the market.

B Supporting Calculations Appendix

B.1 Estimating National Promotional Credit Spending

In Table A.2, we estimate national promotional credit spending by extrapolating from state-level administrative data. We walk through the DraftKings calculation using Ohio data as an example.

The Ohio Casino Control Commission reports that DraftKings offered $103M in promotional credits (face value) in calendar year 2024, on $2.91B in dollars wagered in Ohio. This implies a promotional credit rate of 3.54% of dollars wagered. If DraftKings offers promotional credits at a similar rate nationwide, we can extrapolate to a national face value of $\$48.10B \times 3.54\%$.

However, promotional credits are not worth their face value. A $100 bonus bet, for example, cannot be converted to $100 in cash with certainty. We consider two conversion rates. The "low" rate of 45¢ on the dollar assumes users naively bet into standard -110 two-way markets. The "high" rate of 70¢ on the dollar assumes users exploit promos optimally, using the DarkHorse Odds conversion rate for bonus bets (see Section 4).

At the high conversion rate, DraftKings' national promotional credit cost is $1.19B, which is 113.5% of their $1.05B advertising spend. At the low conversion rate, the cost is $766M, or 72.9% of advertising.

The promo-to-dollars-wagered ratios differ across states and sportsbooks. Table A.2 presents the full set of calculations for two sportsbooks (DraftKings and FanDuel) and two states (Ohio, using calendar year 2024 data, and Pennsylvania, using fiscal year July 2024 – June 2025 data). These estimates assume sportsbooks offer promos at the same rate nationwide as they do in these states. Ohio legalized sports betting relatively recently (January 2023), which may lead to higher promo rates. Pennsylvania allows promotional credit deductibility but has a relatively high tax rate (36%).

B.2 Semi-Elasticity of Dollars Wagered to Industry Advertising

Row 2 of Table 3 reports $s^D_{Q,A}$, the semi-elasticity of industry dollars wagered with respect to a $1-per-100-resident increase in monthly advertising by every sportsbook at once. It is the directional derivative of the fitted log-deposit ad-response function (Table 2, col. 1) at the sample mean, taken along the ray on which own and rival ad spending expand in proportion,

so the \$1 step in own ads is matched by a $\bar{a}^{\text{rival}}/\bar{a}^{\text{own}}$ step in the rival sum. Table A.14 lists each input and step.

In closed form,

$$
\begin{aligned}
s^{D}_{Q,A} &= 100\left[\underbrace{\left(\hat{\gamma}_1 + 2\hat{\gamma}_3\bar{a}^{\text{own}} + \hat{\gamma}_5\bar{a}^{\text{rival}}\right)}_{\partial \ln Q/\partial a^{\text{own}}} + \frac{\bar{a}^{\text{rival}}}{\bar{a}^{\text{own}}}\underbrace{\left(\hat{\gamma}_2 + 2\hat{\gamma}_4\bar{a}^{\text{rival}} + \hat{\gamma}_5\bar{a}^{\text{own}}\right)}_{\partial \ln Q/\partial a^{\text{rival}}}\right] \\
&= 100\left[0.01666 + 2.414 \times 0.01491\right] = 5.26
\end{aligned}
$$

C Data Appendix

C.1 Sample Construction

C.1.1 Sample Construction for Advertising-Deposit Elasticity Analysis (Table 2)

Constructing border experiments. Unlike counties, ZIP3s do not align with DMA boundaries (Figure A.5). For each ZIP3 intersected by a DMA boundary:

1. If ≥80% of its area lies in one DMA, it joins that DMA-side (e.g., ZIP3 080 in Figure A.5b). Adjacent ZIP3s with ≥80% of their area in the other DMA form the other side.

2. If <80% lies in any single DMA, the ZIP3 is dropped (e.g., ZIP3 085 in Figure A.5b). Adjacent ZIP3s on either side of the border that meet the 80% threshold are added.

This procedure creates a gap between the two sides of each border experiment. The median experiment has a 14-mile gap between the nearest edges of opposing ZIP3s. Figure A.5 illustrates how the experiment changes under alternative thresholds: stricter thresholds retain fewer ZIP3s near the border. Figure A.6 shows how our coefficient on own-advertising changes as we vary this threshold choice.

Other sample restrictions.

1. We drop BetMGM because we cannot distinguish between ads for online casino and online sports betting in the Nielsen data.

2. We restrict to states where at least one major sportsbook operates, dropping RI, FL, and AR.

3. Sports betting is regulated at the state level, so we drop cross-state variation. If a DMA border coincides with a state border, we drop the experiment. If a border-side spans states, we keep only ZIP3s from whichever state has the most ZIP3s on that border-side.

4. We drop observations when sports betting was illegal in a state, only including post-legalization months for states that eventually legalized, and dropping states that did not legalize sports betting during our sample period.

5. After the above restrictions, the balanced side-sportsbook-month sample contains 61,226 observations. Of these, 21,099 (34.5%) have zero deposits and are dropped because we estimate $\log(Q)$.

C.1.2 Sample Construction for Synthetic Control

We include advertising by four major sportsbooks: DraftKings, FanDuel, BetRivers, and Caesars. We drop BetMGM because its advertising expenditure cannot be cleanly attributed to sports betting in the Nielsen data. We drop Fanatics and bet365 because they did not operate in Illinois before 2023, so do not have a long enough pre-period.

The donor DMAs are Baltimore, Baton Rouge, Denver, Detroit, Indianapolis, Lafayette La, Memphis, Nashville, New Orleans, New York, Norfolk, Philadelphia, Phoenix, Pittsburgh, Washington DC.

C.1.3 Sample Construction for Advertising-Tax Correlation (Figure 5c)

From the seven major sportsbooks, we use five sportsbooks for this analysis: DraftKings, FanDuel, Caesars, BetRivers, and bet365. We drop two: Fanatics only entered the market in 2023, and only advertised in multi-state DMAs (Boston and Washington DC), so Fanatics is dropped. BetMGM's ads for online casino vs. sports betting are indistinguishable in the Nielsen data, so BetMGM is dropped.

Among the five sportsbooks in this analysis, we remove advertisements whose brand description contains "fantasy" (to exclude daily fantasy sports) and keep only those containing "sports."

Starting from the 30 states and Washington, DC with legal online sports betting at the end of 2024 (when our Nielsen data ends), we apply the following filters:

1. **No major sportsbooks operate there (3 states) or the state has no ad valorem tax (1 state).** This is the same reasoning described in Section C.1.4. We drop Arkansas, Rhode Island, and Florida, where none of the sportsbooks in our sample operate. We drop Tennessee, which taxes dollars wagered rather than revenue.

2. **No county-level Nielsen DMA coverage (1 state).** We drop Connecticut, which has planning regions instead of counties. Counties are used to define the Nielsen DMA regions, so we cannot reliably calculate the population of the DMA for Connecticut DMAs.

3. **Multi-state DMAs (5 states).** Our variation is at the state level, so we keep only Nielsen DMAs that lie entirely within one state. This drops all DMAs from District of Columbia, Delaware, New Hampshire, New Jersey, and Vermont.

4. **Legalized too recently (1 state).** We include a state-year observation only if the state was legal by December 31 of the prior year. North Carolina was legal during

2024, the final year of the Nielsen data, so the associated state-year observations have no full year in the sample and are dropped.

Table A.8 reports the yearly share of the legal-state sample dropped because the physical DMA crosses state borders.

C.1.4 Sample Construction for Promotional Analyses

Our sample includes 27 states and Washington, DC. From the 31 states and Washington, DC with legal online sports betting as of 2025, we drop 4 for data limitations.

None of the sportsbooks in our sample operate (3 states): We drop 3 states because none of the sportsbooks in our sample operate there. We drop Florida, where the only legal online sportsbook is Hard Rock Bet (Seminole Tribe).[28] We drop Rhode Island (served only by Sportsbook Rhode Island) and Arkansas. Arkansas' regulations require licensees to retain 51% of net sports-betting revenue in any market-access agreement with a third-party operator, which discourages national operators.

No ad valorem tax (1 state): We drop Tennessee, which taxes dollars wagered rather than revenue.

C.2 Consumer Edge Benchmarking

This appendix benchmarks the Consumer Edge data.

Figure A.11 plots monthly sportsbook deposits by Consumer Edge cards billed to New York ZIP3s. Deposits spike sharply at New York's January 2022 legalization, demonstrating that the Consumer Edge data captures state-level legalization events.

Figure A.12 plots Consumer Edge deposits against administrative revenue across 25 states. The cross-state correlation is 0.85, and Consumer Edge deposits represent 9.2% of aggregate revenue.

Figure A.13 plots quarterly Consumer Edge sportsbook deposits against quarterly aggregate revenue reported by state regulators. The two series move closely together over the sample, with a quarterly log correlation of 0.97.

[28] Hard Rock Bet is the only legal online betting app in Florida (Legal Sports Report, 2025*b*).

D Proofs Appendix

D.1 Proof of Proposition 1

Proof. Part (i). The symmetric pricing first-order condition under ad valorem tax τ is

$$(1-\tau)\big[\theta\, Q(p^*) + p^*\, Q'(p^*)\big] = 0 \iff 1 - \frac{\theta}{\varepsilon_Q(p^*)} = 0.$$

The tax rate τ drops out as it is a scalar multiplier on the FOC. τ also does not influence prices indirectly through advertising, since advertising does not affect the elasticity of demand (Assumption 2). Hence p^* is determined solely by $\varepsilon_Q(p^*) = \theta$, independently of τ.

Part (ii). A specific tax of t per dollar wagered enters profit in exactly the same way as a marginal cost of t. With $\kappa = 0$, the symmetric pricing first-order condition under specific tax t is

$$G(p^*, t) \;\equiv\; \theta\, Q(p^*) + (p^* - t)\, Q'(p^*) = 0,$$

which is equation (4) with $\kappa = t$ and $\tau = 0$. Implicit differentiation gives $\partial G/\partial t = -Q'(p^*) > 0$ (since $Q' < 0$) and $\partial G/\partial p < 0$ by the second-order condition. Hence $dp^*/dt = -(\partial G/\partial t)/(\partial G/\partial p) > 0$.

Part (iii), ad valorem tax. The symmetric advertising first-order condition is

$$(1-\tau)\, p^*\, \frac{\partial Q_i}{\partial A_i}(A^*) = c'(A^*).$$

Implicitly differentiating with respect to τ:

$$\frac{dA^*}{d\tau} = \frac{p^*\, \frac{\partial Q_i}{\partial A_i}(A^*)}{(1-\tau)\, p^*\, \sum_j \frac{\partial^2 Q_i}{\partial A_i\, \partial A_j}(A^*) - c''(A^*)}.$$

The numerator is positive since $\partial Q_i/\partial A_i > 0$ and $p^* > 0$. Because the symmetric comparative static moves all firms' advertising together, the relevant second-order term is the summed cross-partial $\sum_j \partial^2 Q_i/\partial A_i\, \partial A_j$. The denominator is strictly negative: $c''(A^*) > 0$ by convexity of advertising costs, and $(1-\tau)\, p^*\, \sum_j \partial^2 Q_i/\partial A_i\, \partial A_j \le 0$ because a firm's marginal return to advertising is weakly decreasing in total industry advertising (Section 3). Hence $dA^*/d\tau < 0$.

Advertising under a specific tax. With $Q(p, A) = f(p)g(A)$, $f' < 0$ and $g' > 0$, and pass-through $\rho \equiv dp^*/dt$, the symmetric advertising first-order condition is

$$[p^*(t) - t]\, f(p^*(t))\, g'(A^*) = c'(A^*).$$

Implicit differentiation with respect to t yields

$$\frac{dA^*}{dt} = \frac{g'(A^*)\Big[\underbrace{-(1-\rho)\,f(p^*)}_{\text{margin channel}} + \underbrace{\rho\,(p^*-t)\,f'(p^*)}_{\text{price channel}}\Big]}{c''(A^*) - (p^*-t)\,f(p^*)\,g''(A^*)}.$$

The pricing first-order condition under the specific tax, $\frac{p^*-t}{p^*}\varepsilon_Q(p^*) = \theta$, implies $(p^* - t)f'(p^*) = -\theta f(p^*)$. Substituting into the numerator collapses the two channels into a single term:

$$\frac{dA^*}{dt} = \frac{-\,g'(A^*)\,f(p^*)\,\Big[\,1-\rho(1-\theta)\,\Big]}{c''(A^*) - (p^*-t)\,f(p^*)\,g''(A^*)}$$

The denominator is strictly positive: $c''(A^*) > 0$ by convex advertising costs, and $-(p^* - t)f(p^*)g''(A^*) \geq 0$ since advertising returns weakly diminish under a symmetric increase in industry advertising ($g'' \leq 0$; Section 3). With $g'(A^*), f(p^*) > 0$, the sign of dA^*/dt is opposite to that of the wedge $1 - \rho(1-\theta)$.

When the specific tax undershifts, $\rho < 1$, the wedge is strictly positive, since $\theta \geq 0$ gives $\rho(1-\theta) \leq \rho < 1$, so $dA^*/dt < 0$ and advertising falls. Overshifting ($\rho > 1$), or full pass-through under perfect competition ($\rho = 1$, $\theta = 0$), is necessary for advertising not to fall, since $dA^*/dt \geq 0$ requires $\rho(1-\theta) \geq 1$. A strict increase in advertising requires $\theta < 1 - 1/\rho$. □

D.2 Optimal price under positive marginal cost

Proof. With marginal cost $\kappa > 0$, the symmetric pricing first-order condition under conduct θ is

$$G(p) \;\equiv\; \theta\,Q(p) + \Big[p - \kappa/(1-\tau)\Big]Q'(p) \;=\; 0$$

Implicit differentiation with respect to τ gives

$$\frac{dp^*}{d\tau} \;=\; -\frac{G_\tau}{G_p} \;=\; -\frac{-\kappa\,Q'(p^*)/(1-\tau)^2}{G_p}.$$

The numerator $G_\tau = -\kappa\,Q'(p^*)/(1-\tau)^2$ is strictly positive since $Q'(p^*) < 0$. The denominator G_p is the second-order condition of the firm's pricing problem and is strictly negative at any interior maximum. Hence $dp^*/d\tau > 0$. □

D.3 Proof of Proposition 2

All four formulas share the same denominator, which equals revenue change per unit of Q:

$$\frac{dR/dj}{Q} = \frac{dz_j}{dj} - z_j\,\eta_j^{Tot},$$

since $R = z_j Q$ gives $dR/dj = \frac{dz_j}{dj}\,Q + z_j\,dQ/dj$, with $\frac{dz_j}{dj} = \omega_j + \frac{\partial z_j}{\partial p}\frac{dp}{dj}$ ($= 1$ for the specific tax, $= p + \tau\,dp/d\tau$ for the ad valorem tax).

Item 1 (Decision consumer surplus). With quasilinear preferences, $\partial DCS/\partial p = -Q$. By Assumption 3, $dU/dA_i = 0$; at the consumer's optimum where $\partial V/\partial Q = p$, this implies $\partial V/\partial A = 0$. By the envelope theorem, advertising therefore has no first-order effect on decision consumer surplus. Hence

$$\frac{dDCS}{dj} = -Q\,\frac{dp}{dj}.$$

Dividing by dR/dj gives equation (5).

Item 2 (Producer surplus). $PS = m_j\,Q - c(A)$ where $m_j = p - \kappa - z_j$. Differentiating:

$$\frac{dPS}{dj} = \underbrace{\left(\frac{dp}{dj} - \frac{dz_j}{dj}\right)Q}_{\text{change in per-unit profit}} + \underbrace{m_j\,\frac{dQ}{dj}}_{\text{extensive margin}} - \underbrace{c'(A)\,\frac{dA}{dj}}_{\text{ad cost}}.$$

The firm's advertising FOC gives $c'(A) = m_j\,\frac{\partial Q}{\partial A}$, so $c'(A)\,\frac{dA}{dj} = m_j\,\frac{\partial Q}{\partial A}\,\frac{dA}{dj} = -m_j\,Q\,\eta_j^A$. Substituting and using $m_j\,\frac{dQ}{dj} = -m_j\,Q\,\eta_j^{Tot}$:

$$\frac{dPS}{dj} = \left(\frac{dp}{dj} - \frac{dz_j}{dj}\right)Q - m_j\,Q\,\eta_j^{Tot} + m_j\,Q\,\eta_j^A = Q\left[\left(\frac{dp}{dj} - \frac{dz_j}{dj}\right) - m_j\,\eta_j^P\right].$$

Dividing by dR/dj gives equation (6).

Item 3 (Externalities and internalities). $\frac{d(-\Gamma(Q))}{dj} = -\Gamma_Q\,\frac{dQ}{dj} = \Gamma_Q\,Q\,\eta_j^{Tot}$. Dividing by dR/dj gives the third formula in Proposition 2.

Item 4 (Marginal excess burden). Total surplus is $TS = DCS + PS + R - \Gamma(Q)$. Summing the four components per unit of Q:

$$\frac{dTS/dj}{Q} = \underbrace{-\frac{dp}{dj}}_{\text{DCS}} + \underbrace{\frac{dp}{dj} - \omega_j - \frac{\partial z_j}{\partial p}\frac{dp}{dj} - m_j\,\eta_j^P}_{\text{PS}} + \underbrace{\omega_j + \frac{\partial z_j}{\partial p}\frac{dp}{dj} - z_j\,\eta_j^{Tot}}_{\text{Revenue}} + \underbrace{\Gamma_Q\,\eta_j^{Tot}}_{\text{Ext./Int.}}$$

The $\frac{dp}{dj}$ terms cancel (transfer between consumers and firms) and the ω_j and price-channel revenue terms $\frac{\partial z_j}{\partial p}\frac{dp}{dj}$ cancel (transfers between firms and government), leaving

$$\frac{dTS/dj}{Q} = -z_j\,\eta_j^{Tot} - m_j\,\eta_j^P + \Gamma_Q\,\eta_j^{Tot}.$$

Dividing by $(\frac{dz_j}{dj} - z_j\,\eta_j^{Tot})$ gives equation (8). □

D.4 Calibration details

This appendix derives two inputs to the welfare calibration via two lemmas. Lemma 1 determines the specific tax's ad-channel response. Lemma 2 derives the average decision consumer surplus per advertising-induced consumption unit, under a particular model of normatively beneficial advertising.

We begin by reviewing some notation. Assumption 2 specifies demand as $Q_i = f(p_i, p_{-i}) \cdot g(A_i, A_{-i})$. In the symmetric equilibrium, rivals hold price and advertising at the common values (p, A); evaluated there, we write $f(p) \equiv f(p_i;\, p_{-i}{=}p)$ and $g(A) \equiv g(A_i;\, A_{-i}{=}A)$ as functions of own choices only, with $f'(p) = \partial Q_i/\partial p_i$ and $g'(A) = \partial Q_i/\partial A_i$ the corresponding own-choice partial derivatives. Write $s^D_{Q,P} \equiv -f'(p^*)/f(p^*)$ for the local own-price semi-elasticity at the baseline hold p^*, and $\rho \equiv dp/dt$ for the specific-tax pass-through rate. Using this notation, firm i's profit-maximization conditions in the symmetric equilibrium under the specific tax reduce to:

$$(p - t)\,f'(p) + \theta\,f(p) = 0 \tag{P}$$

$$(p - t)\,f(p)\,g'(A) = c'(A) \tag{A}$$

where (P) is the pricing FOC and (A) is the advertising FOC. For the ad valorem tax, $(1-\tau)p^*$ replaces $p - t = p^*$. Lemma 1 differentiates these conditions with respect to each tax, holding rivals at their symmetric equilibrium values throughout.

Lemma 1 (ad-response). Claim. For pass-through rate $\rho = dp/dt$,

$$\frac{dA^*}{dt} = \frac{\rho\, s^D_{Q,P}\, p^* + (1-\rho)}{p^*}\, \frac{dA^*}{d\tau}.$$

Under full pass-through ($\rho = 1$): $\eta^A_t = s^D_{Q,P}\, \eta^A_\tau$.

Proof. Let $D \equiv p^*\, f\, g'' - c'' < 0$ be the ad second-order condition at common retention p^*.

Differentiate FOC (A) in t using $dp/dt = \rho$. At the baseline retention $p - t = p^*$, and using $f'(p^*) = -s^D_{Q,P}\, f(p^*)$ (definition of local semi-elasticity; no functional-form restriction):

$$\begin{aligned}
(\rho - 1)\, f\, g' + (p^*)\, \underbrace{f'(p^*)}_{=-s^D_{Q,P} f}\, \rho\, g' + p^*\, f\, g''\, \frac{dA}{dt} &= c''\, \frac{dA}{dt} \\
(\rho - 1)\, f\, g' - s^D_{Q,P}\, p^*\, \rho\, f\, g' &= -D\, \frac{dA}{dt} \\
\frac{dA^*}{dt} &= \frac{(s^D_{Q,P}\, p^*\, \rho + 1 - \rho)\, f\, g'}{D}
\end{aligned}$$

Differentiate the ad valorem FOC $(1-\tau)\, p^*\, f\, g' = c'$ in τ using $dp/d\tau = 0$ (Proposition 1); at common retention p^* the same D applies:

$$\begin{aligned}
-p^*\, f\, g' + p^*\, f\, g''\, \frac{dA}{d\tau} &= c''\, \frac{dA}{d\tau} \\
\frac{dA^*}{d\tau} &= \frac{p^*\, f\, g'}{D}
\end{aligned}$$

Therefore

$$\frac{dA^*/dt}{dA^*/d\tau} = \frac{s^D_{Q,P}\, p^*\, \rho + (1-\rho)}{p^*} = \rho\, s^D_{Q,P} + \frac{1-\rho}{p^*}.$$

Setting $\rho = 1$ (row 8) gives $\eta^A_t = s^D_{Q,P}\, \eta^A_\tau$. □

We now turn to the welfare effects of ads. In the main text, we assume that advertising-induced consumption does not increase decision consumer surplus. The lemma below quantifies the decision consumer surplus benefits of ad-induced units under a particular model of informative advertising.

Lemma 2 (ad-margin surplus). Claim. Suppose ads exclusively increase demand on the extensive margin by increasing consumers' awareness of normatively valuable consumption opportunities, and that ad-induced consumers have identical preferences to all other consumers in the market. Ads have no effect on welfare except by changing consumption choices. Suppose further that demand has a constant semi-elasticity functional form, $Q(p) = Q_0\, e^{-s^D_{Q,P}(p-p^*)}$. Then every ad-induced consumption unit provides average decision

consumer surplus of $1/s^D_{Q,P}$ dollars.

Proof. Under this model, ad-induced consumption units are identical in welfare terms to the average inframarginal unit. So, the average decision consumer surplus per ad-induced unit equals the average decision consumer surplus per unit across the baseline population. Under our functional form of aggregate demand, this decision consumer surplus is

$$S = \int_{p^*}^{\infty} Q_0 \, e^{-s^D_{Q,P}(p-p^*)} \, dp = \frac{Q_0}{s^D_{Q,P}},$$

so average surplus per dollar wagered is $\sigma_A = S/Q_0 = 1/s^D_{Q,P}$. $\square$

Appendix Tables

Table A.1. Market share by sportsbook, in dollars wagered, for the month of August 2025

Operator	Market Share (%)
DraftKings	35.2
FanDuel	29.6
BetMGM	14.3
Caesars	6.9
ESPN Bet (since rebranded as theScore Bet)	3.4
Rush Street Entertainment	3.4
Fanatics	2.6
bet365	1.3
Other	3.3

Notes: Source: Casino Reports (2025). Rush Street Entertainment owns BetRivers.

Table A.2. Estimates of national promotional credit costs for DraftKings and FanDuel (2024)

	Low Conversion (45¢)	High Conversion (70¢)
Panel A: DraftKings (National Dollars Wagered: $48.10B, Advertising: $1.05B)		
Pennsylvania (FY 2024-25)		
State promo credits (face value)	$76M	$76M
State dollars wagered	$2.25B	$2.25B
Promo rate (face value)	3.36%	3.36%
Promo cost rate	1.51%	2.35%
National promo cost (extrapolated)	$727M	$1.13B
Promos % of national advertising	69.2%	107.7%
Ohio (CY 2024)		
State promo credits (face value)	$103M	$103M
State dollars wagered	$2.91B	$2.91B
Promo rate (face value)	3.54%	3.54%
Promo cost rate	1.59%	2.48%
National promo cost (extrapolated)	$766M	$1.19B
Promos % of national advertising	72.9%	113.5%
Panel B: FanDuel (National Dollars Wagered: $50.90B, Advertising: $1.97B)		
Pennsylvania (FY 2024-25)		
State promo credits (face value)	$106M	$106M
State dollars wagered	$3.35B	$3.35B
Promo rate (face value)	3.17%	3.17%
Promo cost rate	1.43%	2.22%
National promo cost (extrapolated)	$726M	$1.13B
Promos % of national advertising	36.9%	57.5%
Ohio (CY 2024)		
State promo credits (face value)	$109M	$109M
State dollars wagered	$2.92B	$2.92B
Promo rate (face value)	3.73%	3.73%
Promo cost rate	1.68%	2.61%
National promo cost (extrapolated)	$854M	$1.33B
Promos % of national advertising	43.4%	67.6%

Notes: State-level promo credits and dollars wagered are from administrative data (Ohio Casino Control Commission, Pennsylvania Gaming Control Board). National dollars wagered and advertising are from 2024 10K filings. Low conversion rate (45¢) assumes naive betting into -110 markets. High conversion rate (70¢) uses DarkHorse Odds optimal conversion for bonus bets.

Table A.3. Promotional Offer Expected Values by Sportsbook

Sportsbook	Default Offer	Conversion	EV	Deviations from Default
DraftKings	Bet $5, Get $300 bonus bets + $1000 deposit match	$300 × 0.70 + $1000	$1,210	MA, NC: $210 (no deposit match); OR, NH: $0
BetMGM	$1,500 First Bet (risk-free)	$1,500 × 0.50	$750	iGaming (NJ, WV, PA, MI): $150 bonus bets = $105; NV: $250 bonus bets = $175; NY: $0
Fanatics	Bet & Get up to $2,000 in No Sweat Bets	$2,000 × 0.50	$1,000	NY: $0
BetRivers	2nd Chance Bet (risk-free)	× 0.50	varies	$500 (face) → $250 (EV): DE, IL, IN, LA, MD, MI, PA, VA $250 (face) → $125 (EV): CO, NJ $100 (face) → $50 (EV): AZ, IA, NY, OH, WV
FanDuel	Bet $5, Get $250 bonus bets	$250 × 0.70	$175	MO: $210 ($300×0.7)
Caesars	10×$25 profit boosts	$250 × 0.66	$165	(uniform)
Bet365	$1,000 Safety Net (risk-free)	$1,000 × 0.50	$500	iGaming states (NJ, PA): $200 bonus bets × 0.70 = $140

Notes: Promotional sign-up offers as of January 23, 2026. Conversion rates from DarkHorse Odds (DarkHorse Odds, 2025; The Wall Street Journal, 2024). Expected values computed as offer amount × conversion rate. Bonus bets convert at 0.70; risk-free/second chance/safety net bets convert at 0.50, 100% profit boosts at 0.66 on the dollar. iGaming states are NJ, DE, WV, PA, MI, CT. Caesars offers uniform promos across all states and is excluded from Figure 5d. Bet365 offers uniform promos across non-iGaming states but varies promos within iGaming states, so it is included in the main analysis. States of operation as of Jan 23, 2026: DraftKings (AZ, CO, CT, DC, IL, IN, IA, KS, KY, LA, MA, ME, MD, MI, MO, NH, NC, NJ, NY, OH, OR, PA, TN, VA, VT, WV, WY); BetMGM (AZ, CO, DC, IN, IA, IL, KS, KY, LA, MA, MD, MI, MO, NC, NJ, NV, NY, OH, PA, TN, VA, WV, WY); Fanatics (AZ, CO, CT, DC, IA, IL, IN, KS, KY, LA, MA, MD, MI, MO, NC, NJ, NY, OH, PA, TN, VA, VT, WV, WY); BetRivers (AZ, CO, DE, IL, IN, IA, LA, MD, MI, NJ, NY, OH, PA, VA, WV); FanDuel (AZ, CO, CT, DC, IL, KS, KY, LA, IN, IA, MA, MD, MI, MO, NC, NJ, NY, OH, PA, TN, VA, VT, WV, WY); Caesars (AZ, CO, DC, IL, IN, IA, KS, KY, LA, MA, MD, ME, MI, MO, NC, NJ, NV, NY, OH, PA, TN, VA, WV); Bet365 (AZ, CO, IA, IL, IN, KS, KY, LA, MD, MO, NC, NJ, OH, PA, TN, VA).

Table A.4. Evidence for Uniform Pricing Across States

Sportsbook	Quote	Date	Source
FanDuel	"We can confirm that odds are the same in every state FanDuel operates"	August 2025	Email communication between FanDuel and the authors
BetMGM	"BetMGM offers the same odds in each state. However, there can be differences in the markets we offer. Each state has different regulations on what props they allow."	October 2025	Email communication between BetMGM and the authors
DraftKings, FanDuel	"Neither [DraftKings nor FanDuel] sportsbook employs state-specific odds or pricing, spokespeople with DraftKings and FanDuel confirmed."	September 9, 2024	Legal Sports Report (2024)
DraftKings	"Despite the state's insanely high 51% tax rate, most New York sportsbooks offer the same exact odds and lines featured on their platforms in other states with reasonable rates. For example, any and all odds offered by DraftKings in New York will mirror their offerings available over the bridge in New Jersey. So contrary to popular belief, New York's extraordinary gambling tax isn't going to affect your day-to-day sports betting operations, at all."	October 2025	SportsHandle (2025)
Multiple	"We understand that most US bookmakers use the same sportsbook (same odds) in each state that they operate in."	August 2025	Email communication between staff at odds provider Odds API and the authors
DraftKings	Jason Robins: "If you look at sort of the way it's typically done in other industries, whether it'd be hotel taxes or even the sales tax that you pay when you buy something at the store, taxis, you name it. It's typically line itemed out separately and usually 100% passed along to the consumer. In this case, we're obviously subsidizing a chunk of it. So, we just thought that was most sort of in line with how it's typically done versus trying to obfuscate it..."	Q2 2024	DraftKings (2024*a*)
DraftKings	[DraftKings CEO] "Robins cautioned DraftKings would likely resort to 'draconian' measures like reducing promotional spend even further and **adding additional juice [higher price to wager a dollar] to bets placed in New York**."	Feb 2023	SBC Americas (2023)
Caesars	For the most part, companies such as Caesars Entertainment and William Hill [since acquired by Caesars] offered identical lines and odds in every jurisdiction	January 2020	ESPN (2020)
DraftKings	Jason Robins: "...tweaking pricing is something you need to consider and some of it will depend on your first question, tax treatment... in terms of other states [besides Illinois], I think we have to see how this one goes...this will be a really interesting experiment to find out what the sort of net effects of implementing such a [state-specific] charge will be. And that will give us great data upon which to rely as we think about other states that may have higher tax rates and what we want to do there."	August 2025	DraftKings (2025*b*)

Table A.5. Sportsbook responses to the Illinois per-wager tax

Strategy	Sportsbook	Details	Source
Full pass-through, all wagers	FanDuel	-	SBC Americas (2025*c*)
	Caesars	-	SBC Americas (2025*b*)
	Fanatics	-	Covers.com (2025)
Full pass-through, with exemptions	DraftKings	Applies to singles $\leq$ \$50, parlays $<$ \$10	DraftKings (2025*a*)
	bet365	Applies to wagers $<$ \$10	SBC Americas (2025*a*)
Minimum bet increase	BetMGM	Raised minimum to \$2.50	Deadspin (2025)
	BetRivers	Raised minimum to \$5	Legal Sports Report (2025*a*)

Table A.6. Post-launch ad valorem tax changes and reasons they are not used for within-state identification

State	Change	Reason not used
Ohio	10% → 20% (7/1/23)	6 months after legalization
Maryland	15% → 20% (6/1/25)	No post-2024 ads data
Louisiana	15% → 21.5% (8/1/25)	No post-2024 ads data
New Jersey	14.25% → 19.75% (7/1/25)	No post-2024 ads data
D.C.	10% → 10/20/30% (8/1/24)	Simultaneous license expansion

Table A.7. Sportsbook Launch Month by State

State	Legalized	DraftKings	FanDuel	BetMGM	Caesars	BetRivers	bet365	Fanatics
NV	**Mar '18**	–	–	Mar '20	Mar '18	–	–	–
NJ	**Aug '18**	Sep '18	Sep '18	Aug '18	Sep '18	Aug '22	Aug '19	May '24
PA	**Jun '19**	Jul '19	Jul '19	Jan '20	Mar '20	Jun '19	Jan '24	Jan '24
IA	**Aug '19**	Feb '20	Sep '20	Jan '21	Aug '19	Jan '21	Aug '23	Feb '24
WV	**Aug '19**	Aug '19	Aug '19	Jan '20	Aug '19	Jun '22	–	Nov '23
IN	**Oct '19**	Oct '19	Oct '19	Feb '20	May '20	Oct '19	Jan '23	Feb '24
NH	**Dec '19**	Dec '19	–	–	–	–	–	–
CO	**May '20**	May '20	May '20	May '20	Sep '20	May '20	Sep '22	Dec '23
IL	**Jun '20**	Aug '20	Aug '20	Mar '22	Sep '20	Jun '20	Mar '25	Apr '24
TN	**Nov '20**	Nov '20	Nov '20	Nov '20	Mar '21	–	Mar '25	Aug '23
MI	**Jan '21**	Jan '21	Jan '21	Jan '21	Jan '21	Jan '21	–	Aug '23
VA	**Jan '21**	Jan '21	Jan '21	Jan '21	Jan '21	Jan '21	Feb '23	Feb '23
DC	**Jun '21**	Apr '24	Mar '24	Jun '21	Aug '21	–	–	Sep '24
AZ	**Sep '21**	Sep '21	Sep '21	Sep '21	Sep '21	Oct '21	Oct '23	Apr '24
WY	**Sep '21**	Sep '21	Mar '22	Sep '21	Aug '22	–	–	May '24
CT	**Oct '21**	Oct '21	Oct '21	–	–	–	–	Dec '23
LA	**Jan '22**	Jan '22	Jan '22	Jan '22	Jan '22	Jan '22	Jan '23	Aug '24
NY	**Jan '22**	Jan '22	Jan '22	Jan '22	Jan '22	Jan '22	–	Feb '24
OR	**Jan '22**	Jan '22	–	–	–	–	–	–
KS	**Sep '22**	Sep '22	Sep '22	Sep '22	Sep '22	–	Aug '25	Mar '24
MD	**Nov '22**	Nov '22	Nov '22	Nov '22	Nov '22	Nov '22	Aug '25	Jan '23
OH	**Jan '23**	Jan '23	Jan '23	Jan '23	Jan '23	Jan '23	Jan '23	Jan '23
MA	**Mar '23**	Mar '23	Mar '23	Mar '23	Mar '23	–	–	Aug '23
KY	**Sep '23**	Sep '23	Sep '23	Sep '23	Sep '23	–	Sep '23	Sep '23
ME	**Nov '23**	Nov '23	–	–	Nov '23	–	–	–
VT	**Jan '24**	Jan '24	Jan '24	–	–	–	–	Jan '24
DE	**Jan '24**	–	–	–	–	Jan '24	–	–
NC	**Mar '24**	Mar '24	Mar '24	Mar '24	Mar '24	–	Mar '24	Mar '24
MO	**Dec '25**	Dec '25	Dec '25	Dec '25	Dec '25	–	Dec '25	Dec '25

Notes: Each cell gives the month a sportsbook launched online mobile betting in the state. "–" means the book does not operate there. States are ordered from earliest to latest market opening.

Table A.8. Percent dropped because DMAs cross state borders in the advertising-tax sample

Year	Dropped / total legal-state DMA pieces	Percent by DMA	Percent by population
2019	13 / 15	86.7%	81.2%
2020	42 / 54	77.8%	68.2%
2021	52 / 69	75.4%	72.7%
2022	73 / 101	72.3%	59.6%
2023	90 / 129	69.8%	63.1%
2024	111 / 160	69.4%	62.4%
Pooled 2019–2024	381 / 528	72.2%	64.4%

Notes: "By DMA" counts legal-state DMA pieces, since the regression sample is built from DMAs before aggregation to the state-sportsbook-year level. "By population" weights those same pieces by eligible legal-state population inside each DMA. The pooled row sums dropped and total pieces (and populations) across all state-years in the 2019–2024 regression sample, so it overweights states that are legal earlier — mirroring the weighting implicit in the regression itself.

Table A.9. Tax → Marketing: Controls

Panel A: Advertising (local TV ad spend per 100 residents on tax rate in p.p.)

	(0)	(1)	(2)	(3)	(4)	(5)
Tax Rate		−0.450**	−0.376***	−0.398***	−0.404*	−0.422
Number of Sportsbooks			4.139*	3.562	3.527	3.487
Years Since Legalization				−0.268	−0.268	−0.277
Income ($10k)					0.299	−0.248
Dem Vote Share						0.075
Sportsbook-year fixed effects	Y	Y	Y	Y	Y	Y
N	163	163	163	163	163	163
R^2	0.43	0.46	0.47	0.48	0.48	0.48

Panel B: Promotional offers (promo value in $ on tax rate in p.p.)

	(0)	(1)	(2)	(3)	(4)	(5)
Tax Rate		−7.698*	−6.755*	−6.796*	−7.011*	−8.363**
Number of Sportsbooks			39.431	45.562*	45.822*	48.446*
Years Since Legalization				−27.771***	−28.650***	−27.366***
Income ($10k)					8.388	−26.823
Dem Vote Share						4.733
Sportsbook fixed effects	Y	Y	Y	Y	Y	Y
N	124	124	124	124	124	124
R^2	0.67	0.72	0.73	0.75	0.75	0.76

Notes: Panel A regresses local TV ad spending per 100 residents on tax rate, and the sample mirrors Figure 5c and all columns include sportsbook × year fixed effects. Panel B regresses promotional offer value ($) on tax rate, sample mirrors Figure 5d (all legal states; 124 state-sportsbook pairs, 27 states and DC) and all columns include sportsbook fixed effects. p-values use Wild Cluster Bootstrap. Clusters are states.

Table A.10. Advertising Semi-Elasticity Estimates with Lagged Advertising

		Customers		Dep./Customer	
	Deposits	New	Existing	New	Existing
	(1)	(2)	(3)	(4)	(5)
$\ln Y_{j,m,t-1}$	0.38060***	0.16919***	0.44146***	−0.13608***	0.26313***
	(0.01912)	(0.02189)	(0.02235)	(0.01440)	(0.02051)
Own	0.01914***	0.04826***	0.02168***	−0.00893	−0.00020
	(0.00450)	(0.00722)	(0.00316)	(0.00711)	(0.00394)
Own Lag (t-1)	−0.00061	0.00399	−0.00124	0.00107	−0.00150
	(0.00197)	(0.00247)	(0.00128)	(0.00319)	(0.00195)
Own^2	−0.00034**	−0.00103***	−0.00037***	0.00026	0.00009
	(0.00014)	(0.00021)	(0.00007)	(0.00017)	(0.00010)
Rival	0.01726***	0.02579***	0.01553***	−0.00361	0.00224
	(0.00295)	(0.00343)	(0.00268)	(0.00417)	(0.00272)
Rival Lag (t-1)	0.00234**	0.00051	0.00133	−0.00130	0.00270**
	(0.00114)	(0.00156)	(0.00090)	(0.00219)	(0.00130)
Rival^2	−0.00019***	−0.00025***	−0.00021***	0.00010*	−0.00000
	(0.00006)	(0.00007)	(0.00006)	(0.00006)	(0.00005)
Own × Rival	0.00002	−0.00000	0.00002	−0.00003	−0.00011
	(0.00016)	(0.00016)	(0.00014)	(0.00019)	(0.00015)
SB × Border × DMA FE	Yes	Yes	Yes	Yes	Yes
SB × Border × Quarter FE	Yes	Yes	Yes	Yes	Yes
Observations	20,284	20,284	20,284	20,284	20,284
R^2	0.937	0.864	0.970	0.484	0.781

Notes: Sportsbook × DMA clustered standard errors in parentheses. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$. Column (1) pools all depositors. Columns (2)–(5): "New" = first deposit at that sportsbook in that calendar month. Border experiments restricted to quarters in which sports betting is legal and to ZIP3s where a majority of the population resides in one state. This table uses Consumer Edge data.

Table A.11. Advertising Semi-Elasticity: Allowing Cross-State Border Experiments

		Customers		Dep./Customer	
	Deposits	New	Existing	New	Existing
	(1)	(2)	(3)	(4)	(5)
$\ln Y_{j,m,t-1}$	0.38854***	0.17055***	0.43771***	−0.07493***	0.30338***
	(0.02435)	(0.02374)	(0.03048)	(0.02005)	(0.02682)
Own	0.02303***	0.05580***	0.02223***	−0.00665	0.00101
	(0.00478)	(0.00795)	(0.00330)	(0.00704)	(0.00395)
Rival	0.01435***	0.02853***	0.01477***	−0.00390	−0.00032
	(0.00291)	(0.00388)	(0.00229)	(0.00468)	(0.00269)
Own^2	−0.00043***	−0.00114***	−0.00039***	0.00025*	−0.00000
	(0.00012)	(0.00019)	(0.00006)	(0.00015)	(0.00010)
Rival^2	−0.00016***	−0.00030***	−0.00019***	0.00011	−0.00000
	(0.00006)	(0.00008)	(0.00005)	(0.00008)	(0.00006)
Own × Rival	0.00007	−0.00008	0.00006	−0.00022	0.00005
	(0.00017)	(0.00018)	(0.00012)	(0.00024)	(0.00017)
SB × Border × DMA FE	Yes	Yes	Yes	Yes	Yes
SB × Border × Quarter FE	Yes	Yes	Yes	Yes	Yes
Observations	14,454	14,454	14,454	14,454	14,454
R^2	0.939	0.867	0.966	0.518	0.814

Notes: Sportsbook × DMA clustered standard errors in parentheses. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$. Column (1) pools all depositors. Columns (2)–(5): "New" = first deposit at that sportsbook in that calendar month. Border experiments restricted to legal quarters but cross-state borders allowed. This table uses Consumer Edge data.

Table A.12. Advertising Semi-Elasticity: DraftKings and FanDuel Only

		Customers		Dep./Customer	
	Deposits	New	Existing	New	Existing
	(1)	(2)	(3)	(4)	(5)
$\ln Y_{j,m,t-1}$	0.40818***	0.22341***	0.48014***	−0.12503***	0.27894***
	(0.02279)	(0.02401)	(0.02620)	(0.01658)	(0.02560)
Own	0.01894***	0.05377***	0.02358***	−0.00619	−0.00344
	(0.00437)	(0.00654)	(0.00302)	(0.00647)	(0.00374)
Rival	0.02235***	0.03496***	0.02519***	−0.00933	0.00257
	(0.00384)	(0.00558)	(0.00406)	(0.00612)	(0.00371)
Own^2	−0.00025**	−0.00089***	−0.00029***	0.00009	0.00011
	(0.00011)	(0.00019)	(0.00007)	(0.00016)	(0.00010)
Rival^2	−0.00034***	−0.00032***	−0.00043***	0.00010	−0.00008
	(0.00010)	(0.00011)	(0.00014)	(0.00011)	(0.00008)
Own × Rival	−0.00019	−0.00069***	−0.00037*	0.00037	0.00006
	(0.00022)	(0.00024)	(0.00020)	(0.00026)	(0.00020)
SB × Border × DMA FE	Yes	Yes	Yes	Yes	Yes
SB × Border × Quarter FE	Yes	Yes	Yes	Yes	Yes
Observations	16,894	16,894	16,894	16,894	16,894
R^2	0.943	0.861	0.969	0.450	0.781

Notes: Sportsbook × DMA clustered standard errors in parentheses. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$. Column (1) pools all depositors. Columns (2)–(5): "New" = first deposit at that sportsbook in that calendar month. Border experiments restricted to quarters in which sports betting is legal and to ZIP3s where a majority of the population resides in one state. This table uses Consumer Edge data.

Table A.13. Composition of above- and below-median advertising halves for Section A.2

	Below median	Above median
Sportsbook		
DraftKings	51%	41%
FanDuel	42%	48%
Caesars	1%	3%
BetRivers	2%	2%
Bet365	4%	6%
Cohort year		
2018	0%	0%
2019	2%	2%
2020	4%	4%
2021	9%	9%
2022	19%	14%
2023	40%	44%

Notes: This table uses Consumer Edge data.

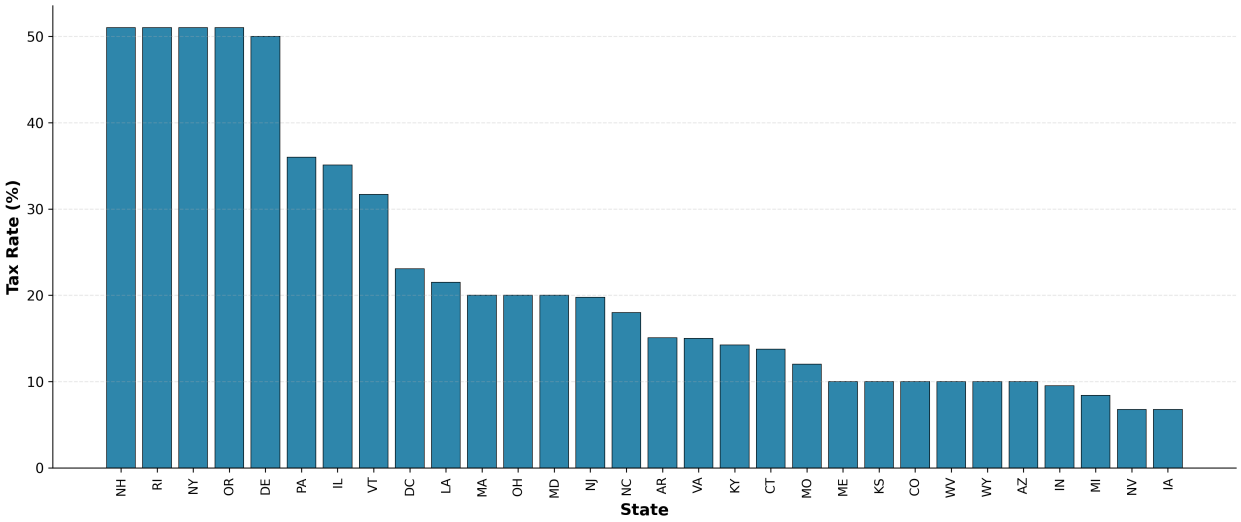
Table A.14. Inputs to the industry-advertising semi-elasticity $s^D_{Q,A}$.

#	Quantity	Value	Unit	Source
1	Own ad coefficient, $\hat{\gamma}_1$	0.01812	log-deposits per \$ per 100 DMA residents per DMA-month	Table 2, col. 1
2	Rival ad coefficient, $\hat{\gamma}_2$	0.01703	log-deposits per \$ per 100 DMA residents per DMA-month (rival sum)	Table 2, col. 1
3	Own^2 coefficient, $\hat{\gamma}_3$	−0.00030	log-deposits per (\$ per 100 DMA residents per DMA-month)^2	Table 2, col. 1
4	Rival^2 coefficient, $\hat{\gamma}_4$	−0.00018	log-deposits per (\$ per 100 DMA residents per DMA-month)^2	Table 2, col. 1
5	Own × rival coefficient, $\hat{\gamma}_5$	0.00000	log-deposits per (\$ per 100 DMA residents per DMA-month)^2	Table 2, col. 1
6	Mean own ad spend, $\bar{a}^{\text{own}}$	\$2.44	\$ per 100 DMA residents per sportsbook per DMA-month	Population-weighted sample mean (Table 2)
7	Mean rival ad spend, $\bar{a}^{\text{rival}}$	\$5.89	\$ per 100 DMA residents per DMA-month, summed over rivals	Population-weighted sample mean (Table 2)
8	Own marginal effect, $\partial \ln Q/\partial a^{\text{own}} = \hat{\gamma}_1 + 2\hat{\gamma}_3\bar{a}^{\text{own}} + \hat{\gamma}_5\bar{a}^{\text{rival}}$	0.01666	log-deposits per \$ per 100 DMA residents per DMA-month	Rows 1, 3, 5, 6, 7
9	Rival marginal effect, $\partial \ln Q/\partial a^{\text{rival}} = \hat{\gamma}_2 + 2\hat{\gamma}_4\bar{a}^{\text{rival}} + \hat{\gamma}_5\bar{a}^{\text{own}}$	0.01491	log-deposits per \$ per 100 DMA residents per DMA-month	Rows 2, 4, 5, 6, 7
10	Lockstep ratio, $\bar{a}^{\text{rival}}/\bar{a}^{\text{own}}$	2.414	unitless	Row 7 ÷ Row 6
11	Own-channel contribution, 100× Row 8	1.666	% \$ wagered per (\$1 ad/100 capita per month, all firms)	Row 8 ×100
12	Rival-channel contribution, 100× Row 10 × Row 9	3.599	% \$ wagered per (\$1 ad/100 capita per month, all firms)	Rows 9, 10 ×100
13	Semi-elasticity, $s^D_{Q,A}$	5.26	% \$ wagered per (\$1 ad/100 capita per month, all firms)	Row 11 + Row 12

Notes: Advertising is measured per firm; dollars wagered is the industry total.

Appendix Figures

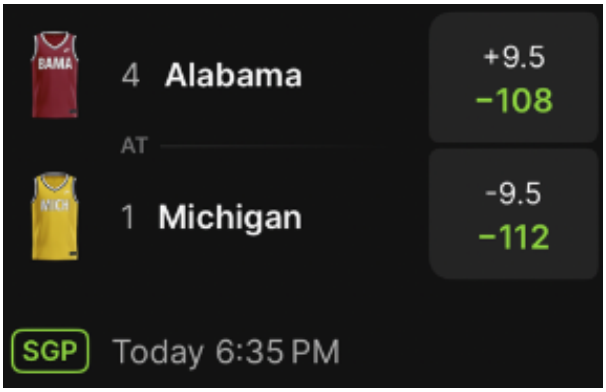
Figure A.1. Tax rates on sports betting revenue (2025)



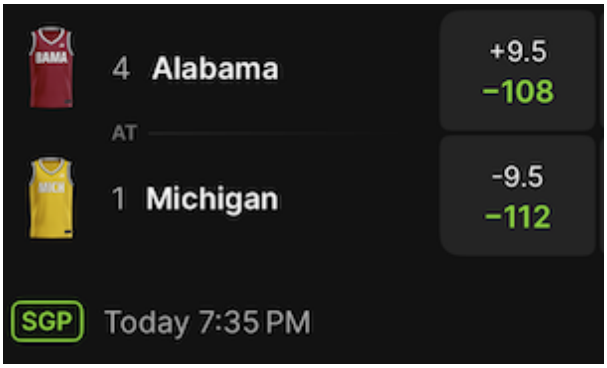
Notes: For Illinois, which has a graduated tax rate on operators, a per-wager tax, and county-level taxation, we show the average tax rate inclusive of all taxes, calculated as total tax payment divided by revenue for online sports betting for October 2024–September 2025. For Arkansas, which has a graduated tax rate, we use the average tax rate for total sports betting (online and retail combined) from September 2024–August 2025. Vermont negotiates revenue-sharing with each sportsbook, which is between 31% and 33% for FanDuel, DraftKings, and Fanatics (New Hampshire Public Radio, 2023); we use the value reported by the State Tax Foundation here. For Washington, DC, different operators face different rates; we use the average tax rate for total sports betting (online and retail combined) from September 2024–August 2025.

Figure A.2. Identical odds across states with different ad valorem tax rates

Illinois (20%-40% graduated tax rate)

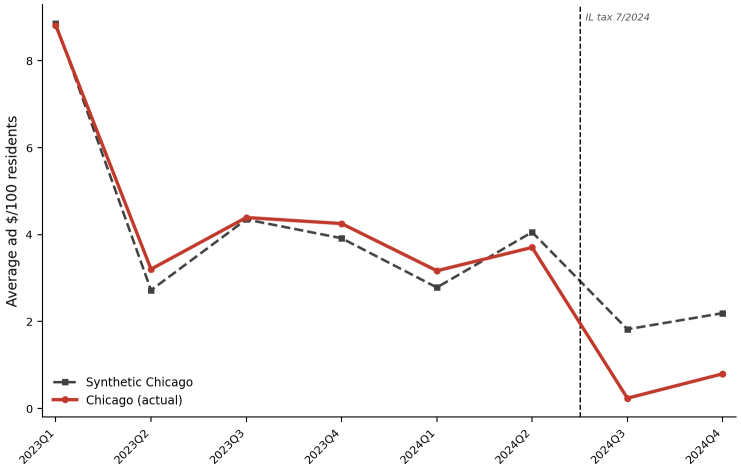


Michigan (8.4% flat tax rate)

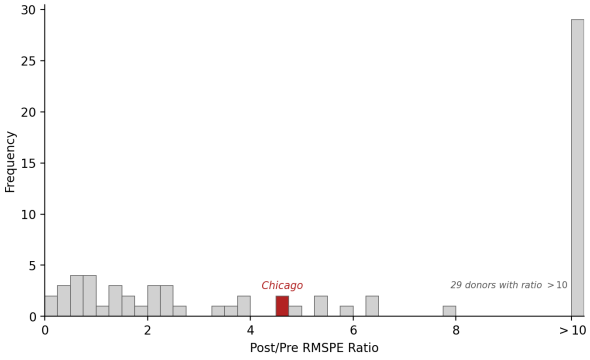


Notes: DraftKings odds for the Alabama at Michigan men's basketball game, captured at 5:04pm Central on March 27, 2026. The Illinois and Michigan apps display identical moneyline odds (odds on who wins the game) of (−108/−112). The implicit price to wager is approximately 4.5 cents per dollar staked.

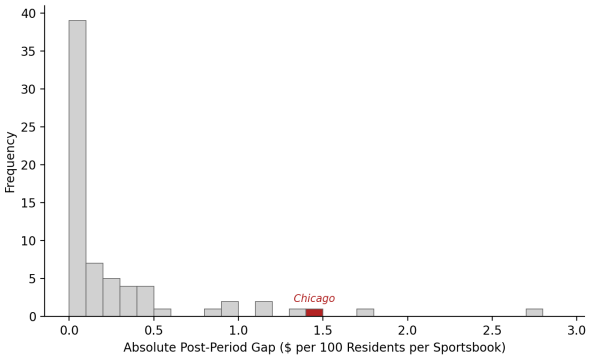
Figure A.3. Synthetic control without the positive-advertising donor filter



(a) Trends in local TV ad spending: Chicago vs. synthetic Chicago



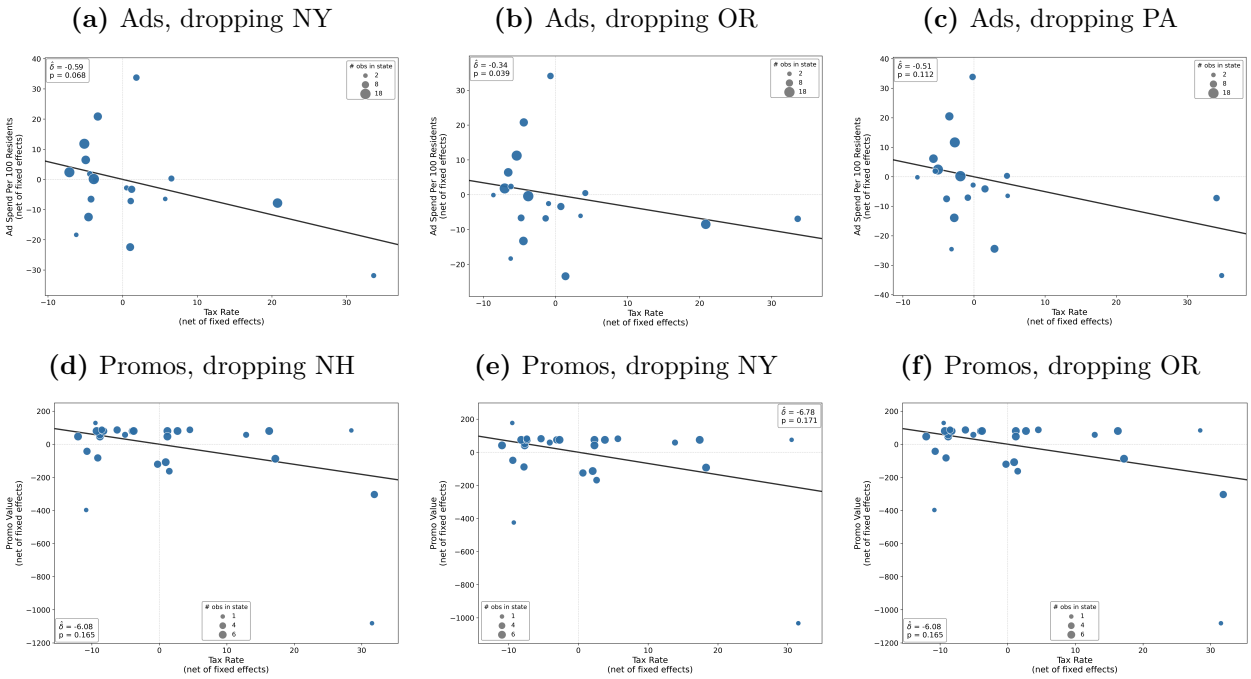
(b) Ratio of post-tax RMSPE and pre-tax RMSPE: Chicago and 68 control DMAs



(c) Absolute post-period gap: Chicago and 68 control DMAs

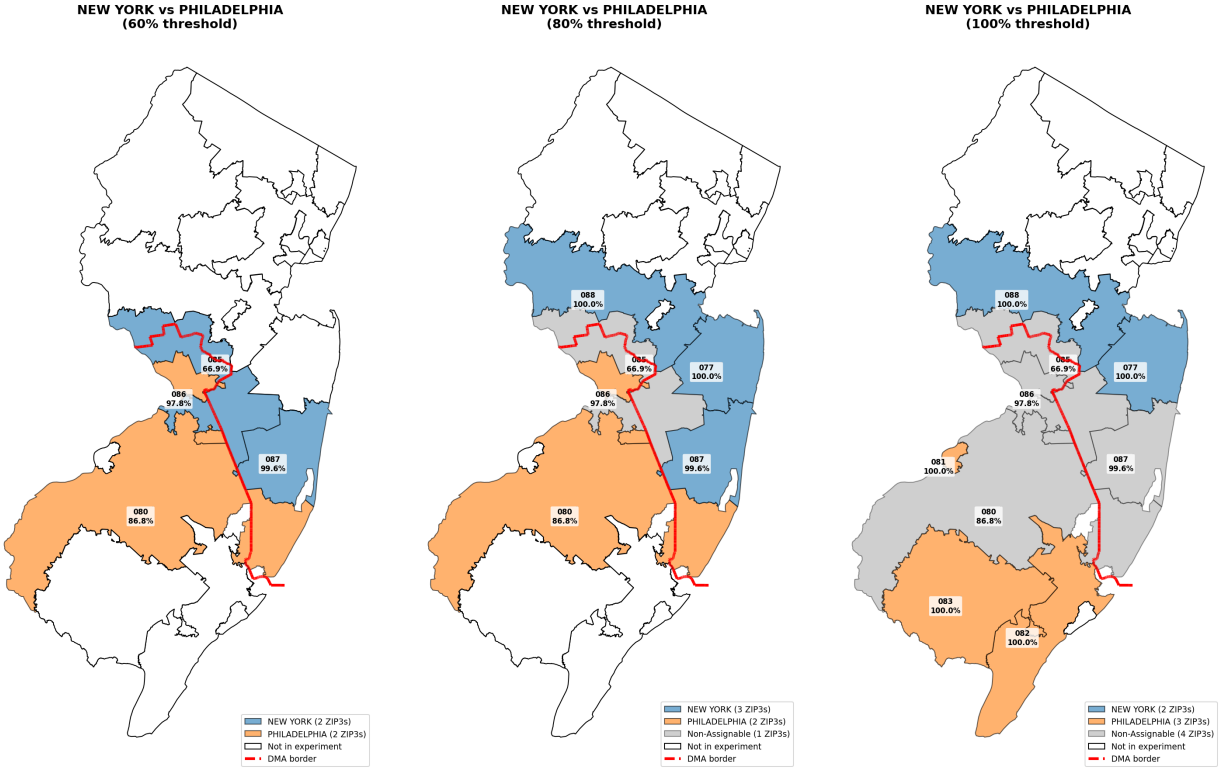
Notes: This repeats the synthetic control in Figure 5 but keeps every donor DMA with positive advertising in its pre-period total rather than in every pre-treatment quarter, enlarging the donor pool from 15 to 68. Panel a plots quarterly local TV ad spending per 100 residents per sportsbook for Chicago and synthetic Chicago; the dashed vertical line marks the July 1, 2024 tax increase, and over the two post-tax quarters Chicago is 32.5% below synthetic Chicago. Panel b compares Chicago's post/pre RMSPE ratio with the ratios from the 68 donor placebos ($p = 0.551$); donors with a ratio above 10 fall in the rightmost bin. Panel c plots the absolute post-period gap between each unit and its synthetic control; Chicago's gap is the third largest of the 68 units ($p = 0.043$).

Figure A.4. Leave-one-state-out: tax rate vs. marketing, dropping each of the highest-tax states



Notes: Top row replicates Figure 5c after dropping a single high-tax state (NY, OR, or PA, the three highest-tax states in the ad sample). Bottom row replicates Figure 5d after dropping NH, NY, or OR—the three states tied at 51% ad valorem tax in the promo sample. Since New Hampshire and Oregon are both DraftKings monopolies with the same promo offer and tax rate, dropping either leaves an identical dataset. NH is not in the ad sample because there is no DMA which lies entirely in NH. Each dot is a state mean; dot size is proportional to the number of underlying observations. Ad-panel axes are residualized on sportsbook $\times$ year fixed effects; promo-panel axes are residualized on sportsbook fixed effects. p-values from wild cluster bootstrap, clustered by state.

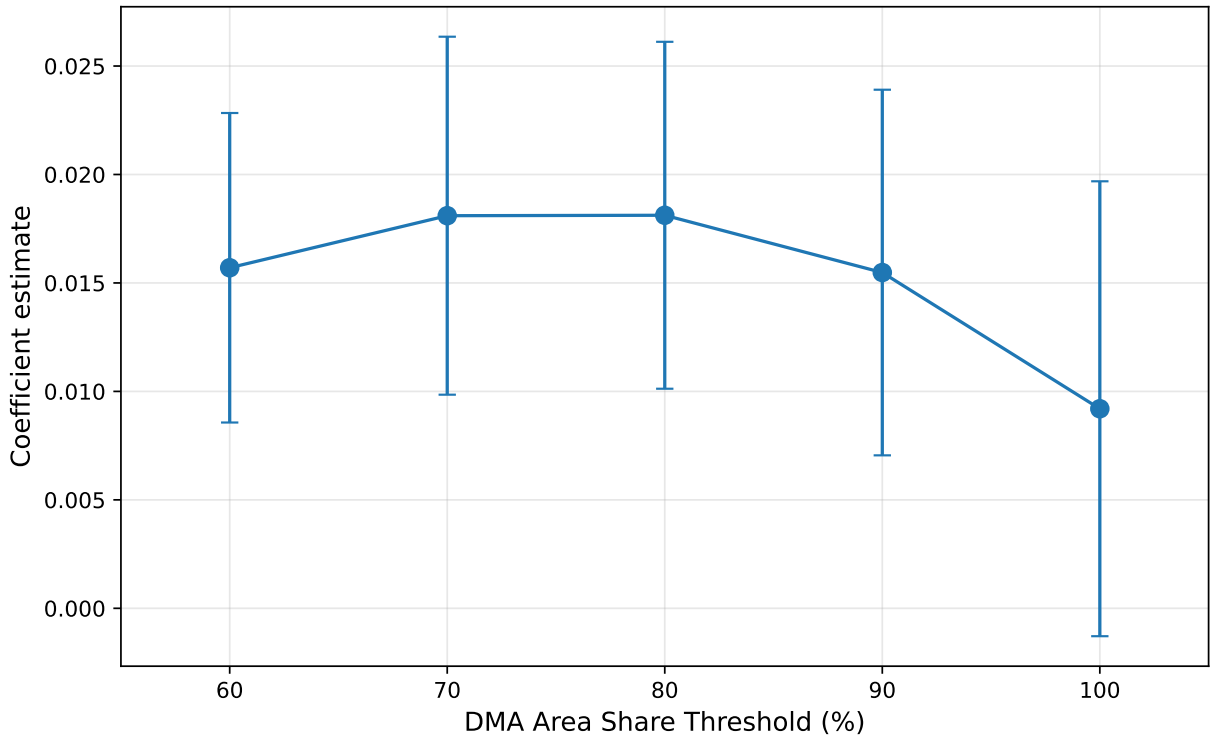
Figure A.5. Example of geographies used for the New York DMA / Philadelphia DMA border experiment depending on area-share threshold used



(a) 60% threshold **(b)** 80% threshold **(c)** 100% threshold

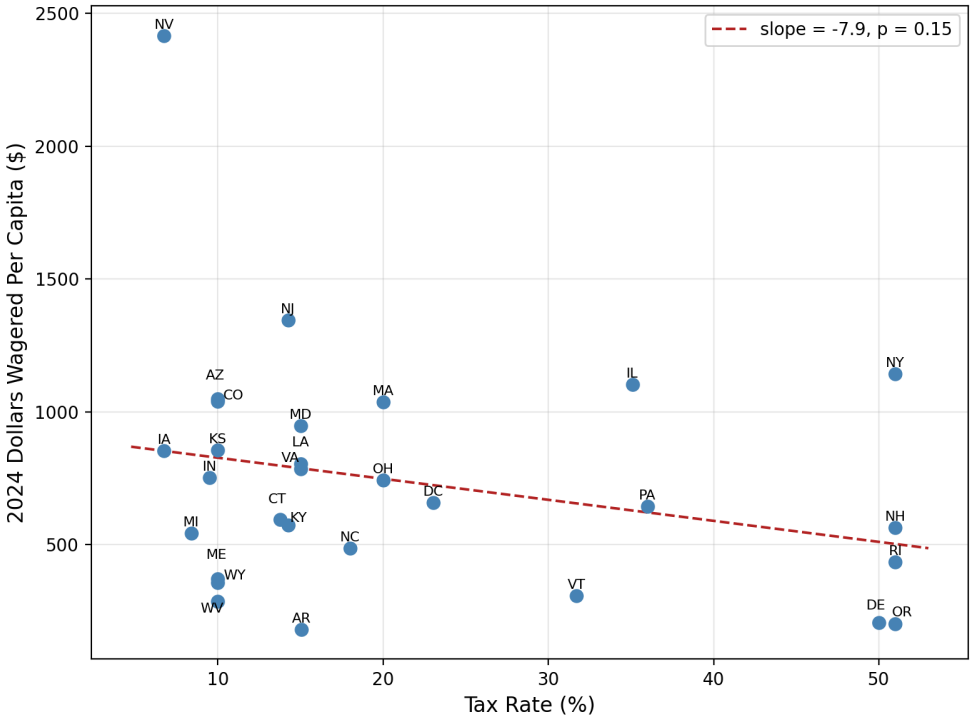
Notes: Percentages show the share of each ZIP3's area in its assigned DMA.

Figure A.6. Sensitivity of the own-advertising coefficient to the chosen DMA area-share threshold



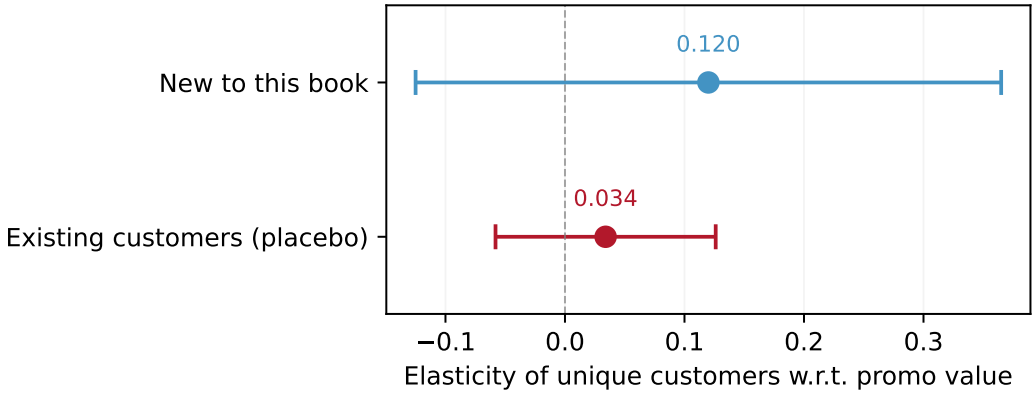
Notes: The figure plots the estimated own advertising coefficient across alternative choices of the DMA area-share threshold. This figure uses Consumer Edge data.

Figure A.7. Reduced-form relationship between dollars wagered per capita and tax rates



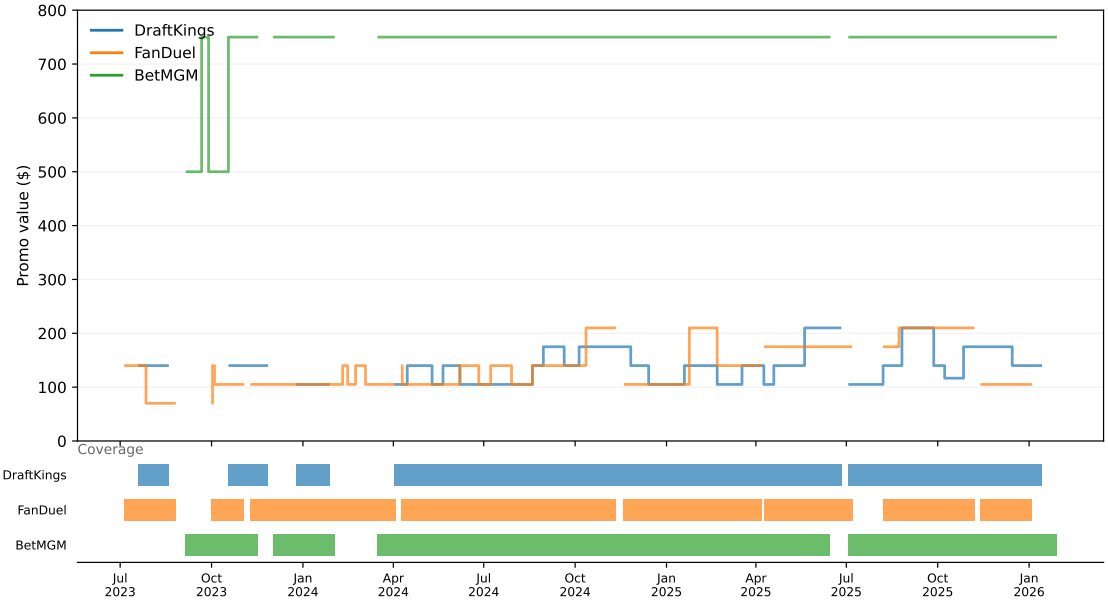
Each point is a state. Dollars wagered per capita are for 2024.

Figure A.8. Elasticity of unique depositors with respect to promotional offer value, by population



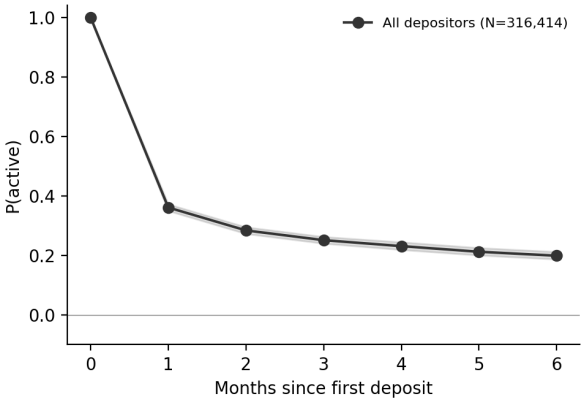
Notes: New-to-book depositors have no prior deposit at that sportsbook; existing customers have deposited before and serve as a placebo. The figure shows 95% confidence intervals. Regressions include book and month fixed effects, with Driscoll–Kraay standard errors (lag = 4). N = 331 (125 weeks × 3 books). This figure uses Consumer Edge data.

Figure A.9. Promotional sign-up offer values over time for DraftKings, FanDuel, and BetMGM

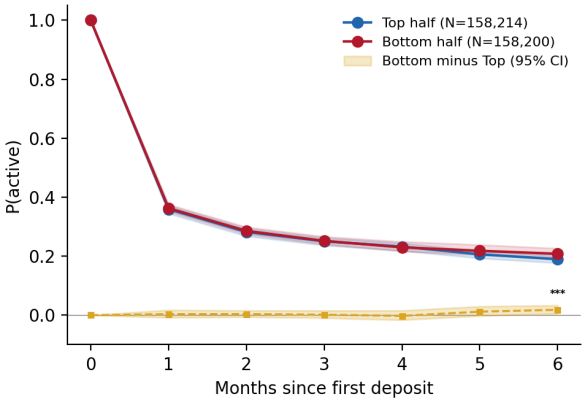


Notes: All offers are converted to expected value in dollars. Values are extracted from Internet Archive snapshots of Action Network pages. When snapshots are missing between days, we carry forward promo values for 30 days, or until the next snapshot in the Internet Archive, whichever comes first. The bottom panel shows coverage windows.

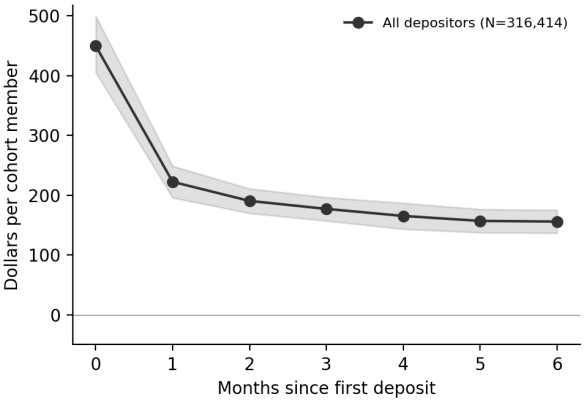
Figure A.10. Dynamics of sports betting deposits, by ad-exposure in month of first deposit



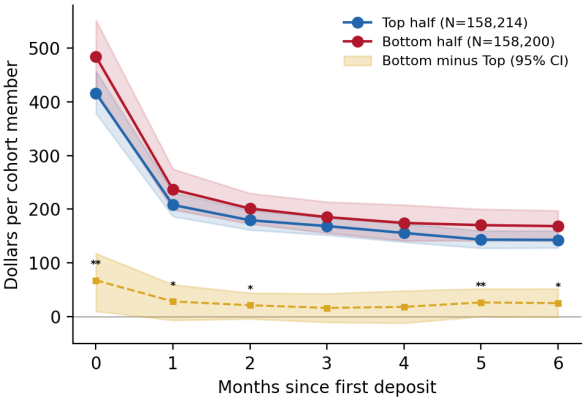
(a) Retention rate (all depositors)



(b) Retention rate by ad intensity



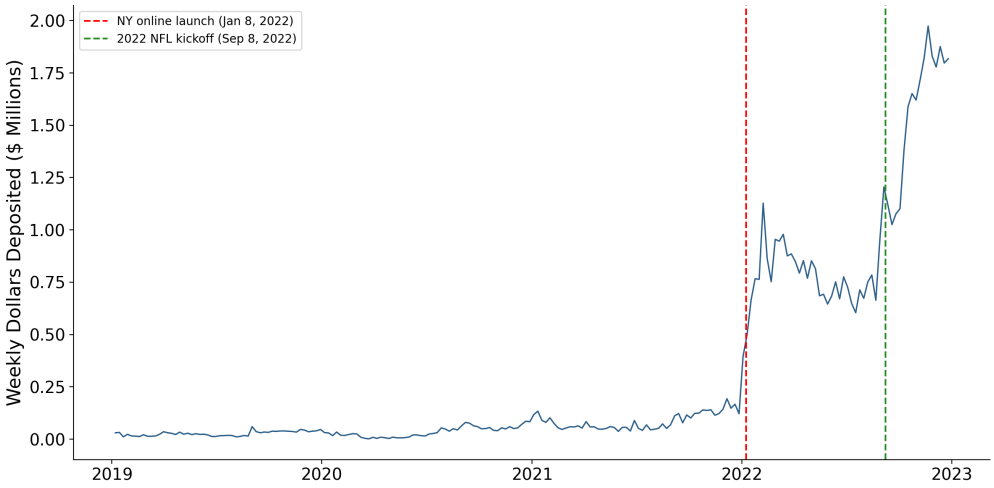
(c) Monthly dollars deposited per new depositor



(d) Monthly dollars deposited per new depositor by ad intensity

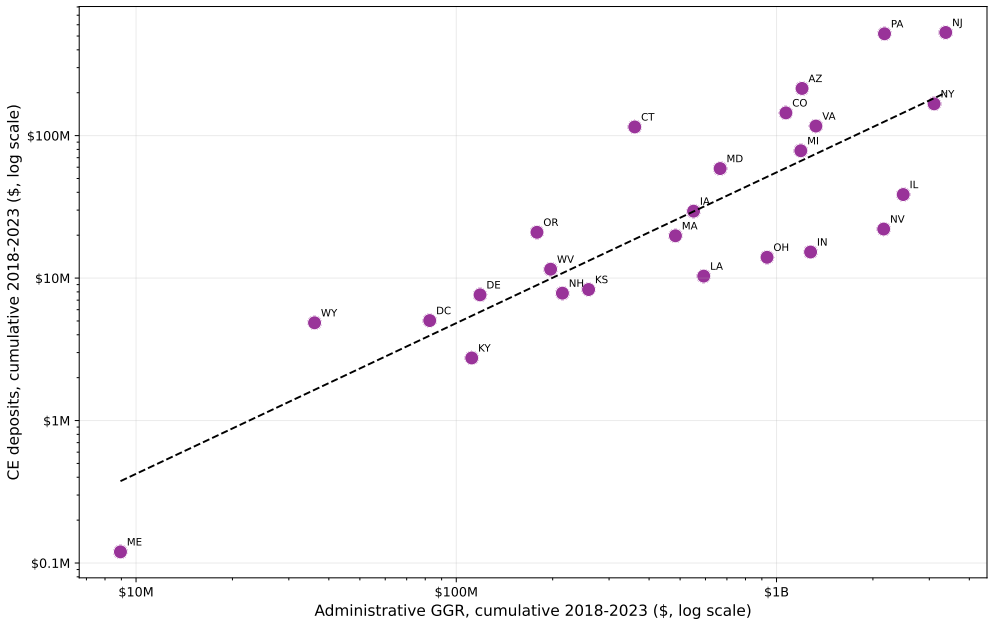
Notes: The left column pools all depositors across ad intensity. The right column compares above- vs. below-median residualized own-advertising intensity in the month of first deposit. Stars denote two-sided p-values (* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$) from the bootstrap distribution constructed by resampling DMA × sportsbook blocks (all ZIP3s and time periods in that block) with replacement. Shaded bands show 95% bootstrap confidence intervals. This figure uses Consumer Edge data.

Figure A.11. Deposits by New York cards to sportsbooks spike after legalization



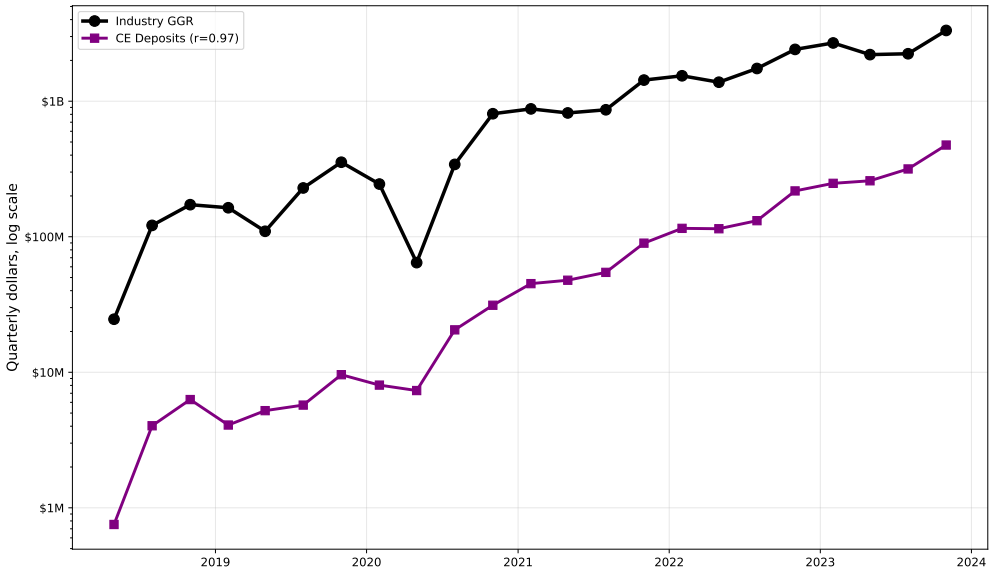
Notes: This figure uses Consumer Edge data.

Figure A.12. Consumer Edge deposits vs. administrative revenue across states



Notes: Each point is a state. Both axes in logs. Log correlation = 0.85. Consumer Edge deposits are 9.2% of aggregate revenue.

Figure A.13. Consumer Edge deposits vs. administrative revenue over time



Notes: Quarterly aggregates. Both series in logs. Log correlation = 0.97.