

Online Casino Gaming & Gambling: An early progress report

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December 10, 2023: *preliminary & incomplete*

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with Wayne J. Taylor (SMU) & Daniel Minh McCarthy (Emory)

Online casino gambling is growing quickly

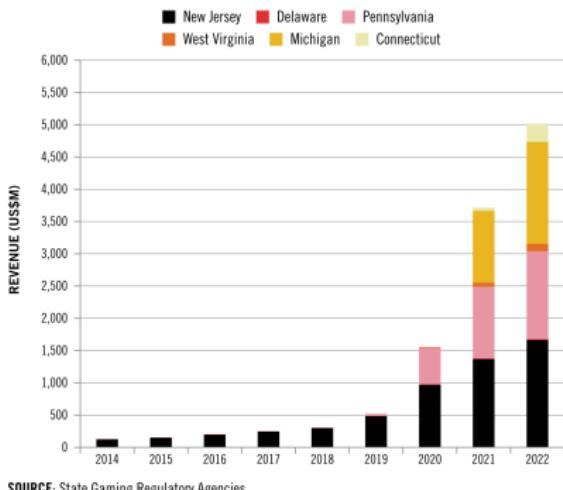
Annual Internet Gaming Revenue

2014 to 2022

Internet casinos continued their strong growth in 2022 despite no new states coming online. Combined iGaming revenue across the six states with lawful online casinos reached a record total of \$5.02 billion, up 35.3 percent compared to the previous year. New Jersey, Michigan and Pennsylvania accounted for more than 88 percent of the nationwide total. Each of those three states secured positions in the top five largest regulated internet casino gaming markets in the world, with annual revenue of \$1.66 billion, \$1.38 billion and \$1.36 billion, respectively. In its first full year of operation, Connecticut reported iGaming revenue of \$280.7 million.

Despite the impressive revenue growth, however, no additional states acted to legalize iGaming in 2022, although legislation was considered by lawmakers in at least seven states, including Indiana, Illinois and New York.

UNITED STATES: REGULATED IGAMING GGR – 2014 TO 2022



SOURCE: State Gaming Regulatory Agencies

- 24 states added online sports betting since 2019; forms differ
- Extensive lobbying ongoing
- Washington state law prohibits all electronic gambling

Why is gambling restricted?

[Am Psychol. 2016 Nov; 71\(8\): 670–679.](#)

doi: [10.1037/amp0000059](https://doi.org/10.1037/amp0000059)

Liking, Wanting and the Incentive-Sensitization Theory of Addiction

[Kent C. Berridge*](#) and [Terry E. Robinson](#)

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Abstract

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Rewards are both 'liked' and 'wanted', and those two words seem almost interchangeable. However, the brain circuitry that mediates the psychological process of 'wanting' a particular reward is dissociable from circuitry that mediates the degree to which it is 'liked'. Incentive salience or 'wanting', a form of motivation, is generated by large and robust neural systems that include mesolimbic dopamine. By comparison, 'liking', or the actual pleasurable impact of reward consumption, is mediated by smaller and fragile neural systems, and is not dependent on dopamine. The incentive-sensitization theory posits the essence of drug addiction to be excessive amplification specifically of psychological 'wanting', especially triggered by cues, without necessarily an amplification of 'liking'. This is due to long-lasting changes in dopamine-related motivation systems of susceptible individuals, called neural sensitization. A quarter-century after its proposal, evidence has continued to grow in support the incentive-sensitization theory. Further, its scope is now expanding to include diverse behavioral addictions and other psychopathologies.

Why is gambling restricted?

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As applied to gambling...



While most people can enjoy gambling as entertainment, for some it can become a significant problem. An estimated **.4% to 4% of adults in the U.S. will** develop a gambling disorder in their lifetime.

Gambling disorder is a recognized mental health disorder that may involve:

- Need to gamble with increasing amounts to achieve the desired excitement.
- Repeated unsuccessful efforts to control, cut back on or stop gambling.
- Frequent thoughts about gambling (such as reliving past gambling or planning future gambling).
- After losing money gambling, often returning to get even ("chasing" one's losses).



What is problem gambling?

Problem gambling—or gambling addiction—includes all gambling behavior patterns that compromise, disrupt or damage personal, family or vocational pursuits. The symptoms include increasing preoccupation with gambling, a need to bet more money more frequently, restlessness or irritability when attempting to stop, "chasing" losses, and loss of control manifested by continuation of the gambling behavior in spite of mounting, serious, negative consequences. In extreme cases, problem gambling can result in financial ruin, legal problems, loss of career and family, or even suicide. For more information on the American Psychiatric Association's criteria for gambling addiction, please see the DSM 5 at www.psych.org.

2 million U.S. adults (1%) are estimated to meet the criteria for severe gambling problems in a given year. Another 4-6 million (2-3%) would be considered to have mild or moderate gambling problems; that is, they do not meet the full diagnostic criteria for gambling addiction but meet one or more of the criteria and are experiencing problems due to their gambling behavior. Research also indicates that most adults who choose to gamble are able to do it responsibly.

NCPG estimates the annual **national social cost of problem gambling is \$7 billion.** These costs include gambling-related criminal justice and healthcare spending as well as job loss, bankruptcy and other consequences. This estimate was based on research from the 1999

We often study addictive goods to help regulate



National Institute
on Alcohol Abuse
and Alcoholism

Alcohol Fa

Alcohol Use in the United States:

- » **Prevalence of Drinking:** According to the 2019 National Survey on Drug Use and Health (NSDUH), 85.6 percent of people ages 18 or older reported that they drank alcohol at some point in their lifetime; 69.5 percent reported that they drank in the past year; 54.9 percent reported that they drank in the past month.¹
- » **Prevalence of Binge Drinking and Heavy Alcohol Use:** In 2019, 25.8 percent of people ages 18 or older reported that they engaged in binge drinking in the past month; 6.3 percent reported that they engaged in heavy alcohol use in the past month.¹ (See sidebar on page 2 for definitions of binge drinking and heavy alcohol use.)

Alcohol Use Disorder (AUD) in the United States:

- » **Adults (ages 18+):** According to the 2019 NSDUH, 14.1 million adults ages 18 and older² (5.6 percent of this age group³) had AUD. This includes 8.9 million men² (7.3 percent of men in this age group³) and 5.2 million women² (4.0 percent of women in this age group³).

Alcohol Use Disorder (AUD): AUD is a chronic relapsing brain disease characterized by an impaired ability to stop or control alcohol use despite adverse social, occupational, or health consequences. AUD can range from mild to severe, and recovery is possible regardless of severity. The fourth edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV), published by the American Psychiatric



Gambling services adjust context to maximize spending



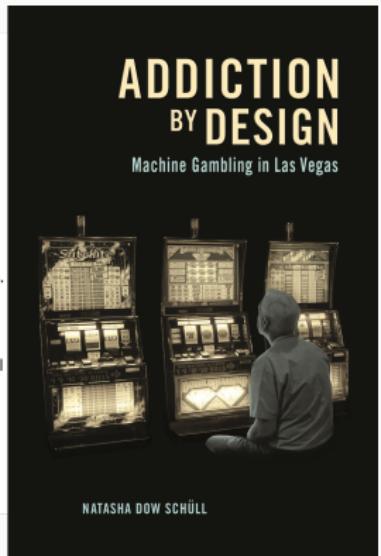
You

please summarize the thesis of "addiction by design"



ChatGPT

"Addiction by Design: Machine Gambling in Las Vegas" by Natasha Dow Schüll is an anthropological exploration of the relationship between technology and addiction, focusing on electronic gambling machines in Las Vegas. The thesis of the book delves into how these machines are meticulously designed to foster compulsive behavior in users, leading to addiction. Schüll argues that **these machines are engineered to create a deeply engaging, immersive, and fast-paced experience that promotes prolonged and repetitive play.** This design is achieved through a combination of factors such as game algorithms, ergonomic features, and audio-visual effects, all of which are finely tuned to manipulate player behavior and emotions. The book underscores the interplay between technology, psychology, and the gaming industry's profit motives, revealing how these factors contribute to the phenomenon of gambling addiction.



Research studying gambling harms

- Numerous self-report surveys explore gambling harms
- Langham et al.(BMC Health 2016): Wide-ranging review
 - Gambling can cause or exacerbate financial, relationship, psychological, health, work, study and social deviance harms. Problems may be individual or communal
- Muggleton et al NHB 2021 partnered with a bank
 - “financial transaction data can produce a view of gambling-related outcomes that is objective, longitudinal and mass-scale”
 - 43% of bank customers gambled
 - Top 1% of gamblers by Gamble% spent >40% on gambling
 - Gamble% correlates with some unhealthy spending behaviors
 - Gamble% correlates with earlier death

Fig. 1: Gambling and financial, lifestyle and well-being outcomes.

From: [The association between gambling and financial, social and health outcomes in big financial data](#)

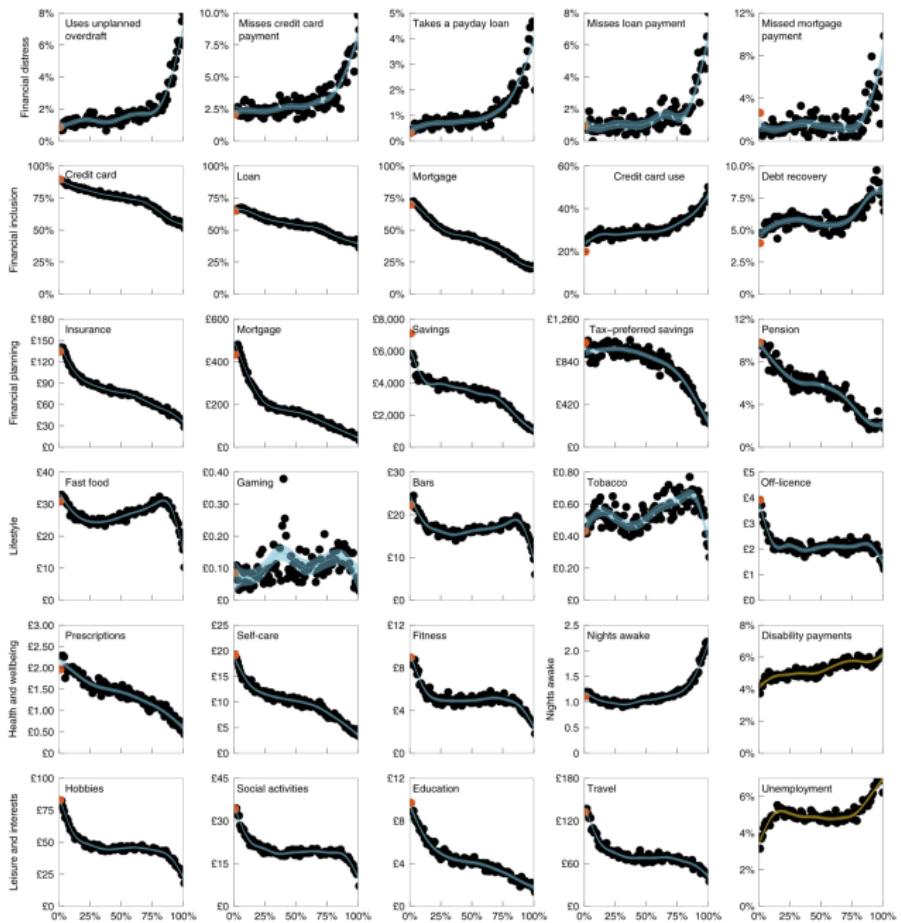
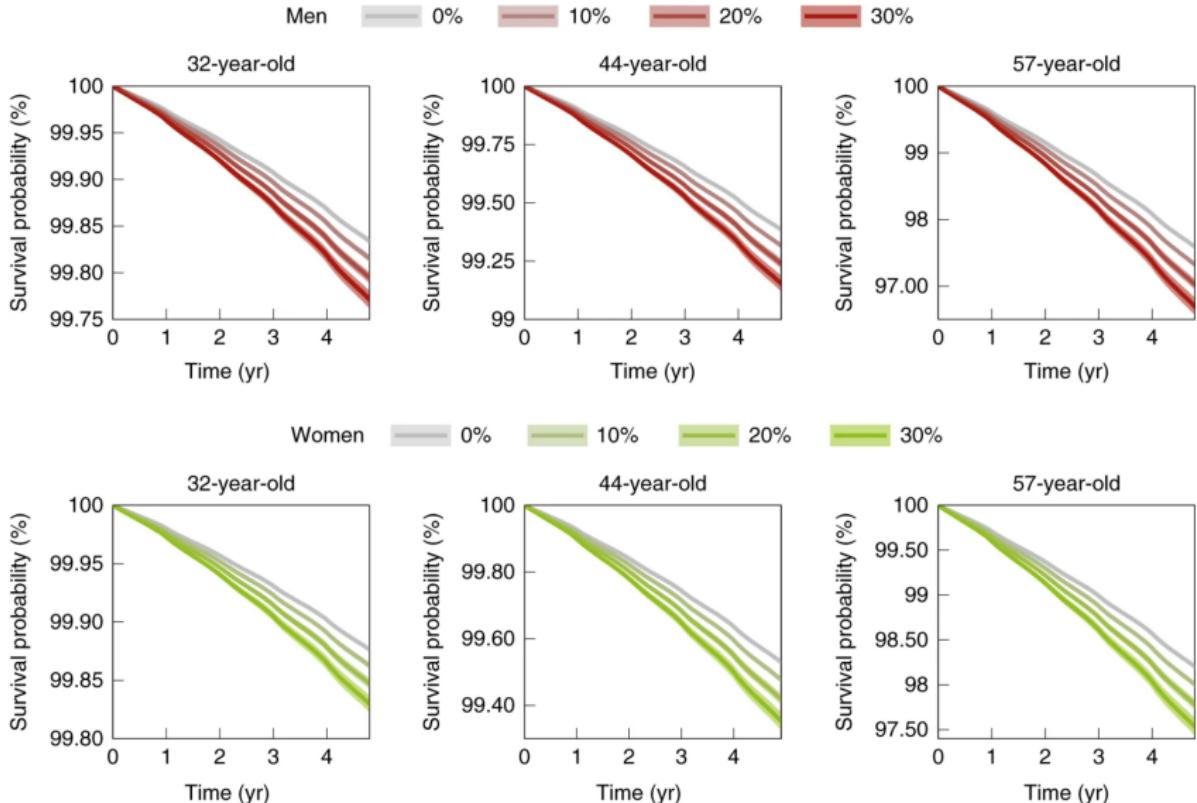


Fig. 2: Gambling and mortality.

From: [The association between gambling and financial, social and health outcomes in big financial data](#)



Cox regression survival analysis of mortality rate (time in years) beginning in 2014 ($n = 6,515,557$). Survival is modelled as the percentage of total spend gambled in 2013 (colour intensity) while controlling for gender and age in 2013 (colour and panel). The model censors individuals who left the sample for reasons other than mortality (for example, switched bank). Shading denotes 95% CI. Note that the y scale varies between panels.

Our research questions

1. Can we measure excessive gambling in transaction data?

- Gambling legalization increases tax revenues; at what cost?

2. How do state policy changes affect gambling outcomes?

- Generalized synthetic control
- Goals: Quantify policy effects on conflicting policy objectives (tax revenue, excessive gambling), to help refine policy

3. Targeting and demarketing

- How well can casinos (a) use non-gambling spend to predict excessive gambling for (anti)targeting, or (b) predict cessation of excessive gambling for demarketing?

Initial Measurement Context

Big Fish Casino

- “Social Casino Game”: Chat, compete w players, groups
- Freemium model: You can pay in but it won’t pay out¹
- Available on Android, Facebook, iTunes, Windows
- Legal everywhere, thick data, no withdrawals
 - Excessive gambling measures defined here might be extended to gambling services



¹Manasa Thimmegowda, et al. v. Big Fish Games, Inc., et al. (2021), settled for \$155 million

Initial Measurement Context



Addicted to losing: How casino-like apps have drained people of millions

NBC News spoke to 21 people who said they were hooked on casino-style apps and had spent significant sums of money. The industry is almost entirely unregulated.

Unlike in a real casino, there is no way to win money back or earn a payout on coins.

But that has not stopped Shellz and her husband from spending about \$150,000 in the game in just two years. She asked to use her in-game username so her family does not find out how much money they have spent on the game.

"We lie in bed next to each other, we have two tablets, two phones and a computer and all these apps spinning Reel Rivals at the same time," she said. "We normalize it with each other."

Joann, 46, who lives in southwest Florida, said she began playing Big Fish Casino about eight years ago.

She estimates that she has spent \$100,000 on the game.

"You know what I tell people? It's a cult, and they suck you in, and once you're in you can't get out," said Joann, who asked to use only her middle name. "You want to play, and you want to spin."

One of the named plaintiffs in the settlement is Crystal Fair of Texas, who said in a sworn declaration that she has spent \$500,000 and described herself as being "addicted" to Big Fish Casino, playing it sometimes "nearly 24 hours a day."

Initial Measurement Context

The screenshot shows a smartphone screen with a dark theme. At the top, the status bar displays the time (7:25), signal strength, battery level (88%), and other icons. Below the status bar is the app store listing for "Big Fish Casino - Slots Games". The app has a 4.5-star rating and over 100,000 reviews. A back arrow and a small icon are visible on the left. On the right, there are three vertical dots and a blue progress bar.

Adam Dodson (Profile picture) 5 stars 9/9/23

The worst of all casino apps. The worst bonuses. The worst payouts. The worst statistics for win percentage. The worst realism. You have better odds of being hit by a bus. Support sucks. Incompetent leadership. 37 separate emails have been sent with technical issues, statistics on poor wins and data on their games. Thanks for the two whole spins very generous of you. I provided them with pictures and they never acknowledged their trickery, poor programming ZERO STARS 🙏🙏

1 person found this helpful

Was this review helpful?

73jennng (Profile picture) 2 stars 9/6/23

I dont win anymore. I enter tournaments and I never win those. I never win jackpots. But this most recent contest, the Birthday Spin Challenge, I completed it and was supposed to win 7.5 billion chips but, Big Fish is not giving me my prize! I'm beginning to think this whole game is one big scam! I have spent real money in the app but, they won't get another penny!

Was this review helpful?

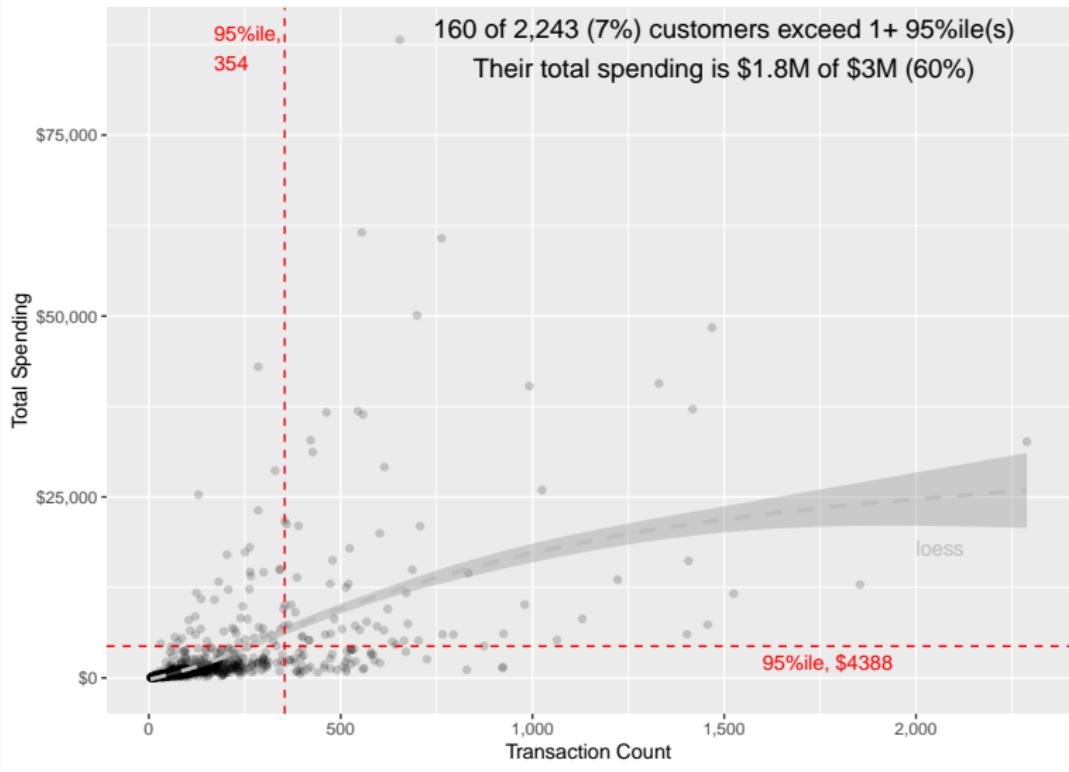
Datasource

- Anonymous credit/debit card spending panel
- Transaction records sourced from financial institutions
- Tracks ~5K merchants and ~8 million US consumers in 2023
 - ~3.1% of US adults, unbalanced, Jan 2016 - Sep 2023
- Big Fish Casino, 2020-23: 34k users, 745k payments, \$8.2M
 - We select 2.2k users with transactions in every calendar year & $\text{max(payment)} < \$500$: 224k payments, \$3.0M
 - Filtering removes quitters but balances panel;
main story is even more unbalanced without filtering

earnestanalytics

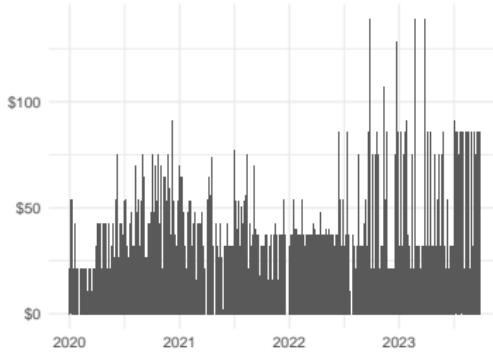
BF Whales vs. Minnows

Transaction Count vs. Total Spending by Customer, Big Fish Games

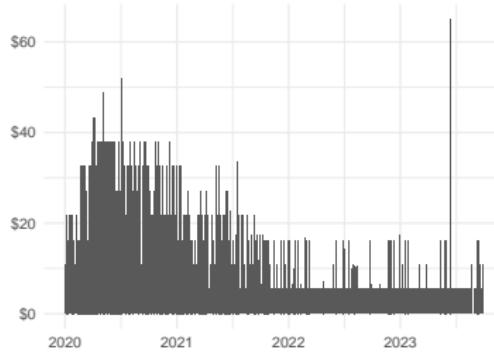


BF Very-frequent Member Spending Paths (1)

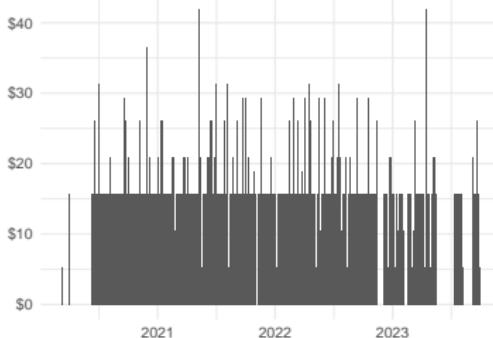
Member 9477 Count: 2,289 Sum: \$32,646



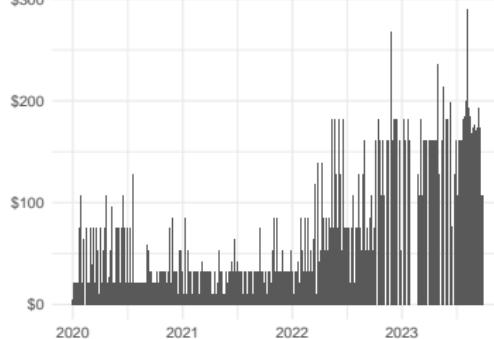
Member 2320 Count: 1,854 Sum: \$12,889



Member 10109 Count: 1,525 Sum: \$11,617

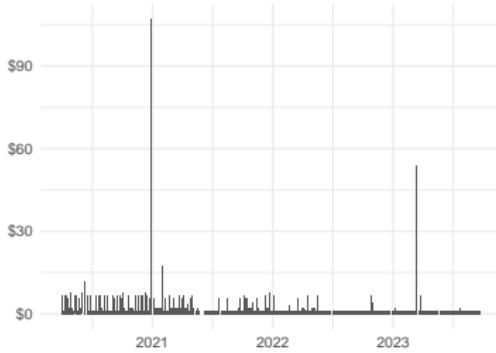


Member 11771 Count: 1,468 Sum: \$48,416

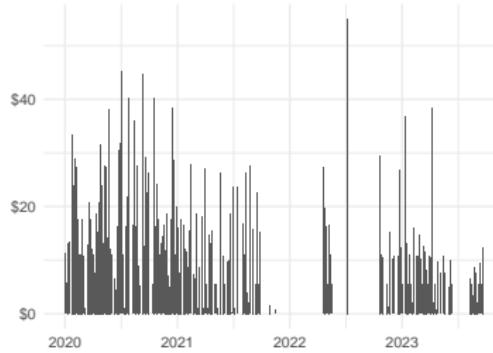


BF Very-frequent Member Spending Paths (2)

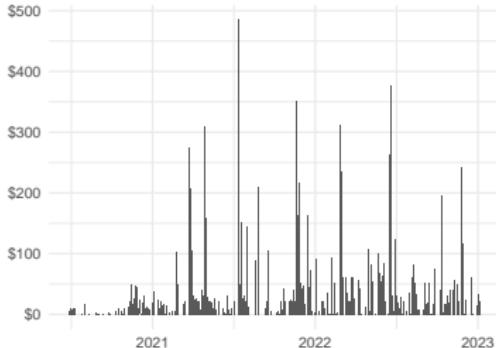
Member 9601 Count: 921 Sum: \$1,429



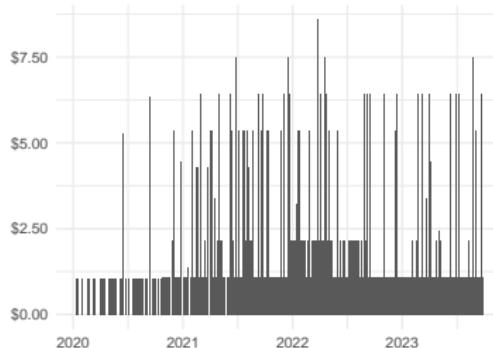
Member 11149 Count: 874 Sum: \$4,396



Member 10306 Count: 833 Sum: \$14,462



Member 3459 Count: 829 Sum: \$1,125



Regularity Analysis

Can spending regularity proxy for self-control among v frequent players?

- Spending invariance shows consistency, non-spending restraint
- Care needed: Consumer incomes and spending baselines differ

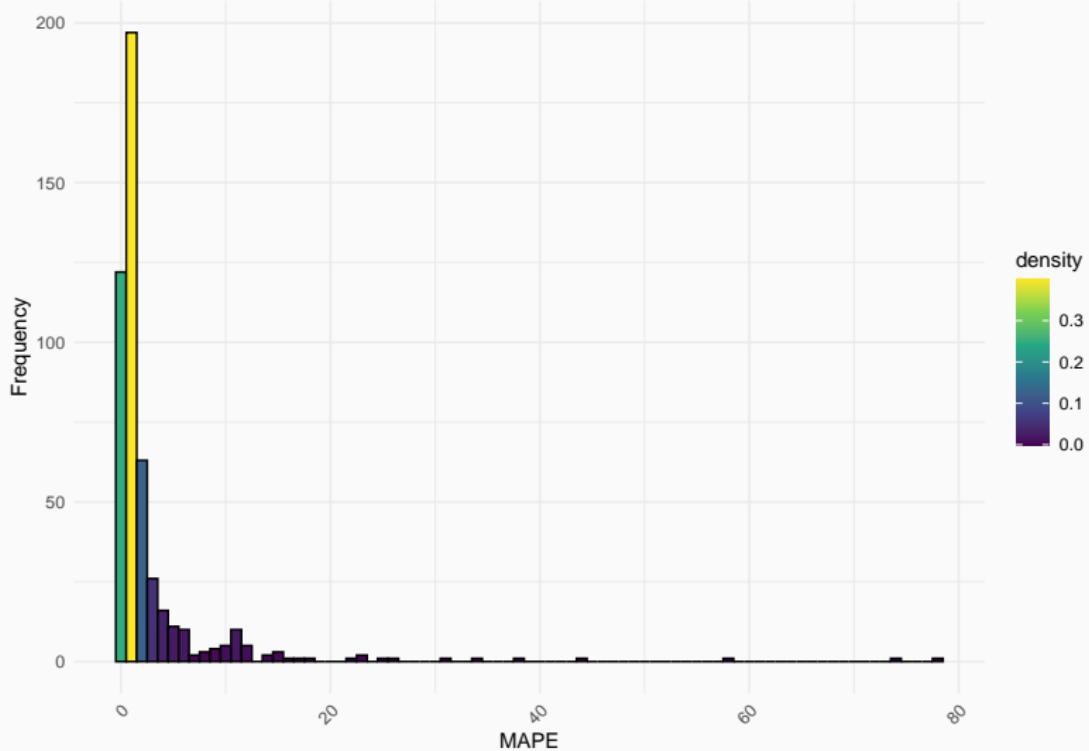
We train customer-specific models to measure regularity

- Rank customers by transaction count & retain 494 with 100+
- Train Prophet on customer's 1st 13 quarters of daily spending
- Predict daily spending in final 180 days
- Calc customer-specific Mean Abs. Prediction Error (MAPE)

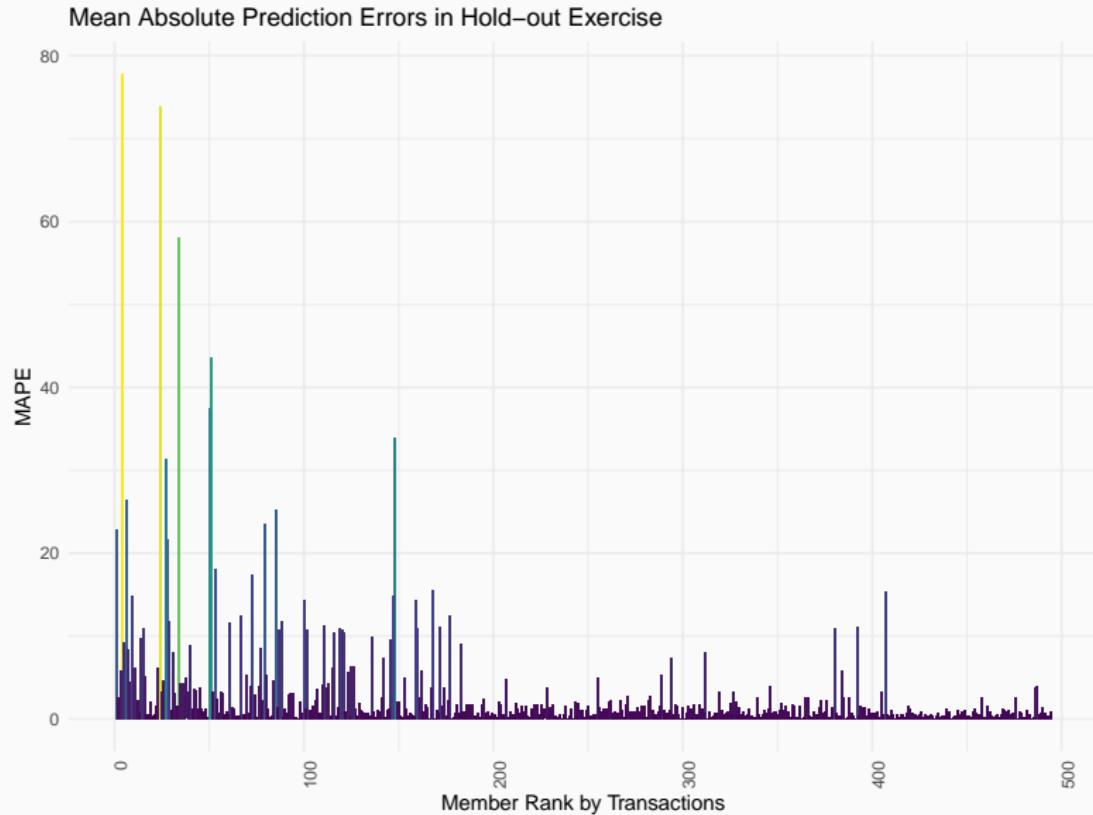
BF MAPE Histogram

Histogram of Customer-Specific Mean Absolute Prediction Errors

Each datapoint is 1 customer. Median is 0.97, Mean is 3.01



BF MAPE by Customer Transactions Rank

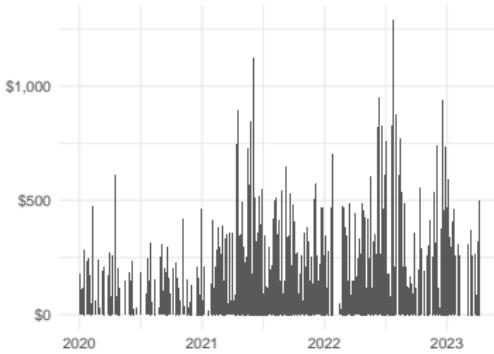


Conceptual replication with Caesars Online Deposits (COD)

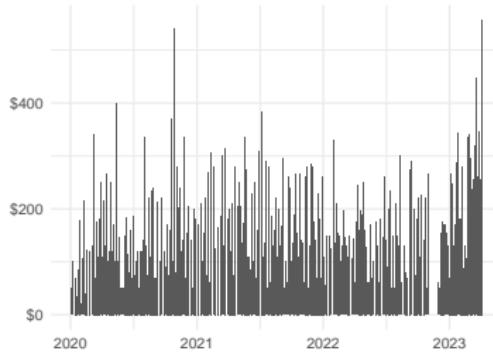
- 7 of 105 customers total account for 50% of revenue
- 49 users with 100+ transactions
- MAPE properties are similar

COD Very-frequent Member Spending Paths

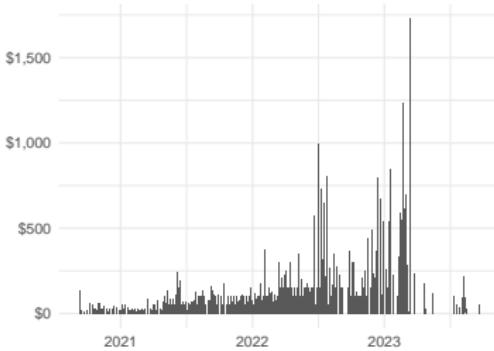
Member 632 Count: 3,735 Sum: \$112,047



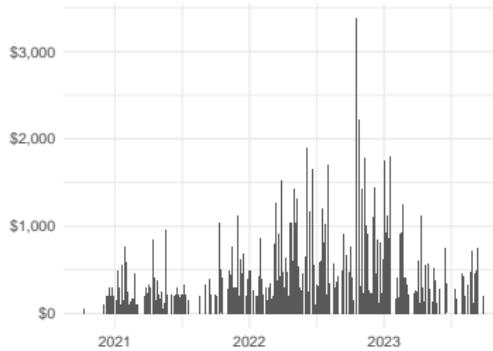
Member 8896 Count: 1,248 Sum: \$68,632



Member 4485 Count: 1,098 Sum: \$58,349



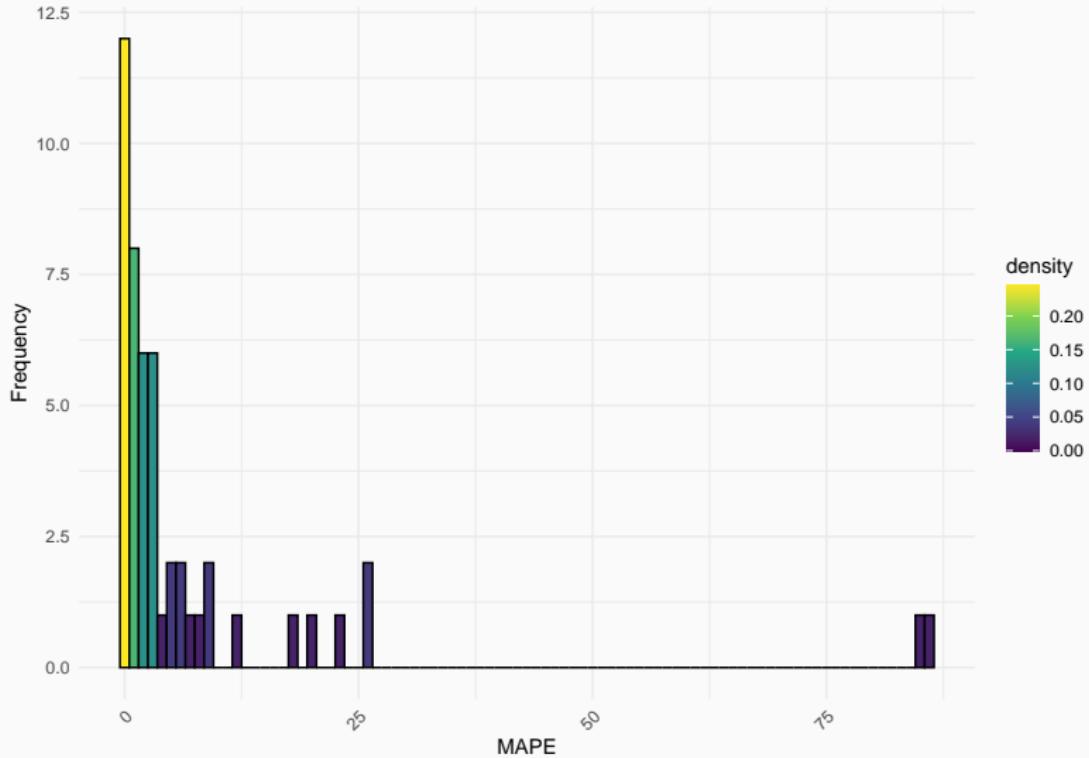
Member 2864 Count: 870 Sum: \$144,919



COD MAPE Histogram

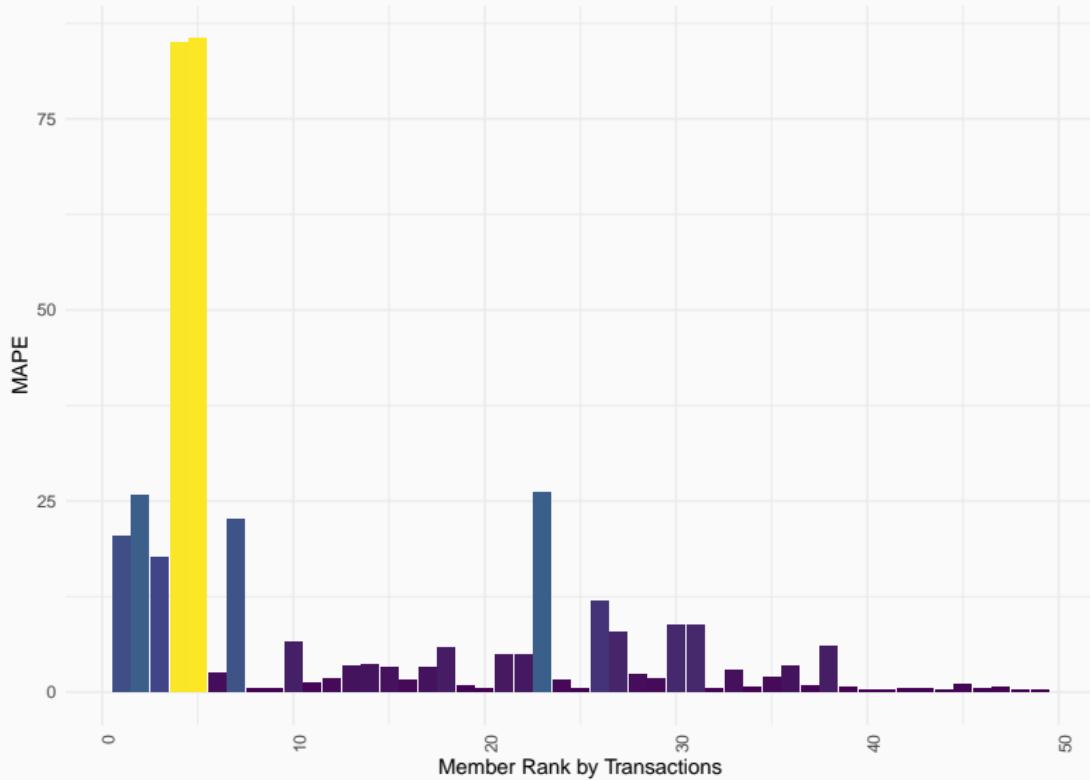
Histogram of Customer-Specific Mean Absolute Prediction Errors

Each datapoint is 1 customer. Median is 1.89, Mean is 8.01



COD MAPE by Customer Transactions Rank

Mean Absolute Prediction Errors in Hold-out Exercise



What we have learned so far

- Whales account for most revenue
- Very frequent players differ in regularity
 - It looks like problematic patterns are often transitory within people ("spells"), not necessarily person-specific
- Clear analogues to RFM metrics like frequency, interpurchase timing, basket size and spending variability
- We care most about Gamble%, i.e. $\frac{\text{Gambling spend}}{\text{Total spend}}$
 - High Gamble% seems socially harmful
 - Low Gamble% may be compulsive or uncontrolled but seems less harmful
 - This may leave some quantifiable problems unaddressed

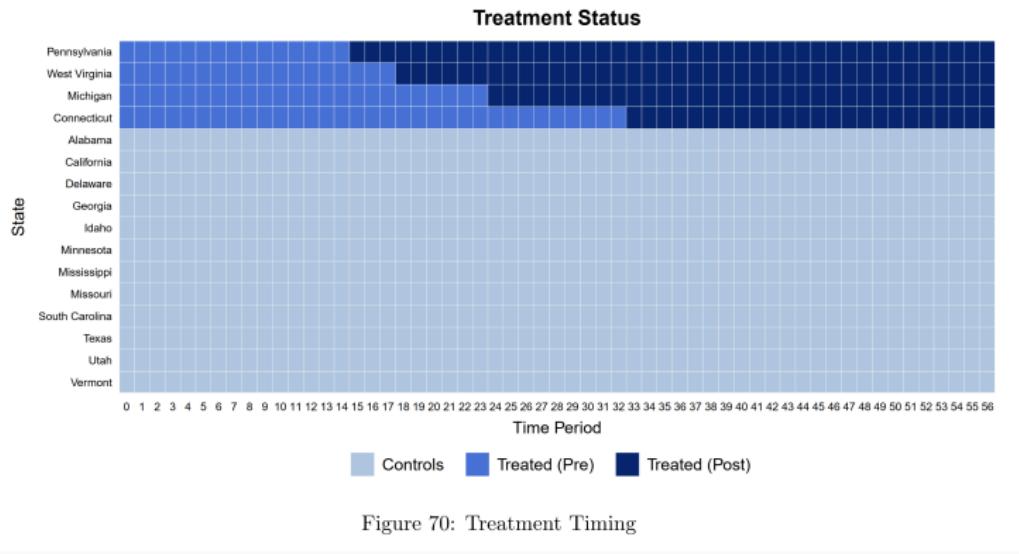
Algorithm to measure Abnormal/Excessive Gambling

- Replace Gambling Spend with $Gamble\%$
- Algorithm to quantify abnormal/excessive gambling
 1. Partition the data for classification and training (CP, TP)
 2. Use $Gamble\%$ to define Normal and Heavy segments in CP
 3. Train TSML models on Normal customer $Gamble\%_{it}$ in TP
 4. Use trained TSML model to predict Heavy customer $Gamble\%_{it}$ in TP, $\widehat{Gamble\%}_{it}$
 5. Define $Abnormal_{it} = f(Gamble\%_{it}, \widehat{Gamble\%}_{it})$ for Heavy customers
 6. Gauge sensitivity to segmentation, TSML model, and $f()$
 7. Count $Abnormal_{it}$ for SynthDD, targeting and demarketing analyses
- Extensible to other addictive goods?

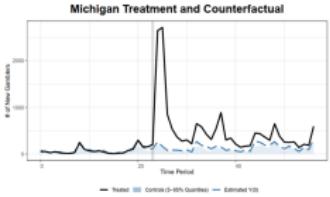
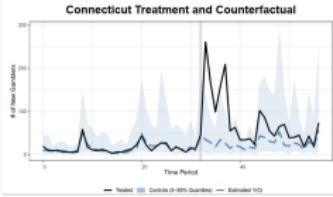
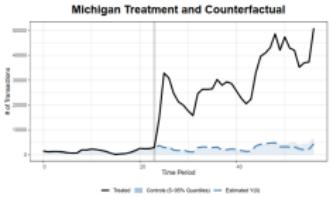
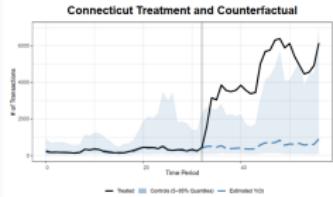
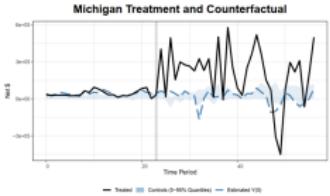
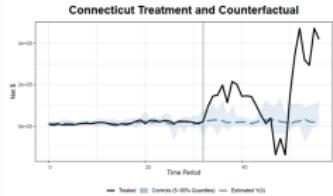
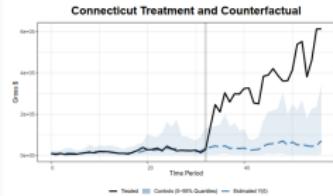
Generalized Synthetic Control Analysis

- Policy changes:
 - CT, MI: Legalized mobile casino gaming & online sports betting simultaneously
 - (Ongoing work) PA, WV: Legalized mobile casino gaming; online sports betting previously legal
- Goal: Estimate how recent state online gaming policy changed gambling outcomes Gross \$, Net \$, Transaction Count, New Gambler Count
 - $Abnormal_{it}$ to be added
- 12 control states had no online gambling policy variation
- Model: GSC (Xu 2017); Staggered DD results similar
- Challenges:
 - Offline gambling available prior to policy change, but transaction data don't identify offline/online, except online-only brands
 - Brands' products change after state policy changes

Treatment Timing



GSC TEs for CT, MI



Discussion

Responsible digital marketers should consider excessive usage,
especially in addictive categories

We are working on an algorithm to identify excessive usage spells,
applied to online gambling

Quantifying policy pros and cons might help policymakers refine
policies

We welcome your comments, ideas, questions

Thank you!

All feedback invited:

kennethcwilbur@gmail.com

Background

COMMERCIAL CASINO GAMING CONSUMER SPEND BY STATE
2021 vs. 2022

	2021	2022	YoY Change
Arizona	\$161,057,784	\$482,932,555	199.9%
Arkansas	\$564,788,794	\$614,115,249	8.7%
Colorado	\$1,226,331,443	\$1,411,926,061	15.1%
Connecticut	\$78,506,752	\$416,196,889	430.1%
Delaware	\$483,161,764	\$491,805,855	1.8%
D.C.	\$26,804,574	\$23,210,844	-13.4%
Florida	\$649,472,056	\$693,967,324	6.9%
Illinois	\$1,712,380,957	\$2,143,654,190	25.2%
Indiana	\$2,724,987,164	\$2,890,358,949	6.1%
Iowa	\$1,861,329,938	\$1,930,787,524	3.7%
Kansas	\$403,500,148	\$478,095,996	18.5%
Louisiana	\$2,380,088,371	\$2,593,096,818	8.9%
Maine	\$146,928,173	\$165,083,231	12.4%
Maryland	\$1,925,556,392	\$2,200,617,997	14.3%
Massachusetts	\$1,020,777,309	\$1,131,925,432	10.9%
Michigan	\$2,700,284,120	\$3,258,076,337	20.7%
Mississippi	\$2,669,186,595	\$2,574,055,232	-3.6%
Missouri	\$1,896,602,363	\$1,905,437,200	0.5%
Montana	\$6,406,202	\$7,172,688	12.0%
Nebraska	\$0	\$14,032,797	
Nevada	\$13,429,949,000	\$14,842,229,783	10.5%
New Hampshire	\$43,832,454	\$66,714,384	52.2%
New Jersey	\$4,737,144,856	\$5,211,274,456	10.0%
New Mexico	\$216,197,456	\$262,037,277	21.2%
New York	\$2,712,733,924	\$4,228,451,328	55.9%
Ohio	\$2,310,305,409	\$2,332,796,678	1.0%
Oklahoma	\$145,792,270	\$150,865,061	3.5%
Oregon	\$30,398,002	\$49,519,355	62.9%
Pennsylvania	\$4,830,812,116	\$5,343,083,196	10.6%
Rhode Island	\$594,082,877	\$688,203,478	15.8%
South Dakota	\$146,063,571	\$142,887,032	-2.2%
Tennessee	\$239,800,000	\$379,409,891	58.2%
Virginia	\$285,895,651	\$563,209,198	97.0%
West Virginia	\$667,980,738	\$756,321,275	13.2%
Wyoming	\$4,012,817	\$14,787,230	268.5%
United States	\$53,033,152,440	\$60,458,338,790	14.0%

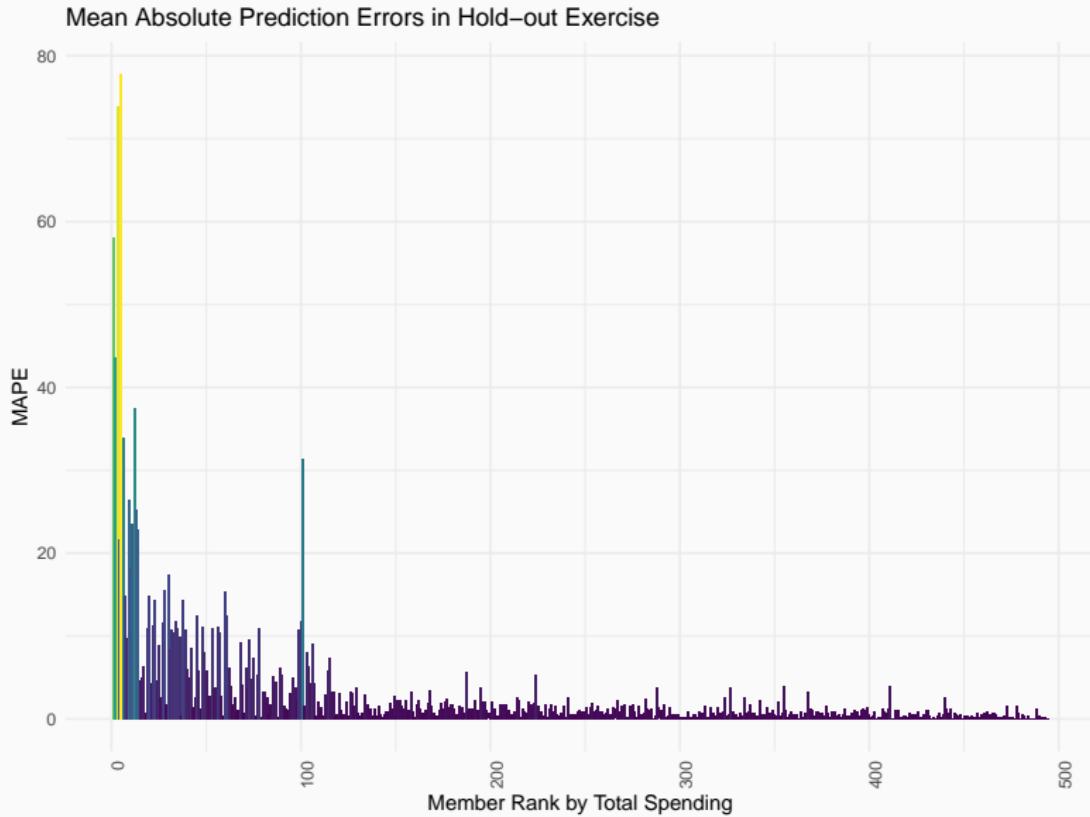
SOURCE: State Gaming Regulatory Agencies

COMMERCIAL CASINO DIRECT GAMING TAX REVENUE BY STATE
2021 vs. 2022

	2021	2022	YoY Change
Arizona	\$5,955,284	\$28,914,695	385.5%
Arkansas	\$80,581,343	\$88,610,186	10.0%
Colorado	\$160,850,119	\$187,666,479	16.7%
Connecticut	\$9,784,045	\$55,104,038	463.2%
Delaware	\$222,208,641	\$225,083,074	1.3%
D.C.	\$5,707,498	\$5,605,145	-1.8%
Florida	\$227,315,219	\$242,888,565	6.9%
Illinois	\$400,773,047	\$495,221,386	23.6%
Indiana	\$654,823,801	\$688,310,140	5.1%
Iowa	\$390,840,981	\$393,176,565	0.6%
Kansas	\$108,960,592	\$110,521,956	1.4%
Louisiana	\$573,080,902	\$601,061,292	4.9%
Maine	\$61,252,475	\$68,231,365	11.4%
Maryland	\$814,354,161	\$854,730,059	5.0%
Massachusetts	\$288,637,795	\$317,316,526	9.9%
Michigan	\$607,607,464	\$733,967,875	20.8%
Mississippi	\$311,479,143	\$303,001,292	-2.7%
Missouri	\$458,768,597	\$458,000,888	-0.2%
Montana	\$1,921,861	\$2,704,350	40.7%
Nebraska	\$0	\$2,806,557	
Nevada	\$1,023,206,554	\$1,151,482,039	12.5%
New Hampshire	\$20,002,022	\$30,696,398	54.8%
New Jersey	\$562,004,880	\$612,350,774	9.0%
New Mexico	\$99,991,322	\$121,192,242	21.2%
New York	\$1,097,285,389	\$1,834,344,554	67.2%
Ohio	\$759,325,907	\$780,963,671	2.8%
Oklahoma	\$66,047,136	\$68,651,961	3.9%
Oregon	\$19,240,449	\$19,501,847	1.4%
Pennsylvania	\$2,016,101,749	\$2,207,789,108	9.5%
Rhode Island	\$300,150,697	\$345,572,062	15.1%
South Dakota	\$17,568,000	\$17,371,560	-1.1%
Tennessee	\$39,300,000	\$68,052,961	73.2%
Virginia	\$20,340,022	\$66,521,292	227.0%
West Virginia	\$272,258,463	\$298,581,597	9.8%
Wyoming	\$111,914	\$843,171	653.4%
United States	\$11,697,837,472	\$13,487,510,670	15.3%

SOURCE: State Gaming Regulatory Agencies

BF MAPE by Customer Spending Rank



BF MAPE by Customer Average Transaction Spend Rank

