Final Project

Gambling Preference and Municipal Bond Return

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CONTENT

Project Overview

Introduction and summary of the project

Project Summary

Motivation

Gambling preference of the team members

Hypothesis

Higher gambling preference is associated with lower price of the Municipal bond and, therefore, higher yield rate.

Possible Mechanism

1. High gambling preference → more aggressive investment profile
2. Policy makers' biased decisions→ lower creditworthiness of municipal bonds

Data and model selection

- Panel data from 2014 to 2022
- OLS model

Process of the Study

01
- Regression on cross-sectional data from the year 2022

⇒Insignificant results →Panel data

02
- Stationarity Test
- Autocorrelation Test
- Heteroskedasticity Test

03
- Hausman test

⇒Adopting random effect model

04
- Variance Inflation factor–multicollinearity

⇒Robustness of the model

Unveiling the key conclusions

A higher gambling preference is associated with higher bond return, but a heightened gambling preference does not necessarily increase the bond risk.

- Model lack of explanatory value
- Coefficient output, although statistically significant, may not reflect the true relationship between variables
- **Evidence is not compelling enough to infer our hypothesis.**

Research Design

Hypothesis, data source and uses, and model design

Research Hypothesis

H1: Municipal bonds from regions with a **strong** gambling preference are **more likely to** produce high excess returns.

Building on Qiong et al. (2021), we examine the impact of gambling culture on U.S. municipal bond returns. Regions heavily dependent on gambling revenue face **increased bond risks**, further complicated by the industry's regulatory and legal challenges. This perception might deter certain investors, but the heightened market volatility could attract those seeking **higher returns**.

Data and Sources

The dataset employed in this study spans from 2014 to 2022 and encompasses the S&P Municipal Bond Index along with Casino Revenue for each state.

- S&P Municipal Bond Index → S&P Dow Jones Indices
- Casino Revenue → American Gaming Association
- Poverty Rate data → U.S. Census Bureau
- High School Population data → U.S. Census Bureau
- State Population data → U.S. Census Bureau and the American Community Survey.

Nevada and New Jersey were excluded from the analysis given that their gambling demographics could be skewed by external individuals traveling to these states specifically to gamble.

Methods and Model Construction

$$\text{MunicipalBond\_r}_{it} = \beta_0 + \beta_1 \text{GambleRev}_{it} + \beta_2 \text{Poverty}_{it} + \beta_3 \text{Edu}_{it} + \beta_4 \text{GambleRev\_d}_{it} + \beta_5 \text{Pop}_{it} + u_{it}$$

Where:

i = State, t = Time period (2014-2022)

MunicipalBond_r : Time-series data from 2014 to 2022 on per capita casino revenue

Gamb_Rev: Time-series data from 2014 to 2022 allows for dynamic analysis

Poverty : Represents the poverty rate in each state. Higher poverty rates could indicate a less stable economic environment, potentially affecting bond returns.

Edu : Indicates the percentage of the population with less than a high school diploma. Lower educational attainment could be associated with lower economic productivity and higher risk, which may influence bond yields.

GambRev_d : Dummy variable for 2022, 1 if average gambling revenue > mean

Pop : Represents the total population of each state. Larger populations might offer a broader tax base, potentially stabilizing bond returns.

Preliminary Test

Before delving into the intricacies of panel data analysis, it is essential to ensure that the data meets certain assumptions.This section discusses the preliminary tests carried out on the dataset comprising municipal bond returns across various U.S. states.

These tests include:

1. Stationarity Test
2. Heteroskedasticity Test
3. Autocorrelation Test

Stationarity Test

Stationary bias is crucial to address in OLS modeling to prevent misleading results stemming from spurious relationships in non-stationary time series data. Stationarity in the dataset was tested using the **Augmented Dickey-Fuller (ADF) test**. The result is shown in the table below.

Variables	P-value
Municipal bond return	0.0004 (Stationary)
Revenue from gambling per capita	0.097 (Non-stationary)
Poverty	0.016 (Stationary)
Education variable	0.038 (Stationary)
Gambling Revenue Dummy	0.020 (Stationary)
Population	0.102 (Non-stationary)

Stationarity Test - Handling

Applying **first-order differencing**, both variables were found to be stationary

Variables	P-value
Municipal bond return	0.0004 (Stationary)
Revenue from gambling per capita	2.90 × 10^-11 (Stationary)
Poverty	0.016 (Stationary)
Education variable	0.038 (Stationary)
Gambling Revenue Dummy	0.020 (Stationary)
Population	2.36 × 10^-13 (Stationary)

Heteroskedasticity Test

- Heteroskedasticity can lead to unreliable regression estimates.
- Used the Breusch-Pagan test for bias assessment.
- P-values > 0.05: Data is homoskedastic.

Autocorrelation Test

- Autocorrelation can skew OLS regression estimates.
- Tested using Durbin-Watson statistic: Result = 2.13 (slight negative autocorrelation).
- Panel data assumptions mostly met; addressed stationarity via first-order differencing.
- Dataset now primed for panel data analysis.

3 Empirical Analysis

Key findings and Robustness

Regression Result

H1: Municipal bonds from regions with a strong gambling preference are more likely to produce high excess returns.

Per Capita Casino Revenue (GambleRev_r):

- Negative relationship with municipal bond returns
- Possible Explanation: Higher casino revenue per capita over time indicates a stable revenue base, reducing perceived risk and leading to lower yields.

Gambling Revenue Dummy (GambleRev_d):

- Positive related with dependent variables
- Could be used to analyze the most recent impact of recent gambling revenue trends on bond returns

VARIABLES	(1) MunicipalBond_r
GambleRev_r	-3.195***
	(0.954)
Poverty	0.0229
	(0.495)
Edu	-0.367
	(0.337)
GambleRev_d	0.689**
	(0.315)
Pop	-0.101
	(0.144)
Constant	-1.496***
	(0.495)
Observations	225
Number of state_id	9

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Robustness Check

Multicollinearity Test

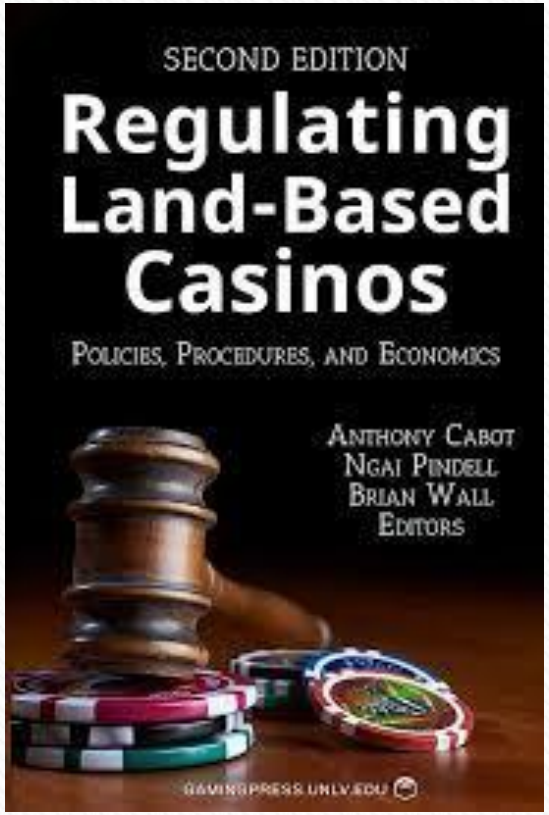
Variables	VIF
Revenue from gambling per capita	1.62
Poverty	5
Education variable	5.35
Gambling Revenue Dummy	1.5
Population	1.52

The average VIF is 2.998, which is below 5 suggesting that multicollinearity bias is not a major concern.

Endogeneity - Instrumental Variable(Unfinished)

Tourist Arrivals: The number of tourists could be a good instrument for casino revenue, assuming that higher tourist numbers lead to higher casino revenue but do not directly affect municipal bond returns.

Casino Licensing Policies: The number of casino licenses issued in a year could be used as an instrument, assuming that more licenses would increase casino revenue but are not directly related to bond returns.



Conclusion

Key findings and rationale

Conclusion

1. Regression on panel data
2. Test
3. Random Effect Model
4. Results

Hypothesis: Municipal bonds originating from regions with a strong gambling preference would likely yield higher excess returns. We get significant negative correlation between casino revenue and municipal bond returns

Conclusion

Correlation>0

Regions with higher casino revenue tend to have higher bond excess returns

Increase in the predictor variable (Casino Revenue) is associated with a decrease in the dependent variable (Municipal Bond Returns)

Coefficient<0

R-squared=0.3394

Approximately 33.94% of the variability in municipal bond returns can be accounted for by the combination of Casino Revenue and the control variables

Interpret

GambleRev_r

Coefficient: -3.195 (Significant at 1%)

- Higher may indicate a more stable and diversified revenue base for the state.
- This could reduce the perceived risk of the state's municipal bonds, leading to lower yields or returns.

GambleRev_d

Coefficient: 0.689 (Significant at 5%)

- May capture the short-term effects or market sentiments.
- For instance, a sudden increase in gambling revenue in 2022 might be viewed as a positive economic indicator, leading to higher demand and thus higher returns on municipal bonds.

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Interpret

Possible Explanation

- **Time Horizon**: Negative time-series coefficient (GambleRev_r) represents long-term effects - stability and risk reduction valued, leading to lower yields. Positive dummy coefficient (GambleRev_d) reflects short-term market sentiments driving up yields.

- **Investor Behavior**:Negative relationship for long-term investors valuing stability. Positive relationship for short-term investors being speculative and reacting to sudden revenue spikes.

- **Policy Changes**: 2022 dummy variable captures effects of recent policy changes boosting gambling revenue and municipal bond returns temporarily.

But still…..

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Possible Explanation

01 · Confounding Variable

02 · Time Lag Effects

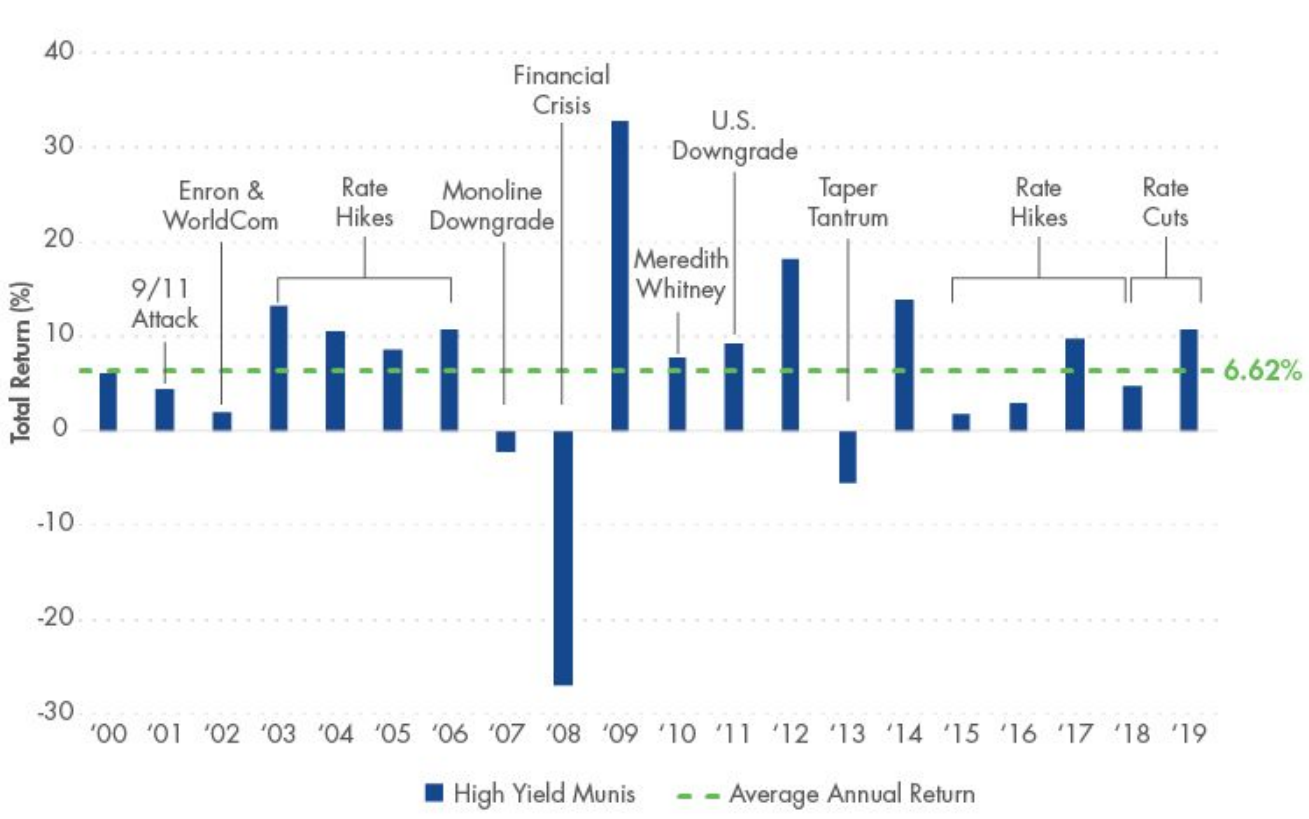
03 · Non-linear Relationship

04 · Omitted Variable

5 Limitations and Future Research

How to improve in the future?

Regression Model limitation



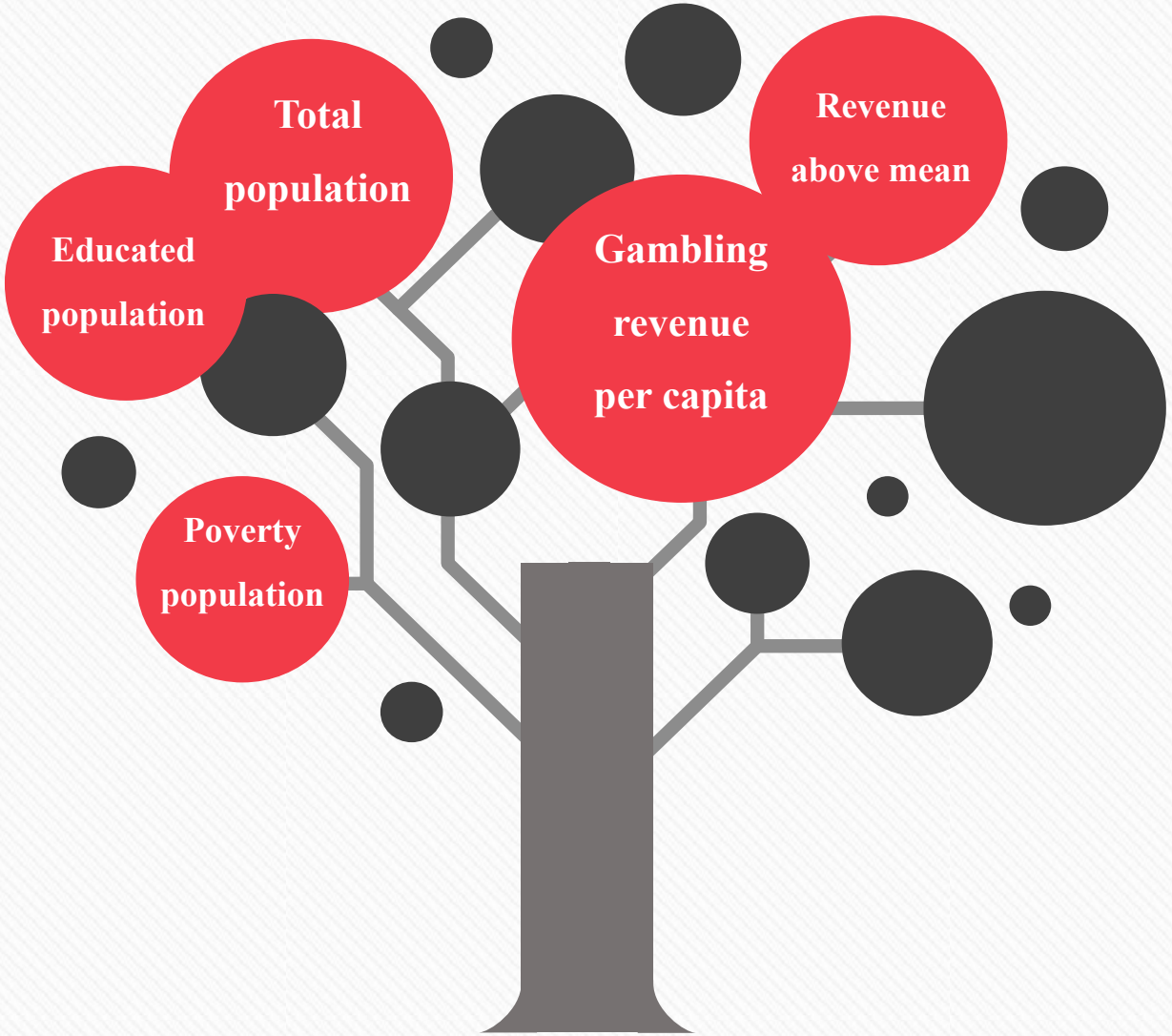
Limitations:

- Assumption violation
  - Linearity
  - Exogeneity
  - Homoscedasticity
- Endogeneity biases

Mitigations:

- Instrumental variables technique
- Structural equation modeling
- Non-parametric approaches or qualitative insights

Missing Variables



Limitations:

- Omitted Variable Bias
  - Inflation levels
  - Non-casino profits
- Collinearity
- Measurement Inaccuracies

Mitigations:

- Comprehensive Literature Review
- Principal component analysis
- Sensitivity Analysis

Future Research

Multilevel modeling

Uncovering regional variations and provide nuanced insights into the relationship.

Mechanism test

More thorough exploration of the causal pathways that connect gambling preferences to bond return

Qualitative research

Including interviews and surveys to delve into the underlying motivations and decision-making processes behind gambling preferences and financial choices

Unconventional data

Such as sentiment analysis from social media to unveil real-time public sentiment dynamics and its potential influence on financial behaviors

Thank you

谢谢聆听