Senior Project

Department of Economics

Impact of Sports Gambling Legality on U.S. State's Real GDP per Capita

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Spring 2023

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Abstract

This paper analyzes the impact of the Supreme Court's decision in 2018 to allow states and Washington D.C. to implement state-sponsored sports gambling on that state's real GDP per capita. In addition, this paper also analyzes if there is a statistically significant difference in the measures of the real GDP per capita between the various levels of legalization states have incorporated including retail-only, online-only, and fully legalized. The motivation for this research stems from the recent increase in the number of states that have legalized sports gambling to some degree as well as the growing popularity of the sports betting industry.

Relevant data over the past decade was organized and analyzed through a Two-Way Fixed Effects Difference-In-Differences Method due to the presence of fixed effects and the ability to compare group that were administered treatment at different points in time. This paper provides an argument for a causal relationship between real GDP per capita and legalization status. The results of this study indicate that legalizing sports gambling online or fully (online and retail) increases the real GDP per capita of a state, on average, by $1,073.28 and $2,845.88 respectively. These findings are within the threshold of the 99% confidence level and indicate as well that the respective levels of legalization statuses are significantly different from one another. In addition, having retail sports betting has no significant impact on a state's real GDP per capita. The significant positive effect that online and fully legalized sports betting has on the real GDP per capita may incentivize politicians to adopt sports betting if their state has not done so already. Purely economically, the idea of introducing sports betting is beneficial, although further research should be done to test other economic factors or relevant non-economic factors before implementing any policies.

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1. Introduction

As of March 3rd, 2023, Americans have legally wagered a total of 200 billion dollars, resulting in over 2.55 billion dollars being collected in tax revenue by 28 states (Waters, 2023). This means that the state in which a sports bettor resides, on average, receives approximately 1.275% of the value of the bet placed. However, the landscape for American sports betting has not always been like it is today.

In 2018, the Supreme Court case of *Murphy v. National Collegiate Athletic Association* resulted in the overturning of the Professional and Amateur Sports Protection Act of 1992 which banned almost all state-sanctioned sports gambling across the United States; the only exceptions were mainly Nevada which maintained sports gambling completely and Oregon/Delaware which maintained sports lotteries (Murphy, 2017). As a result, the remaining states and Washington D.C. have since been allowed to determine the legality and extent of sports gambling individually. As of March 2023, twenty-two have full legalization, nine have retail (in-person) only, two have online only, and eighteen have banned sports gambling entirely. As the landscape of sports gambling in the United States continues to change, both the economic and non-economic implications of these decisions will become more evident.

My research determines that the legalization of sports gambling at a state level has a significant effect on that state's real Gross Domestic Product (GDP) per capita and analyzes how the various types of legalization (online only, retail only, or fully legal) have different impacts on a state's GDP. This is achieved through a two-way fixed effect difference-in-differences model which benefits from the staggered fashion in which states legalized sports gambling. Data for this research is collected across several sources, with the main outcome variable obtained from the U.S. Bureau of Economic Analysis (BEA) with the usage of individual calculations.

The results of this research can inform economists and policymakers alike about the potential economic impacts that legalizing sports gambling to different extents has on the GDP per capita of the states. Although other contributing factors must be analyzed when attempting to determine if legalized sports gambling is beneficial as a whole, those factors are not within the scope of this paper. Further studies should analyze the impact on individuals who regularly bet on sporting events regarding their mental health, financial status, and general well-being. This will allow policymakers and the public to be informed with a comprehensive understanding of the effects of sports betting legalization on a state and its residents.

Before the detailed results section, this paper first analyzes the existing literature on this topic, then proceeds to provide a comprehensive review of the data used, followed by a section on the economic theory, and finally, the methodology used to derive those results. The first of these sections, regarding the literature on the topic, can be seen below.

2. Literature Review

The literature surrounding sports gambling falls into three distinct categories. The first category examines U.S. data before the ability of a state to determine the legal status of sports gambling for themselves, which is looked at by McGowan and Mahon (2013). Naturally, another category of literature arises post-2018 once states began implementing their individual sports gambling policies. The final strand of literature revolves around sports gambling in different countries around the world. As many countries legalized sports gambling before the United States, many more comprehensive results are seen in the international studies in comparison to ones done in America, especially those done before 2018.

In their 2013 paper, five years before any state besides Nevada could have legalized sports betting, McGowan & Mahon find that sports gambling was accounting for a yearly

average of 48.1% of all online gambling revenue from 2004 to 2010. This was likely the result of a combination of illegal sports gambling (which was prevalent across the United States before legal means were accessible) and a high interest in sports gambling in areas such as Las Vegas where it was both legal and controlled by the state. Illegal sports gambling, which was usually done online and featured offshore accounts in smaller countries where sports gambling was legal, deprived the state governments of valuable tax dollars from this industry. McGowan and Mahon compare the government restriction of sports gambling to prohibition in the 20th century due to a poll that stated that the large majority (85%) of the public believed that Congress should not interfere with the internet gambling industry. McGowan and Mahon also find evidence that sports gambling, among other forms of gambling, explains positive mean deviations in total online gambling revenue. Due to such support and financial investment from the public, the legalization of sports gambling across the majority of the United States was largely inevitable.

Despite the recency of the Supreme Court decision, which overturned the Professional and Amateur Sports Protection Act (PASPA) and legalized sports gambling in 2018, several papers analyze topics such as the estimated financial impact of sports gambling on the amount of tax revenue collected by the national government (Marchi, 2020), the impact of sports gambling within a single state (Bruneteau, 2020), the massive financial incentives of professional American sports leagues to push for legalized sports betting (Spitz, 2020), the relation between placing a wager and watching a sporting event (Ricciardelli, 2018) and the potential partnerships and deals which will promote sports betting to a larger audience (Sklar, 2021).

Marchi (2020) finds and analyzes expert opinions and financial projections in which the resulting data suggests that $22.4 billion will be contributed to the GDP of the United States annually. The current reported figure, which only looks at the revenue generated by states as a

result of sports betting, accounts for only approximately 10% of the figure estimated in Marchi's paper. This indicates that some factors have led to a significant difference between predictions and reality. This may be due to the notion that states will require more time than estimated to fully pass laws regarding sports gambling as well as setting up the appropriate infrastructure required for either in-person or online betting. It is important to note that the estimate will be reached at some point, it is just a matter of when. Regardless of the potential overestimation, the figures that Marchi finds are no doubt a glimpse into what fully legalized sports betting across all fifty states and Washington D.C. can offer in terms of financial benefits to the United States both in the short and long run.

Bruneteau (2020) analyzes the specific economic impact of sports betting in the state of Nebraska and finds that the economic landscape in Nebraska is suitable for sports gambling given the proximately to casinos for each resident as well as the legislative "pressure" being applied from having nearby states like Iowa with legal sports gambling. Bruteneau argues that Nebraskans may travel to Iowa to legally sports bet or may still choose to do so illegally in Nebraska, but either choice deprives the Nebraskan state government of valuable tax dollars generated through sports betting taxes. As a result, Bruteneau is in favor of legalized sports betting and encourages politicians to act accordingly. If other states develop a similar mindset to that of Bruteneau in Nebraska, sports gambling will rapidly develop in all willing states and only increase the disparity in tax revenue generated between states with legal sports gambling and those with a ban.

Spitz (2020) focuses on the perspective of the different major sports leagues in American sports. Despite this, Spitz still agrees with Bruteneau and supports legalized sports gambling as well. The NFL projects to earn 2.3 billion annually in additional revenue from the legalization of

sports betting (due to increased viewership), but the NHL, NBA, and MLB all have much to gain as well (Spitz, 2020). This could potentially create a positive feedback loop where sports betting is advertised on major televised sporting events across the top sporting leagues in America, which leads to bets being placed, which in turn increases television viewership and in-person attendance numbers. This can be attributed to Ricciardelli's findings in 2018 that state people are 70% more likely to watch a game if they put a wager on it. Sklar (2021) also finds that the emergence of sports gambling and the profits generated by sportsbooks allow for partnerships such as MGM and the NBA/NHL. Such partnerships present higher risks for the average sports better as access to private sports data by MGM allows them to create sharper models which decrease the chance that the average sports better will win their bet. This, in turn, leads to an increase in overall profit and therefore overall tax revenue generated by states. Although financially speaking these partnerships may provide benefits, they may also lead to problems in the future regarding the well-being of their customers because of the potentially predatory actions taken by sportsbooks and casinos to maximize profit from sports betters.

Internationally, several studies look at sports gambling in areas around the world such as Central Europe (Raspor et al., 2019), Western Europe (García-Fernández et al., 2022), and China (Mao, 2013). For example, Raspor et al. (2019) analyzes data from Austria, Croatia, Italy, and Slovenia, and finds that the rate of gambling consumption is increasing every year, especially remote gambling. This is especially relevant in the United States today, where most states allow for remote gambling in some capacity. Raspor et al. (2019) also finds that sports betting has a significant impact on the GDP of the countries in the study, but the state budgets of Croatia and Italy also became increasingly dependent on gambling taxes, providing reasonable fears of the possibility that such consequences could also come to the United States if profit maximization

continues to be pursued by both the state and national government. In Spain, García-Fernández et al. (2022) finds that an estimated 39% of the whole gambling industry was dominated by sports betting. It is, however, China in which sports gambling has been historically the most prevalent. Mao (2013) finds that China experienced drastically more rapid developments in its sports gambling sector compared to the United States or the United Kingdom. Mao (2013) attributes this to being largely because Chinese sports gambling has experienced a growth of at least 20% per year despite already accounting for 0.52% of the total GDP of China. As sports gambling becomes more accessible throughout the world, statistics such as these are only likely to rise, further elevating the importance of the laws and legality of sports betting in the United States.

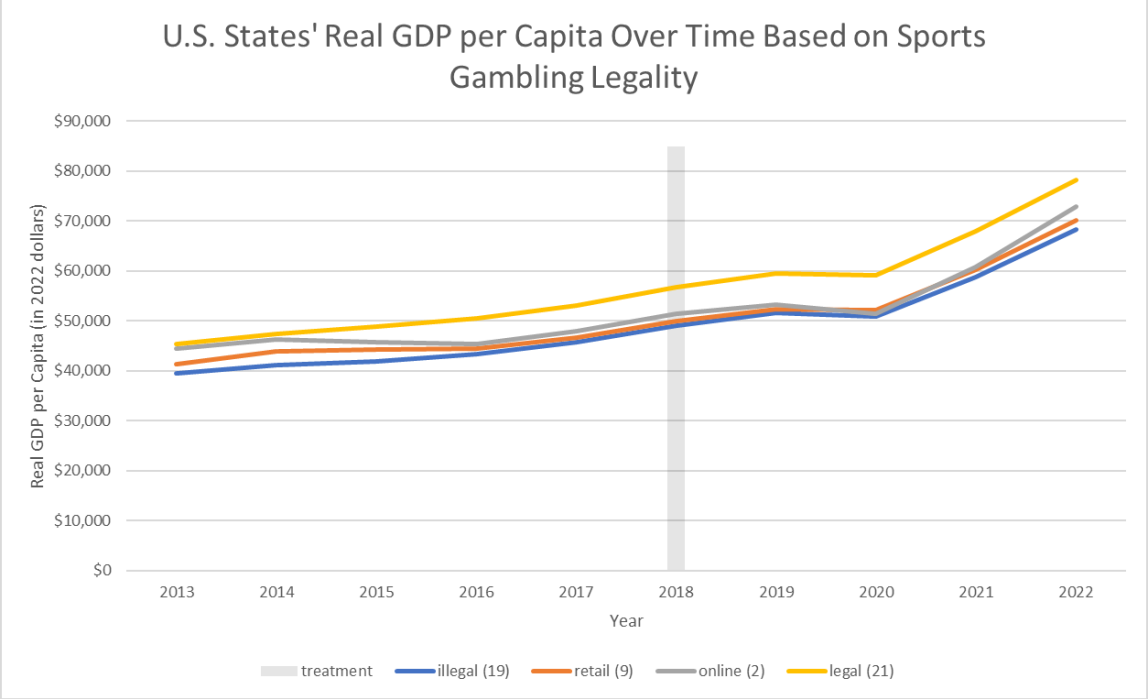
While all of these papers cover certain aspects of sports gambling, a paper that analyzes the impact of the legalization of sports gambling on a state's real GDP per capita will be beneficial to this space. Other U.S.-based papers have previously been limited by the amount of data available, but now there is enough data to conduct a thorough analysis. Although this paper analyses much of the economic impact for each state (and Washington D.C.), this paper does not necessarily advocate for the legalization of sports gambling. The examples mentioned previously describe some of the interesting possibilities regarding future research, however, there may be even more factors that must be considered when formulating an overall opinion on the topic of legalized sports betting.

3. Data

The data used for the regression analysis features the outcome, key, and control variables. The outcome variable is real GDP per capita. The BEA produces quarterly state-level nominal GDP data for all 50 states and Washington D.C., allowing for a selection of almost 10 years' worth of

data and a total of 1989 data points. The value for this variable for each state and time is derived by taking the nominal GDP information from the BEA, dividing those by the population estimates from MacroTrends, and then using the Bureau of Labor Statistics (BLS) inflation calculator.

Figure 1: Summary Statistics



Source: BEA and MacroTrends with individual calculations
Note: This data includes GDP per capita values from 2013Q1-2022Q3 and is measured in 2022 dollars. Each state (and Washington D.C.) is placed in the group based on their legalization status of sports gambling as of 2022Q3. See Appendix A. State Distribution for the list of states in each group.

As can be seen in Figure 1, the fully legalized states averaged the highest real GDP per capita across all periods, followed by the online-only states, and then the retail-only and illegal states respectively. Each group appears to move similarly to the other three, with notable instances including the general decline in real GDP per capita for all groups from 2019-2020 and the sharp uptick following 2020, which is partially due to inflation in general and differences in inflation rates across different regions of the country. Online-only states recovered from the dip faster than retail-only or illegal states, while the long-term effects of the growth experienced post-COVID are to be seen.

In addition to the outcome variable, key variables are present in the analysis and are used to represent the legalization status of each state in each period. Included are the statuses of illegal, retail-only, online-only, and fully legalized sports betting. McQuillan (2023) provides up-to-date data regarding which states fall into which treatment group currently, allowing for the creation of Figure 1.

Lastly, the control variables will include several state-wide indicators such as individual consumption per capita (Figueroa, 2022), expenditure per capita (U.S. Census, 2021), international exports per capita (U.S. Census, 2023), and unemployment rate (BLS, 2023). These variables are included in the analysis to account for observable differences between the different groups. The per capita control variables are calculated through the same method used for the real GDP per capita, where the raw data is extracted from various sources and then divided by the same population estimates each year and put through the inflation calculator.

The variable population, which is abbreviated as pop, was obtained for all 50 states and Washington D.C. through the same source (MacroTrends, 2023). The summary statistics for the population variable are shown in Table 1.

Table 1. Population Summary Statistics

Status	Average Pop	StDevPop
Illegal	8,330,747	10,053,227.78
Retail-Only	3,582,465	3,266,483.24
Online-Only	3,664,801	3,105,718.51
Fully Legalized	6,070,707	4,638,581.73

Source: MacroTrends 2023 and individual calculations

Note: This data includes population values from 2013-2022. Each state (and Washington D.C.) is placed in the group based on their legalization status of sports gambling as of 2022Q3. See Appendix A. State Distribution for the list of states in each group.

The statistics in Table 1 indicate that the average populations are likely statistically different from one another in this period, however, this discrepancy is not alarming. The difference in population amounts between groups is controlled by the other variables in the analysis. One theory as to why this discrepancy exists though may be due to large states either not wanting to have sports gambling (illegal) or having the necessary financial resources/demand to fully incorporate it before the end of 2022 (fully legal). The states which correspond to the middle two options may lack either the financial ability or the desire to expand into fully legalized sports betting.

The variable consumption per capita, also known as conspc, is measured in real dollars and ranges from $22,937 to $57,582. It was obtained for all fifty states and Washington D.C., but only featured data up to 2021Q4, leaving three time periods empty. Despite this, conspc is still used in the regression analysis as the final periods can be omitted, especially due to the presence of state and time-fixed effects in the regression which will naturally account for some of the variations in state real GDP per capita values. The remaining summary statistics are as follows:

Table 2. (Consumer) Consumption per Capita Summary Statistics

Status	AverageConspc	StDevConspc
Illegal	$ 31,858	$ 9,331
Retail-Only	$ 32,496	$ 9,563
Online-Only	$ 32,202	$ 9,423
Fully Legalized	$ 32,785	$ 9,888

Source: Figueroa 2022 and individual calculations

Note: This data includes real consumption per capita values from 2013-2021 measured in 2022 dollars. Each state (and Washington D.C.) is placed in the group based on their legalization status of sports gambling as of 2022Q3. See Appendix A. State Distribution for the list of states in each group.

The results from Table 2 generally do not appear to indicate an economically significant difference between the treatment groups and the control group in terms of consumption per

capita. From this, it does not appear that consumers unconditionally are spending more because of legalized sports gambling and might instead be changing their means of consumption.

The variable expenditure per capita (expc) also has a similar problem in which data is not available post-2021Q4, as well as the additional problem of not having data for the District of Columbia. Expc is also measured in real dollars and ranges from $3,211 to $16,721. Although these problems exist, the variable is still useful in the regression due to the overall contribution it provides to the analysis as well as the presence of the fixed effects mentioned previously making small gaps in the dataset less significant. The summary statistics for expenditure per capita can be seen below:

Table 3. (Government) Expenditure per Capita Summary Statistics

Status	AverageExpc	StDevExpc
Illegal	$ 7,717	$ 10,755
Retail-Only	$ 8,061	$ 11,033
Online-Only	$ 7,937	$ 10,744
Fully Legalized	$ 7,513	$ 11,405

Source: U.S. Census 2021 and individual calculations

Note: This data includes real expenditure per capita values from 2013-2021 measured in 2022 dollars. Each state is placed in the group based on their legalization status of sports gambling as of 2022Q3. Washington D.C. is omitted from this table as data is not available. See Appendix A. State Distribution for the list of states in each group.

Much like the consumption per capita, the expenditure per capita results in Table 3 appear to have economically insignificant differences from one another. This might signify that state governments do not spend more because of increased sports gambling revenue (and possibly even indicates that they spend less overall).

Next, the variable international exports per capita are used to analyze the number of international exports that a state reported in each period divided by their state population. This

variable is known as “iepc” and features a range of $27 per capita to $6,381 per capita depending on the state. The remaining summary statistics can be seen below:

Table 4. International Expenditure Per Capita Summary Statistics

Status	AverageIntExp	StDevIntExp
Illegal	$ 1,006.60	$ 557.69
Retail-Only	$ 948.83	$ 627.52
Online-Only	$ 713.97	$ 531.82
Fully Legalized	$ 1,106.65	$ 710.86

Source: U.S. Census 2023 with individual calculations

Note: This data includes real international export values from 2013Q1-2022Q3 measured in 2022 dollars. Each state (and Washington D.C.) is placed in the group based on their legalization status of sports gambling as of 2022Q3. See Appendix A. State Distribution for the list of states in each group.

Table 4 indicates that states with fully legalized, and fully illegal sports betting tend to export the most per capita, while states with Online-Only statuses export the least. This, again, is likely skewed by the inclusion of only two states in the online-only category and the differences observed in the summary statistics are likely largely not statistically significant given the circumstances of the placement of different states.

The last control variable is the unemployment rate, which is also known as “unemp”. This figure ranges from 1.90% to 23.47%. The data set used incorporated monthly data over the course of the given years which was condensed into quarterly data by taking the average of the unemployment rate in the applicable three-month windows that correspond with the appropriate quarter. The summary statistics are available in the following table.

Table 5. Unemployment Summary Statistics

Status	AverageUnemp	StDevUnemp
Illegal	4.72	1.99

Retail-Only	4.79	1.80
Online-Only	4.78	1.52
Fully Legalized	5.32	2.16

Source: BLS 2023 with individual calculations

Note: This data includes unemployment values from 2013Q1-2022Q3 measured in 2022 dollars. Each state (and Washington D.C.) is placed in the group based on their legalization status of sports gambling as of 2022Q3. See Appendix A. State Distribution for the list of states in each group.

The results of Table 5 may not be noticeable when factoring in GDP per capita even if the difference in the groups is statistically significant. All four groups are within half a percentage point of one another, so drawing assumptions based on these initial results may be premature. After more testing is concluded, a concrete answer will be provided to the results seen in this model and the previous tables as well. To conduct such testing, a model must first be built.

4. Theoretical Discussion

In theory, the legalization of sports gambling should have a significant impact on a state's real GDP per capita. The nominal GDP of a given state can be calculated through the formula of

$$Y = (C + I + G + (X\text{-}M)), \quad (1)$$

where Y is GDP, C is consumer spending, I is investment, G is government spending, X is exports, and M is imports. The resulting value can then correspond to the correct value using the aforementioned inflation calculator. The most important determinants in this formula are "C' and "G" since they accounted for 70% and 17% of the GDP in 2019 (Amadeo, 2022) In this analysis, however, the figure used is the GDP per capita, which can be represented as such

$$Ypc_{st} = (Y_{st}/P_{st}) \quad (1.1)$$

where Ypc_{st} is GDP per capita, Y_{st} is real GDP, and P_{st} is the estimated population of state *s* at time *t*. This formula still maintains all the previously mentioned variables in Equation 1 but factors in a state's population as well. This is done to minimize differences between states to

create a better comparison as GDP per capita figures tend to deviate less from the mean than regular GDP figures.

The ability to collect tax revenue from sportsbooks should, in theory, encourage state governments to spend more, increasing the "G" in Equation 1 and therefore increasing the GDP and GDP per capita of the state in Equation 1.1. In addition, the presence of private sportsbooks may also increase "C" and "G" as they contribute to the economy through external factors such as potentially paying fees to states for exclusive rights or fees to casinos for hosting their platform or on internal factors such as their website/platform, employees, and other applicable costs.

"G" or "C" may not always increase in certain situations, causing there to be no observable differences in GDP and GDP per capita. For example, "G" may not increase if a state chooses to collect tax revenue from sportsbooks, but also decides to cut back taxes elsewhere. The state budget would remain the same, with the only difference being the source of the taxes, and therefore the government spending would be confined to the same budget as the previous year(s) without tax revenue from sportsbooks. The other argument is that measuring "C" would also fail to a similar principle in which consumers do not increase overall consumption with the inclusion of sports betting but rather allocate their money differently and still spend the same amount of money, just rather to a different source. The results shown in the later sections provide an argument against this idea.

There is also an expectation that the values of state GDP per capita may have a layered effect in which the proportion of GDP per capita attributed to tax revenue generated by sports betting increases which each level of legalization. Simply put, a state with fully legalized sports betting will have a higher proportion of its GDP per capita attributed to the legalization of sports

betting than one that is online only, which (online-only) will have a higher proportion than retail only. This is based on two principles, mainly the principle that having two options for sports betting will encapsulate more of the population's interest, as well as the principle that online sports betting is more accessible, has lower barriers to entry, and appeals to the target audience more. The first principle can also be seen in lotteries across many states, where the presence of many companies allows for a variety of products, which in turn captures a larger segment of consumers as compared to if there was only one form of lottery. The second principle is supported by the popularity of online betting (such as in games of poker) in many urban and rural areas as well as predictions from economic theory which state that economic activity in the online-only market would increase due to lower transaction costs relative to the retail-only market. In most states, as well, there is a greater selection of online sportsbooks, increasing the likelihood that there are unique and different bets that one can place online that may not be available in a retail location. Accounting for these factors, there is even a possibility that the proportion of state GDP per capita attributed to the legalization of sports gambling for states that have online-only betting is closer to states with full legalization than that of states with retail betting only.

If the results indicate that the legalization of sports gambling (across any level) does not have a significant impact on the proportion of a state's GDP per capita, the likely explanation is either that the sports gambling industry is simply not big enough to make a significant impact at a state GDP per capita level, the data is still relatively new and there have not been enough observations to determine the full effects of legalization yet, or that the arguments made prior in this section are accurate and both the state government and consumers maintain the same consumption level despite the addition of sports betting. Analytically, this would result in all

three forms of legalized sports betting having an impact that is not statistically different from the zero revenue generated by states without legalized sports betting.

Given all the prior information, the working hypothesis of this research paper is that legalized sports gambling does indeed impact U.S. state real GDP per capita significantly enough to be measured and observed in the testing done. The second part of the hypothesis is that the different forms of legalized sports betting are statistically significant from one another. Simply put, this hypothesis claims that the presence of fully legalized sports betting may be more beneficial to the outcome variable than having either retail-only or online-only options instead. Before the results of these hypotheses can be presented, it is crucial to understand the methodology used to obtain these results in the first place.

5. Empirical Methodology

In the analysis, three Difference-In-Differences (DID) variables are present which are used to represent the four possible legal statuses of sports gambling in a state. These variables, as mentioned before, represent retail-only, online-only, and fully legalized states, respectively. With the inclusion of these variables, a general formula can be calculated, which is as follows:

$$GDPpc_{st} = B_0 + B_1RETAIL_{st} + B_2ONLINE_{st} + B_3FULL_{st} + X_{st} + STATE_s + \\ + QUARTERYEAR_t + \varepsilon_{st} \quad (2)$$

Where GDPpc measures the GDP per capita in state “s” and quarter-year “t”. RETAIL, ONLINE, and FULL are indicator variables with the one corresponding to the legality of sports betting in a state at a given time (t) being a 1 and all others being a 0. To indicate a state having no legalized sports betting, a value of 0 is attributed to all three variables. X represents several

state-level control variables, of which some are measured per capita (pc), such as consumption pc, expenditure pc, international exports pc, state population, and the unemployment rate. The STATE and QUARTERYEAR variables represent the state and quarter of the year fixed effects, respectively, and ε is the error term.

The model used to analyze these variables is the Two-Way Fixed Effects Difference-In-Differences Model (TWFE DID), which is used when members of the treatment group are treated at different points in time as well as used to control for unobservable variables through the state and quarter-year fixed effects listed above. State-fixed-effects control for variables constant for a given state across all quarters, while time-fixed-effects (like the quarter of the year) control for factors impacting all states in each quarter. For example, time-fixed-effects should control for much of the impacts of COVID-19, inflation, and any national government policy which impacted all states' GDP per capita.

To use this model, however, some assumptions about the dataset will have to be made. The two main assumptions revolve around the behavior of the variables had they not been administered treatment. The first assumption is that the control group, which are states with no legalized method of sports gambling, and the three treatment groups which represent the different levels of legalization, would move similarly through time had the Supreme Court never overturned PASPA in 2018 and allowed states to choose on the legal status of sports betting. This is not something that can be factually proven, however, a parallel trends test will be conducted to at least determine if the four groups were moving similarly before being administered treatment in the second financial quarter of 2018 (2018Q2). Results that indicate that the groups do behave similarly before treatment (indicated by having similar slopes) allow for the argument that they would have continued to move together without the addition of

legalized sports betting. This, in turn, allows for the argument to be made that if the results of the regression are statistically significant, there is strong evidence that the legalization status of sports gambling did have an impact on state GDP per capita that would not otherwise be seen had the industry remained illegal. The other assumption revolves around a similar idea, in which it is assumed for this research that the control variables would not have been statistically different from one another had treatment not been administered in 2018Q2. Simply put, the argument is that a given group's (1 control, 3 treatment) control variables would not have changed significantly had treatment not been administered. As with the previous assumption, this cannot be directly tested, however, the usage of a balance of regressors test allows for the control variables of both the control and treatment groups to be analyzed before 2018Q2. A similar argument can be made dependent on the outcome of the test. In this scenario, however, the ability to make the argument revolves around the data being insignificant from one another, proving that there is no real difference between the variables before 2018. This differs from the first assumption as that assumption is only concerned with the significance of the slopes for each treatment group compared to the control group.

6. Results

As mentioned previously, the balance of regressors and parallel trend tests used to generate an argument for causality rather than correlation are vital to the results of this paper. Without proper context, the values of the results may be misinterpreted. Therefore, these two tests will be conducted first before the demonstration of the final model.

When running the balance of regressors test, the results of each variable in the analysis are as follows:

Table 6. Balance of Regressors Test

Regressors	Control (ILL)	Treatment (RET)	Treatment (ONL)	Treatment (FULL)	Difference(RET)	Difference (ONL)	Difference (FUL)
Consumption Per Capita	$29,951	$30,604	$29,926	$30,837	$810**	$-25	$886***
Expenditure per Capita	$5,881	$6,144	$6,143	$5,678	$263*	$262	$-203*
International Exports per Capita	$800	$808	$557	$867	$8	$-243***	$67**
Population	8.2 mil	3.5 mil	3.6 mil	6.0 mil	-4.7 mil***	-4.6 mil***	-2.2 mil***
Unemployment Rate	4.90%	4.91%	5.01%	5.45%	0.01%	0.11%	0.55%***

Source: Previously mentioned sources with individual calculations
Note: Each state (and Washington D.C.) is placed in the group based on their legalization status of sports gambling as of 2022Q3. See Appendix A. State Distribution for the list of states in each group Three stars are used to represent the 99% confidence threshold, two stars are used to represent the 95% confidence threshold, and one star is used to represent the 90% confidence threshold. The inclusion of no stars represents statistical significance. Only pre-treatment data is considered.

Table 6 shows each variable used in the analysis and the significance of the difference in means between the fully legalized and fully illegal states. For the population variable, the results indicate that there is a statistically significant difference between fully illegal and fully legalized states. This may normally be a cause of concern, however, all the variables in the regression account for differences in populations of states. The purpose of this variable is not to control for differences (as the other variables do this), but rather to aid in the creation of the regression model.

The consumption per capita variable is different in the sense that differences in this variable are not accounted for elsewhere, so the significance of the difference may be alarming at first glance, however, the mean difference is only $886. In purely economic terms, a difference of roughly $29,500 and $30,800 in annual consumption spending per capita does not alter GDP per capita to a degree where the results presented in the following sections are inaccurate. This difference, although it is present, would likely do little to change the overall impact of legalized sports betting. The only change may be a slight shift in coefficients discussed later, but the general trend would remain stable.

The unemployment rate also has a similar problem and logical explanation as the consumption per capita. The unemployment rate, which is measured in percentage points, has

only a half-percentage point difference between the two groups. The result may appear statistically significant, but half a percentage point in context also does not alter the general trends observed in the final model.

Expenditure per Capita and International Exports per Capita can be branched together due to their similarities as well. The differences in both variables fail the 99% confidence level test, with expenditure per capita failing the 95% test as well. This indicates that the difference in these variables may not be as certain as the previous variables. However, if one would like to argue that these values still pass the 90% confidence level test, the same logical solution can be applied from previously where the difference in the means is $203 and $67 per capita difference. Differences of such small amounts, regardless of significance levels, do not alter the results either. These two variables likely provide the most evidence that the means are roughly the same before 2018.

Following the balance of regressors test, the parallel trends test is used to provide further evidence of causation rather than correlation. As mentioned in previous sections, this test is conducted to determine if the real GDP per capita was changing year-on-year in similar ways across the treatment and control groups. In this instance, the fully legal and fully illegal states were once again used for comparison. Shown in Table 7 are the two parallel trend tests, with the model with no control variables being listed first followed by the model with control variables. which features no control variables in the equation. Immediately after is a parallel trends test with the inclusion of control variables to prove that the addition of control variables does not significantly alter the interpretation of the results.

Table 7. Parallel Trends Test

Regressors	Model 1	Model 2
Illegal	-4257.21	-2866.46**
	(-3,450.65)	(1,251.59)
Year	3643.19	-1210.0807
	(-4,901.92)	(1,178.79)
Year^2	-1072.9	-187.4962
	(2085.22)	(501.82)
Year^3	148.7017	35.45
	(-250.04)	(60.67)
Illegal x Year	-1019.29	-1489.9385
	(-5559.00)	(2,068.29)
Illegal x Year^2	326.55	687.66
	(2,358.08)	(887.49)
Illegal x Year^3	-33.00	-77.64
	(-282.35)	(107.09)
Control Variables?	No	Yes
Observations	1122	1100
F-Statistic	13.18***	183.76***

Source: Previously mentioned sources with individual calculations
Note: Each state (and Washington D.C.) is placed in the group based on their legalization status of sports gambling as of 2022Q3. See Appendix A. State Distribution for the list of states in each group. Three stars are used to represent the 99% confidence threshold, two stars are used to represent the 95% confidence threshold, and one star is used to represent the 90% confidence threshold. The inclusion of no stars represents statistical significance. Only pre-treatment data is considered.

Table 7 results show that the difference in changes in GDP per capita values (trends) between the fully illegal and the fully legal group is not statistically significant, with or without the inclusion of control variables in the model. This indicates that there is no evidence that the different groups behaved differently in response to external factors before 2018, allowing for an assumption to be made that this would continue until 2022Q3 and there would not have been a significant difference in trends had treatment not been administered. These results also allow for the creation of the argument that even if the balance of regressors test would have been a failure, then this test could still provide a potential argument for causality due to the similarity of trends before treatment (with the assumption that these trends would naturally continue had they not been impacted by a treatment)

After analyzing the results of the two tests used to argue for causality, the only remaining analytical aspect is the regression model. Three models are presented below, ranging from the initial model with no control variables, to the model with all control variables, to the final model with provides the best logical explanation of the factors involved.

Table 9. Regression Models

Variables	Model1	Model2	Model3
Retail-Only	-757.19 -485.92	- 1632.17*** -467.47	-757.11 -490.38
Online-Only	955.72** -381.53	833.93** -397.15	1,073.28*** -370.67
Fully Legal	2,516.1*** -661.65	560.15** -239.64	2,845.88*** -662.89
Unemployment Rate		-321.36*** (62.21)	-268.51*** -74.14
International Exports per Capita		-1.41*** -0.41	-1.79** -0.77
Population		0.001*** 0	0.002*** 0
Intercept	28,204.81*** -714.73	-553.41 -3,533.13	25,696.14*** -1,944.27
Consumption per Capita		0.68*** -0.11	
Expenditure per Capita		1.33*** -0.24	
State & Year Fixed Effects?	Yes	Yes	Yes
Observations	1989	1800	1989
Adjusted R-Squared	0.9706	0.9702	0.9711
F-Stat	720.14	842.66	684.92

Source: Previously mentioned sources with individual calculations

Note: Each state (and Washington D.C.) is placed in the group based on their legalization status of sports gambling **in that given quarter**. Figures are represented in 2022 dollars. The starts on each coefficient represent the significance level of the variable. Three stars represents the 99% confidence threshold, two stars represents the 95% confidence threshold, and one star represents the 90% confidence threshold. The inclusion of no stars represents statistical significance.

In the table above, the variable consumption per capita is dropped from Model 2 to Model 3. This was done due to the logical argument that can be made that consumption per capita has a direct relationship with the outcome variable GDP per capita, in that consumption naturally increases because of higher GDP according to economic theory. For that reason, the variable may be a biased estimator and unfit to be included in the final model.

It is, however, important to interpret the coefficients of some of the variables in the models. For the retail-only variable, it is negative, which is contradictory to the hypothesis earlier in the paper. However, there is a possibility that this figure, along with the figures for Online-Only and Fully Legalized sports gambling are biased by other factors not controlled for in this paper. This is a result of the natural limitation of data acquisition possible in certain topics. For this reason, as well, the treatment variables should possibly be seen more as lower bounds for their true values. As more relevant variables were added, the coefficients of both of the significant treatment groups went up, this means the reported values in Model 3 of $1,073.28 and $2,845.88 likely are the lowest estimates of the real-world impact of sports betting.

The population variable is essentially 0 for models 2 and 3, however, the exact non-rounded figures are an increase of $0.001 and $0.002 (respectively) in State GDP per capita as the state population increases by 1. This equates to a fraction of a penny and is not crucial in the understanding of the results.

The unemployment rate in Models 2 and 3 has a negative relationship with the outcome variable, as expected through the usage of economic theory. This might be due to states generally producing less GDP overall (and per capita) when more people are unemployed and unable to contribute to the labor force which is responsible for a sizeable portion of GDP. A one

percentage point increase in the unemployment rate tends to decrease GDP per capita for all, on average by $268.51 according to Model 3.

The final variable included in the final model is International Exports Per Capita, which has a coefficient of negative two. This indicates that for every dollar's worth exported, the GDP per capita decreases by two dollars. Although this may seem contradictory at first, the variable itself may be biased and therefore the coefficient may not be accurate. For instance, the addition of import data may correct this bias and the coefficient of International Exports per Capita may flip to a positive value.

7. Conclusion

With the Supreme Court's decision in 2018 to allow states to choose the status of sports betting for themselves, a 200-billion-dollar industry, which is still rapidly growing as well, spawned. At that time, this decision seemed inevitable to some due to the number of dollars that were being gambled illegally in offshore accounts every year. With the recent introduction of fully legalized sports betting in Ohio as well as numerous advertisements seen across the country, the foundation for this paper is now set.

This research focuses on the impact of legalized sports betting on the U.S. State's real GDP per capita. This measure is chosen as a general benchmark of a state's financial well-being due to the nature of its measurement (economic activity). This idea is novel, as other recent papers focus on different aspects of sports gambling. In addition, the data in this analysis is obtained through various sources, including but not limited to the BEA and the United States Census Bureau. This paper also makes the argument that the results in the previous section are evidence of causation and not correlation through the inclusion of both a Balance of Regressors and Parallel Trends Test. This then allowed for the usage of a Two-Way Fixed Effects

Difference-In-Differences model which provided the results of approximately a $1,100 GDP per capita boost for Online-Only states and an approximate $2,800 GDP per capita boost for fully legalized states. These two figures serve as lower bounds as discussed in the previous section, with the real economic impact likely being higher than these estimates.

While these results do not address other potential benefits or drawbacks of legalized sports betting, they can inform policymakers about its direct impact on real GDP per capita. However, it is also important for politicians and anyone else invested in the topic to seek additional research done on other financial and non-financial impacts of legalized sports betting. Going forward, the potential impacts of legalized sports betting should be studied, with special consideration to mental health and other social outcomes because of potential gambling addictions. Policies regarding a topic such as sports betting should only be implemented after extensive research covering different aspects.

While this study is subject to certain limitations including the assumptions required to use the Two-Way Difference in Differences Model, this paper maintains the discovery of a positive economic impact because of legalized sports betting, with the greatest increases being seen in fully legalized states. These results contribute to the growing body of research on this topic and highlight one of the prominent potential financial benefits of legalized sports betting.

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Appendix A

State Distribution

There are nineteen states without any form of legalized sports gambling as of 2022Q3. These states include Alabama, Alaska, California, Florida, Georgia, Hawaii, Idaho, Kentucky, Maine, Massachusetts, Minnesota, Missouri, Nebraska, Oklahoma, Ohio, South Carolina, Texas, Utah, and Vermont. Nine states only have retail, or in-person, sports gambling as of 2022Q3. These states include Delaware, Mississippi, Montana, New Mexico, North Carolina, North Dakota, South Dakota, Washington, and Wisconsin. Two states only have online sports gambling as of 2022Q3. These states are Tennessee and Wyoming. Twenty-one states have fully legalized sports betting as of 2022Q3. These states include Arizona, Arkansas, Colorado, Connecticut, Illinois, Indiana, Iowa, Kansas, Louisiana, Maryland, Michigan, Nevada, New Hampshire, New Jersey, New York, Oregon, Pennsylvania, Rhode Island, Virginia, Washington D.C., and West Virginia

Appendix B

SAS Codes

```
LIBNAME honors "/home/u53699677/Honors";

PROC IMPORT

DATAFILE="/home/u53699677/Honors/SportsGamblingData3.7.xlsx"

OUT=honors.main

DBMS=xlsx

  REPLACE;

  SHEET="Mega Table";

  GETNAMES=YES;



PROC IMPORT

DATAFILE="/home/u53699677/Honors/SportsGamblingData3.7.xlsx"

OUT=honors.mini

DBMS=xlsx

  REPLACE;
```

```
  SHEET="Mini Table (AsOf2023Q3)";
  GETNAMES=YES;

/*
PROC IMPORT
DATAFILE="/home/u53699677/Honors/sastable.xlsx"
OUT=honors.gdp
DBMS=xlsx
  REPLACE;
  SHEET="Sheet1";
  GETNAMES=YES;

proc transpose data=honors.gdp out=honors.cleangdp;
var Q12013 Q22013 Q32013 Q42013 Q12014 Q22014 Q32014 Q42014 Q12015 Q22015
      Q32015 Q42015 Q12016 Q22016 Q32016 Q42016 Q12017 Q22017 Q32017 Q42017
      Q12018 Q22018 Q32018 Q42018 Q12019 Q22019 Q32019 Q42019 Q12020 Q22020
      Q32020 Q42020 Q12021 Q22021 Q32021 Q42021 Q12022 Q22022 Q32022;
```

```
by GeoName;

run;



proc export data=honors.cleangdp

outfile="/home/u53699677/Honors/cleantable.xlsx"

    dbms=xlsx

    replace;

    sheet="Sheet1";

run;

*/



data honors.mini2;

set honors.mini;

yf = yearfrac-2013;

yf2 = yf * yf;

yf3 = yf * yf * yf;
```

```
illyf = ill * yf;

illyf2 = ill * yf2;

illyf3 = ill * yf3;

run;



/*BALANCE OF REGRESSORS (DEFEND USING PARALLEL TRENDS TEST)*/

Proc TTest Data = honors.mini2;

Where yearfrac<2018.50 and ret ne 1 and onl ne 1;

Var pop rconspc unemp rexpc riepc;

Class leg;

Run;



Proc TTest Data = honors.mini2;

Where yearfrac<2018.50 and leg ne 1 and onl ne 1;

Var pop rconspc unemp rexpc riepc;

Class ret;
```

```
Run;



Proc TTest Data = honors.mini2;

Where yearfrac<2018.50 and ret ne 1 and leg ne 1;

Var pop rconspc unemp rexpc riepc;

Class onl;

Run;



/*NO CONTROLS*/

ods output ParameterEstimates= Model1;

Proc SurveyReg Data= honors.main;

class state yearfrac /ref=first;

model rgdppc = ret onl leg state yearfrac /solution adjrsq;

run;



/*BAD CONTROLS*/
```

```
ods output ParameterEstimates= Model2;

Proc SurveyReg Data= honors.main;

class state yearfrac /ref=first;

model rgdppc = ret onl leg state yearfrac pop rexpc rconspc unemp riepc/solution adjrsq;

run;



/*FINAL MODEL*/

ods output ParameterEstimates= Model3;

Proc SurveyReg Data= honors.main;

class state yearfrac /ref=first;

model rgdppc = ret onl leg state yearfrac pop unemp riepc /solution adjrsq;

run;



Proc SurveyReg Data= honors.main;

class state yearfrac /ref=first;

model rgdppc = ret onl leg state yearfrac unemp riepc /solution adjrsq;
```

```
run;



/*PARALLEL TRENDS TEST w/out control*/

Proc SurveyReg Data= honors.mini2;

*class state yearfrac /ref=first;

where yearfrac<2018.50;

model rgdppc = illyf illyf2 illyf3 ill yf yf2 yf3/solution adjrsq;

run;



/*PARALLEL TRENDS TEST w/ control*/

Proc SurveyReg Data= honors.mini2;

*class state yearfrac /ref=first;

where yearfrac<2018.50;

model rgdppc = illyf illyf2 illyf3 ill yf yf2 yf3 pop rconspc unemp rexpc riepc /solution adjrsq;

run;
```

```
data Table_final;

length Parameter $25;

set Model1 Model2 Model3 indsname=DataBase;

keep Model Variable: value Parameter;

Model=scan(DataBase, -1, ".");

Parameter=compress(Parameter);

Variable=cats(Parameter,"_1");

Estimate_Rounded=round(estimate, 0.01);

if Probt>0.1 then Star="   ";

else if Probt>0.05 then Star="*";

else if Probt>0.01 then Star="**";

else star="***";

Value=cats(Estimate_Rounded,Star);

output;

Variable=cats(Parameter,"_2");

StdErr_Rounded=round(StdErr, 0.01);
```

```
Value=cats("(",StdErr_Rounded,")");

output;

where estimate ne 0;

run; quit;



proc sort data=Table_final;

by model Variable;

run; quit;



data Model1Reg Model2Reg Model3Reg;

set Table_final;

if model="MODEL1" then output Model1Reg;

if model="MODEL2" then output Model2Reg;

if model="MODEL3" then output Model3Reg;

run; quit;
```

```
data Table_Final2(drop=model parameter variable);

merge Model1Reg(rename=(Value=Model1)) Model2Reg(rename=(Value=Model2))
      Model3Reg(rename=(Value=Model3));

by Variable;

if mod(_n_,2)=1 then variable2 = Parameter;

run; quit;



ods excel file="/home/u53699677/Honors/results.xlsx";

proc print data=Table_Final2 noobs;

var variable2 model:;

run;

ods excel close;
```