Impact of municipal bond on local GDP growth

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Abstract

This paper investigates the impact of China's municipal bond issuance on local GDP growth using a panel dataset covering 298 cities from 2005 to 2022. The analysis utilizes empirical models to conduct primary, regional difference, and lagged effect analyses. Findings indicate that while municipal bond issuance generally promotes GDP growth, the results exhibit significant regional variations and diminishing marginal returns. However, the study also highlights the challenges posed by high incidences of missing data, which affect the robustness of the results. This research underscores the need for improved data quality and tailored bond issuance strategies to maximize the economic benefits of municipal bonds in China's diverse regions.

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1 Introduction

This research paper delves into the influence of Chinese municipal bonds on local GDP growth, a critical aspect of regional economic development in China. Municipal bonds, integral to China's financial architecture, have significantly shaped urban development and local government financing. This study examines how these municipal bonds drive or impede regional economic growth and development across various cities in China.

This study is structured into several sections. The first section provides an overview of China's municipal bond framework, summarizing how these bonds function within the broader economic landscape. It introduces the research questions that guide this study, aiming to uncover the linkage between municipal bonds and GDP growth. This section also reviews existing literature on the subject to provide a foundation for the analysis.

The second section details the empirical methodology. It describes the sources of data, statistical techniques, and regression models employed to explore the relationship between bond issuance and economic growth at the local level. Additionally, this section explains the different models used in the analysis, including the primary analysis, regional difference analysis, and lagged effect analysis.

The third section focuses on the analysis of results, where we interpret the empirical findings. This includes examining the overall impact of municipal bond issuance on GDP growth, the regional variations in these effects, and the potential lagged impacts of bond issuance over different time horizons.

The final section offers conclusions drawn from the analysis, highlighting key drawbacks and limitations of the study. In addition, it provides suggestions for

future research directions, emphasizing areas that could further illuminate the role of municipal bonds in China's economic landscape.

1.1 Background Information

1.1.1 Local Government and Municipal Bond

Local governments in China are prohibited from directly issuing bonds and instead use Local Government Financing Vehicles (LGFVs) to raise funds.

Government Financing Vehicles (LGFV). By (7), local governments capitalize their investment by transfer the public land usage right. They borrow money to finance infrastructure project from bank using these public lands as collateral. The flow chart from IMF report below explains the relationship between local government and municipal bond.

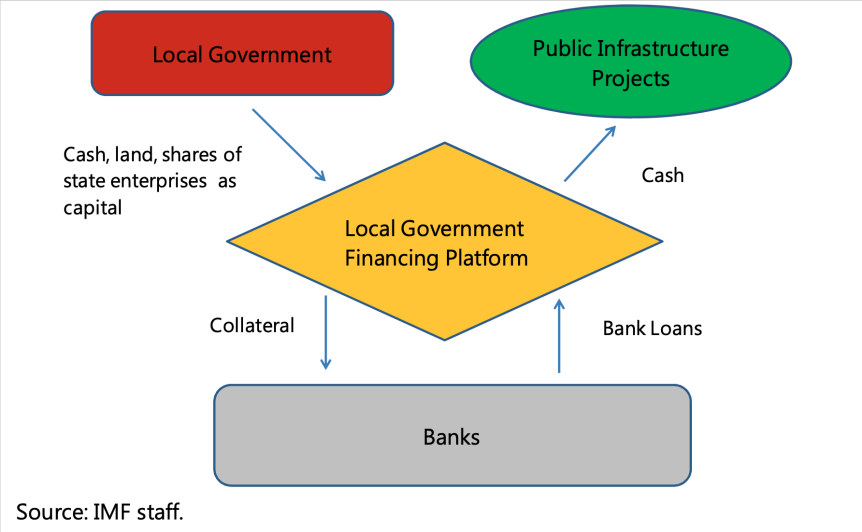

Figure 1: The structure of LGFV (source: (7))

1.1.2 Properties of Municipal Bond

1. As one kind of SOE, LGFV played a significant role in facilitating the construction of public welfare projects financed by municipal bonds, such as affordable housing construction, infrastructure, social services, and ecological and environmental protection. Therefore, municipal bonds promote economic growth by increasing government spending and public infrastructure development.

2. Even if Municipal bonds are not issued directly by local governments, they are still considered to be endorsed by the government. Therefore, in addition to the repayment capacity of the platform company, banks also consider the financial condition of the local government as one of the criteria for evaluating the creditworthiness of LGFV.

1.2 Motivation and Research Question

This research interest stems from my experience working on a municipal bond database for a financial institution in the summer of 2023. I established the database of asset liability ratio, financing cost, debt growth rate and so on of each LGFV. During this process, I found that most LGFVs have very high debt ratios (around 60-70% on average). At the same time, the central government has repeatedly stressed the need for local governments to control their debts and has launched four debt reduction campaigns so far.

This raises the question whether is rational or irrational for local governments to borrow on this scale. Additionally, to what extent it can achieve the goals of the local government for attracting investment, attracting labor force, and promoting local GDP growth.

Besides, the exploration of the role of municipal bonds in China's economic landscape is motivated by the considerable and growing challenge of local government debt, a critical issue in the country's financial stability. As of the end of 2022, China's official explicit local government debt has soared to 35.06 trillion RMB (approximately US$4.8 trillion), with market estimates of implicit debt exceeding a staggering 60 trillion RMB (around US$8.2 trillion). According to China's GDP of US$17.96 trillion in 2022, explicit local government debt has exceeded a quarter of the China's total GDP, and implicit debt has reached half of the China's total GDP. This burgeoning debt highlights the urgency of understanding the real impact of municipal bonds on economic development. The effects of these bonds remain ambiguous; while some researchers, like Xu et al. (11), assert a significantly positive influence on city development, others like Zhou (13) indicate an inverse relationship between local government debt and economic growth. Furthermore, local governments frequently issue these bonds for dual purposes: financing infrastructure projects, which in turn could potentially enhance land values and revenue, and attracting a larger workforce to their jurisdictions. This study seeks to unravel the complexities of these motivations, examining if and how municipal bond issuance effectively fulfills these objectives and contributes to urban and regional economic dynamism in China.

To address these issues, this research focuses on the effects of municipal bonds on economic growth (GDP) and other economic factors (such as the unemployment rate and real estate prices) at the prefecture city level in China. The focus on real estate prices stems from the strategic goals of local governments in issuing municipal bonds. As highlighted by Ambrose et al. (1), the issuance is often aimed at funding infrastructure projects and local company financing, which are expected to elevate land values, leading to higher revenues from land sales

or enabling the use of land as collateral.

Inspired by the regional difference analysis conducted by Chen and Li (2), this study also tests the effect of municipal bonds on different regions of China. There might be some connections between the effects of municipal bonds and geographical and demographic conditions. Thus, we divided China into seven regions that share similar properties: Northeast, North, Central, East, South, Northwest, and Southwest. Each region encompasses a group of neighboring Chinese provinces, sharing geographic proximity and cultural commonalities.

2 Literature Review

The study of local government debt has evolved into a robust theoretical framework, with substantial contributions illuminating its role in public finance and economic development. A pivotal work by Hildreth and Zornt (6) investigates the development of the municipal debt market in the USA since 1980, underscoring the positive influence of government debt in supporting public goods. Similarly, Hildreth and Miller (5) delve into the dynamics of local economic levels and their impact on governmental debt capacity, highlighting the interplay between economic conditions and fiscal policy. The IMF report about China's Local Government Financing Platforms by (7) gives a detailed introduction to the functions, historical development, and potential risks of local debt, which I mentioned in the introduction.

An intriguing perspective is offered by Wang (10), who identifies an inverse "U" shaped relationship between local debt and economic growth, suggesting a complex, non-linear interaction between fiscal policy and regional development.

Among the pivotal studies on local government debt in China, the work of Chen

and Li (2) stands out, particularly for employing a dynamic model to analyze the impact of local debts on regional economic growth. While Chen et al. broadly categorize China into three regions, our study refines this approach by dividing the country into seven regions, based on more detailed geographical and cultural considerations. This allows for a more granular analysis of municipal bonds' impacts. Inspired by Chen et al.'s integration of theoretical and empirical methods, our study will adapt a specific empirical model tailored to our distinct research focus on the economic effects of municipal bonds.

Such diverse viewpoints emphasize the nuanced nature of municipal bonds and their impact on economic growth. These literature forms the foundation upon which our study builds, aiming to add a new dimension to the understanding of how municipal bonds function within China's unique economic landscape.

3 Data Sources

This study employs datasets encompassing various aspects of economic, demographic, and real estate data across multiple cities in China. These datasets provide a broad spectrum of information, essential for analyzing the impact of municipal bonds on economic growth and other related factors.

The datasets of this study primarily consists of two parts. The first part includes key indicators such as GDP, GDP per capita, and municipal bond issuance (annual). The second part consists of control variables, which are further divided into economic indicators (e.g. trade, government expenditure, etc.) and demographic indicators (e.g. population, education, etc.)

3.1 Data set for key variables

- **Municipal Bonds Data:** For municipal bond issuance, this study adopts two datasets. The first dataset spans a wide range of time but has more missing data, while the second dataset covers a narrower range of time with less missing data.

    1. The first dataset covers 316 cities from 2006 to 2022. It includes annual bond issuance details for each city in RMB billion, sourced from public Chinese econometrics dataset websites, originally from the Shenzhen Stock Exchange and Shanghai Stock Exchange, as well as the official websites of financial regulators such as the People's Bank of China and the China Securities Regulatory Commission.

    2. The second dataset covers 298 cities from 2014 to 2022. It also includes the annual amount of municipal bond issuance for each prefecture-level city in China in RMB billion, sourced from the Wind Database.

- **GDP:** Spanning from 1991 to 2023, this dataset provides annual GDP figures for each city in ten billion RMB, sourced from the National Bureau of Statistics.

- **GDP per capita:** Spanning from 1991 to 2023, this dataset provides annual per capita GDP figures for each city in RMB, sourced from the National Bureau of Statistics.

3.2 Controls variables

Economic Data:

- **Government Expenditure:** Spanning from 2001 to 2023, this dataset provides local government expenditure for each prefecture-level city in RMB million, sourced from the National Bureau of Statistics.
- **Export & Import**
  - **Export Data:** Annual export data for each prefecture-level city from 2004 to 2022, in USD million, sourced from the National Bureau of Statistics.
  - **Import Data:** Annual import data for each prefecture-level city from 2004 to 2022, in USD million, sourced from the National Bureau of Statistics.
- **Investment**
  - **Foreign Direct Investment:** Annual utilized foreign direct investment (FDI) data for each prefecture-level city from 1996 to 2023, in USD million, sourced from the National Bureau of Statistics.
  - **Fixed Asset Investment:** Annual fixed asset investment data from 1996 to 2023 (the majority from 1996 to 2017), in RMB million, sourced from the National Bureau of Statistics.
- **Real Estate Price Data**
  - **China Property Price Data:** Spanning from 2005 to 2022, this dataset includes annual residential property prices in RMB per square meter, as reported by the National Bureau of Statistics.

Demographic Data:

- **Population Data:** Annual data describing each prefecture-level city's

population from 1996 to 2022, with population figures in thousands, provided by the National Bureau of Statistics.

- **Number of Employees:** Annual data for each prefecture-level city's number of employees from 2002 to 2022, in thousands, sourced from the National Bureau of Statistics.
- **Registered Unemployment Rate:** Annual data for each prefecture-level city's registered unemployment rate from 2001 to 2021, sourced from the National Bureau of Statistics.
- **Government Education Expenditure:** Annual data for each prefecture-level city's education expenditure by local government from 2003 to 2022, in RMB million, sourced from the National Bureau of Statistics.

All datasets, with the exception of the municipal bond data, are sourced from the *National Bureau of Statistics* or the *Municipal Bureau of Statistics*, covering the period from 1996 to 2022. However, these datasets are not exhaustive and contain numerous missing values. Despite this, the primary data-related challenge in this study is not the completeness of these datasets, but rather the acquisition of data on municipal bond issuance. Various versions of local government debt data from different institutions, coupled with a high incidence of missing data, have resulted in a very limited usable sample size, particularly with respect to the numerous variables involved.

To address this issue, this study employs two datasets for municipal bond issuance. We chose to use the dataset with a broader temporal range to investigate the lagged effects and the dataset with fewer missing values from the *Wind Database*—a platform analogous to the Bloomberg database in China—for general analysis and regional difference analysis. Although not without flaws, it

is more comprehensive than other available datasets, and the dataset from the *Wind Database* has been widely utilized in previous studies.

4 Empirical Analysis

This study utilizes a panel data approach, suitable for exploring time-series and cross-city data, to analyze the relationship between municipal bond issuance and economic growth.

Additionally, inspired by the previous studies about the invert U shape relationship existing between local government debt and GDP growth, this study also examined the existence of such invert U shape relationship between municipal bond and GDP growth by introduce the square term of MB.

Therefore, we establish our empirical model based on the framework provided by (2), and their basic measurement model is as follows:

$$\gamma_{i,t} = c + \beta_1 \cdot \ln \text{debt}_{i,t-1} + \beta_2 \cdot \ln \text{debt}_{i,t-1}{}^2 + \delta \cdot X_{i,t-1} + \alpha_i + \varepsilon_{i,t}.$$

In this model, the subscript i refers to the city (or region) and t refers to the year. Here, the dependent variable γ represents the GDP per capita growth rate. On the right-hand side, *debt* denotes municipal bond issuance, and X represents other control variables.

Based on this model, this study conducts analyses on three aspects related to our research question. First, we investigate the effect of municipal bonds on local GDP growth using panel data and fixed effects at the prefecture city

level (see Section4.1). Second, we explore the regional differences in the effect of municipal bonds on GDP growth (see Section4.2). Lastly, we examine the lagged effect using simple OLS regression (see Section4.2).

4.1 Primary Analysis

4.1.1 Empirical model

In addition to the municipal bond issuance itself, we also need to consider other factors also affect GDP growth, such as original GDP per capita, new investment each year (fixed asset investment), land price, trade, foreign direct investment, government expenditure, government expenditure on education, employee, population, etc....

Then the regression model as follows:

$$\begin{aligned}\ln y_{i,t+1} = {} & constant + \beta_1 \ln \mathrm{MB}_{i,t} + \beta_2 \ln \mathrm{MB}_{i,t}{}^2 \\ & + \beta_3 \mathrm{gdppc}_{i,t} + \beta_4 \ln \mathrm{TO}_{i,t} + \beta_5 \mathrm{FDI}_{i,t} + \beta_6 \mathrm{GovExp}_{i,t} + \beta_7 \mathrm{Education}_{i,t} \\ & + \beta_8 \ln \mathrm{Employee}_{i,t} + \beta_9 \ln \mathrm{Population}_{i,t} + \beta_{10} \ln \mathrm{LandPrice}_{i,t} \\ & + \theta_t year_t + \alpha_i + \varepsilon_{i,t}.\end{aligned}$$

where $\ln y_{i,t+1}$ represents the GDP per capita; $\ln \mathrm{MB}$ and $\ln \mathrm{MB}^2$ denote the logarithm of per capita annual municipal bond issuance and its square, respectively. For municipal bond issuance, this model utilizes the second dataset2 sourced from the *Wind Database*. The control variables are defined as follows: $\ln \mathrm{gdppc}$ represents the logarithm of GDP per capita; TO signifies trade openness, measured as the ratio of the total volume of exports and imports to GDP;

FDI is the ratio of foreign direct investment to GDP, commonly used in conjunction with TO in previous studies to reflect economic openness; ln GovExp denotes the logarithm of per capita local government expenditure; Education is the ratio of local government expenditure on education to GDP; ln LandPrice indicates the logarithm of the average land price; ln Employee is the logarithm of the number of employees; and ln Population represents the logarithm of the population. The subscripts i and t refer to city and year, respectively. Lastly, $\theta_t year_t$ are year fixed effects to control for time-specific factors, α_i captures city-specific fixed effects, and $\varepsilon_{i,t}$ is the error term.

It is important to note that while the second municipal bond dataset spans from 2014 to 2022, the fixed asset investment (FAI) dataset covers the period from 1996 to 2017. Due to this discrepancy, FAI is not included in this model.

4.1.2 Data processing

This study first encoded the *city* as a numerical categorical variable, i, and then identified and removed rows with any missing data. Due to the high incidence of missing data, we filtered the dataset by only including cities with at least five observations to ensure sufficient data for analysis. After this step, 109 cities remained in the filtered dataset. Since there were still some missing data, we interpolated missing values for several key economic indicators over time for each city to provide a continuous data series. To achieve more stable and robust results, we transformed each indicator into the same unit, RMB, by multiplying the magnitude of the indicator by its respective unit. Next, we performed logarithmic transformations for variables such as MB, $Employee$, $Population$, and $LandPrice$.

We then conducted two types of regression analyses:

1. OLS Regression: Estimates the relationship between the log of GDP per capita and the explanatory variables, with robust standard errors.

2. Fixed Effects Regression: Accounts for unobserved heterogeneity by including city fixed effects and year fixed effects, clustering standard errors by city.

4.2 Regional Difference Analysis

Inspired by Chen and Li (2), which conducted regional difference analysis with three regions, this study extends the analysis to seven regions. Based on geographic proximity and cultural commonalities, we divide China into seven regions: Northeast, North, Central, East, South, Northwest, and Southwest, as previously described.

Therefore, the regression equation is almost the same as the one for the basic effect analysis, as follows:

$$\begin{aligned}\ln y_{j,t+1} = {} & constant + \beta_1 \ln \mathrm{MB}_{j,t} + \beta_2 \ln {\mathrm{MB}_{j,t}}^2 \\ & + \beta_3 \mathrm{gdppc}_{j,t} + \beta_4 \ln \mathrm{TO}_{j,t} + \beta_5 \mathrm{FDI}_{j,t} + \beta_6 \mathrm{GovExp}_{j,t} + \beta_7 \mathrm{Education}_{j,t} \\ & + \beta_8 \ln \mathrm{Employee}_{j,t} + \beta_9 \ln \mathrm{Population}_{j,t} + \beta_{10} \ln \mathrm{LandPrice}_{j,t} \\ & + \theta_t year_t + \alpha_j + \varepsilon_{j,t}.\end{aligned}$$

where $j = \{1, 2, \ldots, 7\}$ represents each region under the division scheme of seven regions, and other variables retain the same meaning as in the first model. Similar to the basic effect analysis, we conduct the regional difference analysis by grouping the city data. We combine the data of cities within the same region and then perform the same regression for each region, using j to represent the

region instead of the city in the previous model.

4.3 Lagged Effect Analysis

In line with insights from previous studies, the model will consider dynamic effects, particularly the lagged effect. Here, we utilize $\frac{\ln y_{i,t+s} - \ln y_{i,t}}{s}$, where $s = \{2, 3, 5, 7, 9\}$ represents the length of the gap to address the lagged effect[1].

The regression model is specified as follows:

$$\begin{aligned}\frac{\ln y_{i,t+s} - \ln y_{i,t}}{s} &= constant + \beta_1 \ln \mathrm{MB}_{i,t} + \beta_2 \ln \mathrm{MB}_{i,t}{}^2 \\ &+ \beta_3 \mathrm{TO}_{i,t} + \beta_4 \mathrm{FDI}_{i,t} + \beta_5 \mathrm{FAI}_{i,t} + \beta_6 \mathrm{GovExp}_{i,t} \\ &+ \beta_7 \mathrm{Education}_{i,t} + \beta_8 \ln \mathrm{Population}_{i,t} + \beta_9 \ln \mathrm{LandPrice}_{i,t} + \varepsilon_{i,t}.\end{aligned}$$

where $\frac{\ln y_{i,t+s} - \ln y_{i,t}}{s}$ captures the average GDP growth rate within s years. Other variables retain the same meaning as in Section 4.1. However, this time, we utilize the first municipal bond dataset1.

5 Results

5.1 Primary Analysis

This section presents the primary analysis of the relationship between municipal bond issuance and local GDP per capita growth. We employ both Ordinary Least Squares (OLS) and fixed effects regression models to account for different aspects of the data and to provide a relatively clear understanding of the impact. The OLS model offers initial insights into the relationship, while the fixed effects

[1]This concept stems from the insightful suggestion by my ECON580 advisor, Professor Simeon Alder.

model controls for unobserved heterogeneity by incorporating city and year fixed effects. By using these complementary approaches, we aim to identify the significance and magnitude of municipal bond issuance on economic growth, while also considering other relevant economic variables. The results are detailed in the following subsections.

5.1.1 OLS regression result

The Ordinary Least Squares (OLS) regression analysis investigates the relationship between municipal bond issuance and GDP per capita growth at the city level. The results, presented in Table 1, show a significant relationship between municipal bond issuance and economic growth.

The coefficients for $\ln \mathrm{MB}$ are positive and statistically significant at the 1% level in Models 1-4, indicating that an increase in municipal bond issuance is associated with higher GDP per capita growth. This suggests that municipal bonds play a crucial role in stimulating local economic activity. However, the relationship is not linear, as evidenced by the negative and statistically significant coefficients for $\ln \mathrm{MB}^2$ across the same models. This negative coefficient indicates a diminishing marginal effect of bond issuance on GDP growth, suggesting that while initial bond issuance promotes growth, there is a threshold beyond which additional bonds become less effective.

In Model 5, where only the key variables and two trade indicators are included, the coefficients for $\ln \mathrm{MB}$ and $\ln \mathrm{MB}^2$ change signs, with $\ln \mathrm{MB}$ becoming negative and $\ln \mathrm{MB}^2$ becoming positive. This reversal suggests potential multicollinearity or model misspecification when fewer control variables are included. It highlights the importance of a comprehensive model to accurately capture the complex dynamics of municipal bond issuance and economic growth.

The results for the control variables are mixed. The coefficient for *gdppc* is consistently positive and statistically significant across Models 1-4, indicating that cities with higher initial GDP per capita levels tend to experience higher subsequent GDP per capita growth rates. This aligns with the expectation that wealthier cities have more resources for growth. On the other hand, the coefficient for trade openness (TO) is negative and statistically significant in Models 1-4, suggesting that higher trade openness is associated with lower GDP per capita growth. This counterintuitive finding may reflect underlying economic complexities or the specific context of Chinese cities. The coefficients for foreign direct investment (FDI) are positive but not statistically significant in most models, indicating that the impact of FDI on GDP per capita growth is not clearly established in this study. Similarly, the coefficients for government expenditure (GovExp) and education spending (Edu) are not consistently statistically significant across models, suggesting that their direct impact on GDP per capita growth may be limited or influenced by other factors not captured in this analysis. Employment and population also show significant results in some models. Higher employment levels, as indicated by the positive and significant coefficients for ln Employee, are associated with higher GDP per capita growth. Conversely, higher population levels, as indicated by the negative and significant coefficients for ln Population, are associated with lower GDP per capita growth, potentially due to resource constraints. The coefficient for land prices (ln LandPrice) is not statistically significant, suggesting that land prices do not have a clear impact on GDP per capita growth in this analysis.

Table 1 also shows high R^2 values for Models 1-4, all around 0.94, indicating that these models explain a substantial portion of the variability in GDP per capita growth. The number of observations is 716, providing a robust dataset

for the analysis. However, Model 5, with an R^2 of 0.35, explains much less variability.

Here the OLS regression results indicate a significant but complex relationship between municipal bond issuance and GDP per capita growth. While increased bond issuance generally promotes growth, there is an optimal level beyond which additional bonds become less effective. The mixed significance of control variables highlights the need for further investigation into the specific mechanisms through which municipal bonds influence local economic performance. Future research should address potential data quality issues and explore non-linear and interactive effects in more detail.

5.1.2 Fixed effect regression result

The fixed effect regression analysis aims to account for unobserved heterogeneity by including city fixed effects and year fixed effects, providing a more robust understanding of the relationship between municipal bond issuance and GDP per capita growth. The results are presented in Table 2 and Table 3.

The coefficients for ln MB are positive and statistically significant at the 1% level in Models 1-4, with values ranging from 0.1140 to 0.1281. This indicates that an increase in municipal bond issuance is associated with higher GDP per capita growth. However, the positive effect diminishes as the level of bond issuance increases, as evidenced by the negative and statistically significant coefficients for $\ln \mathrm{MB}^2$, which range from -0.0080 to -0.0091. This suggests that while initial increases in bond issuance stimulate economic growth, there is a point beyond which the marginal benefits decrease, highlighting the importance of optimal bond issuance levels.

Table 1: OLS Regression for the Impact of Municipal Bond on GDP Growth

	Model 1	Model 2	Model 3	Model 4	Model 5
ln MB	0.1529***	0.1535***	0.1449***	0.1446***	-0.4043***
	(0.0526)	(0.0524)	(0.0525)	(0.0524)	(0.1062)
$\ln \text{MB}^2$	-0.0106***	-0.0106***	-0.0096***	-0.0095***	0.0434***
	(0.0037)	(0.0037)	(0.0037)	(0.0037)	(0.0074)
gdppc	0.000014***	0.000014***	0.000015***	0.000015***	
	(2.93e-07)	(2.68e-07)	(2.65e-07)	(2.65e-07)	
TO	-0.0009***	-0.0009***	-0.0005**	-0.0006**	0.0017**
	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0008)
FDI	0.0041	0.0041	0.0058	0.0062	0.0208
	(0.0037)	(0.0038)	(0.0044)	(0.0045)	(0.0228)
GovExp	-0.0270	-0.0270	-0.0224	-0.0127	
	(0.0180)	(0.0183)	(0.0186)	(0.0106)	
Edu	0.2272*	0.2238*	0.0728		
	(0.1325)	(0.1336)	(0.1218)		
ln Employee	0.0543***	0.0530***			
	(0.0056)	(0.0055)			
ln Population	-0.0481***	-0.0499***			
	(0.0083)	(0.0081)			
ln LandPrice	-0.0114				
	(0.0170)				
Intercept	10.4816***	10.4107***	9.4943***	9.4956***	11.5983***
	(0.2366)	(0.2051)	(0.1844)	(0.1842)	(0.3764)
Observations	716	716	716	716	716
F	549.76	582.40	642.98	718.24	116.45
R^2	0.9425	0.9425	0.9362	0.9361	0.3523
Root MSE	0.11759	0.11754	0.12369	0.12362	0.39312

Note * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$. In model 1, we examined all the control variables; due to heterogeneity issues, we dropped ln LandPrice in model 2. We further dropped additional control variables such as ln Population and ln Employee, but the coefficients of our key variables remained significant. In model 5, we only kept the key variables and two trade indicators; the coefficient of $\ln \text{MB}^2$ became positive initially, and the R^2 dropped to 0.35.

In Model 5, the inclusion of fewer control variables results in the coefficients for $\ln \mathrm{MB}$ and $\ln \mathrm{MB}^2$ becoming statistically insignificant, with $\ln \mathrm{MB}$ at 0.0208 and $\ln \mathrm{MB}^2$ at 0.0009. This change in significance and the shift in coefficient values suggest potential multicollinearity or model misspecification when fewer control variables are included, underscoring the necessity of a better model to accurately capture the dynamics of municipal bond issuance and economic growth.

While the primary focus of this study is on municipal bond issuance, it is important to note the role of other control variables. The coefficient for *gdppc* remains positive and statistically significant across Models 1-4, suggesting that cities with higher initial GDP per capita levels tend to experience higher subsequent growth rates. Trade openness (TO) and foreign direct investment (FDI) exhibit mixed results, indicating that their impacts on GDP per capita growth are context-dependent and may vary based on other underlying economic factors.

The fixed effect models include city and year fixed effects, which control for unobserved heterogeneity and time-specific factors that could influence GDP growth. The significant year dummies indicate that there are important time-related factors affecting GDP growth across all cities. The inclusion of city fixed effects ensures that the unique characteristics of each city are accounted for, providing a more accurate estimation of the impact of municipal bond issuance.

The σ_α values, representing the standard deviation of the unobserved panel-level effect, range from 0.1455 to 0.4460, indicating substantial city-specific effects. The σ_ε values, representing the standard deviation of the idiosyncratic error term, range from 0.0593 to 0.0981. The ρ values, representing the fraction of variance due to the panel-level effect, are high, ranging from 0.8575 to 0.9538, confirming the importance of accounting for city-specific effects in the analysis.

Tables 2 and 3 also show high R^2 values for Models 1-4, ranging from 0.8783 to 0.8965, indicating that these models explain a substantial portion of the variability in GDP per capita growth. The number of observations is 716, providing a robust dataset for the analysis.

Overall, the fixed effect regression results support the findings from the OLS models, highlighting a significant but complex relationship between municipal bond issuance and GDP per capita growth. The diminishing marginal returns of bond issuance suggest an optimal level of issuance. The fixed effects models further underscore the importance of considering city-specific characteristics and time effects in the analysis. Future research should continue to address data quality issues and explore the interactions between municipal bonds and other economic variables in more detail.

5.2 Regional Difference

The regional difference analysis investigates the varying impacts of municipal bond issuance on GDP per capita growth across different regions in China. Given China's diverse economic landscape, the effects of municipal bonds are expected to differ across regions. The regression results for different regions are presented in Table 4.

The analysis reveals significant regional disparities in the impact of municipal bond issuance on GDP per capita growth. In the overall regression for all regions combined, the coefficient for $\ln \mathrm{MB}$ is positive and statistically significant, while the coefficient for $\ln \mathrm{MB}^2$ is negative and statistically significant. This suggests a diminishing marginal effect of bond issuance on GDP growth, consistent with the findings from the primary analysis.

Table 2: Fixed-effects Regressions for the Impact of Municipal Bond on GDP Growth (Part 1)

Variable	(1)	(2)	(3)	(4)	(5)
$\ln \mathrm{MB}_{i,t}$	0.1140***	0.1180***	0.1281***	0.1278***	0.0208
	(0.0339)	(0.0349)	(0.0367)	(0.0367)	(0.0356)
$\ln \mathrm{MB}_{i,t}{}^2$	-0.0080***	-0.0083***	-0.0091***	-0.0090***	0.0009
	(0.0026)	(0.0027)	(0.0028)	(0.0028)	(0.0029)
$\mathrm{gdppc}_{i,t}$	9.26e-06***	9.03e-06***	1.02e-05***	1.02e-05***	
	(7.72e-07)	(7.97e-07)	(8.67e-07)	(8.65e-07)	
$\ln \mathrm{TO}_{i,t}$	0.0002	0.0002	0.0003**	0.0003**	-0.0001
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
$\mathrm{FDI}_{i,t}$	0.0042	0.0048	0.0056	0.0058**	0.0035
	(0.0026)	(0.0025)	(0.0030)	(0.0027)	(0.0024)
$\mathrm{GovExp}_{i,t}$	-0.0204*	-0.0259**	-0.0289**	-0.0255**	
	(0.0119)	(0.0115)	(0.0142)	(0.0073)	
$\mathrm{Education}_{i,t}$	0.0099	0.0266	0.0269		
	(0.0870)	(0.0903)	(0.1056)		
$\ln \mathrm{Employee}_{i,t}$	0.2611***	0.2539***			
	(0.0623)	(0.0629)			
$\ln \mathrm{Population}_{i,t}$	-0.1180	-0.1368			
	(0.0839)	(0.0930)			
$\ln \mathrm{LandPrice}_{i,t}$	-0.1215**				
	(0.0477)				

Note: Robust standard errors in parentheses. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table 3: Fixed-effects Regressions for the Impact of Municipal Bond on GDP Growth (Part 2)

Variable	(1)	(2)	(3)	(4)	(5)
$year_{2015}$	0.0417***	0.0412***	0.0325***	0.0325***	0.0629***
	(0.0050)	(0.0048)	(0.0051)	(0.0051)	(0.0069)
$year_{2016}$	0.0717***	0.0667***	0.0491***	0.0491***	0.0930***
	(0.0106)	(0.0093)	(0.0099)	(0.0099)	(0.0144)
$year_{2017}$	0.1225***	0.1028***	0.0752***	0.0752***	0.1737***
	(0.0163)	(0.0121)	(0.0123)	(0.0123)	(0.0141)
$year_{2018}$	0.1766***	0.1366***	0.1014***	0.1016***	0.2484***
	(0.0251)	(0.0160)	(0.0163)	(0.0162)	(0.0139)
$year_{2019}$	0.2178***	0.1718***	0.1314***	0.1315***	0.2947***
	(0.0326)	(0.0221)	(0.0220)	(0.0220)	(0.0253)
$year_{2020}$	0.2372***	0.1847***	0.1362***	0.1365***	0.3097***
	(0.0354)	(0.0249)	(0.0257)	(0.0257)	(0.0302)
$year_{2021}$	0.2978***	0.2457***	0.1860***	0.1862***	0.4496***
	(0.0413)	(0.0316)	(0.0329)	(0.0329)	(0.0333)
$year_{2022}$	0.2331***	0.1836***	0.1042***	0.1043***	0.4325***
	(0.0454)	(0.0375)	(0.0377)	(0.0377)	(0.0384)
Constant	13.2267***	12.4700***	9.8019***	9.8033***	10.6335***
	(1.4088)	(1.4424)	(0.1306)	(0.1306)	(0.1133)
Observations	716	716	716	716	716
R-squared	0.8965	0.8938	0.8783	0.8783	0.7140
σ_α	0.1455	0.1520	0.1759	0.1760	0.4460
σ_ε	0.0593	0.0600	0.0642	0.0641	0.0981
ρ	0.8575	0.8651	0.8826	0.8828	0.9538

Note: Robust standard errors in parentheses. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$. These two tables (2 & 3) presents fixed-effects regressions examining the impact of municipal bond issuance and various control variables on GDP per capita growth. The results are robust to the inclusion of year fixed effects. $\sigma_\alpha$represents the standard deviation of the unobserved panel-level effect, σ_ε is the standard deviation of the idiosyncratic error term, and ρ is the fraction of variance due to the panel-level effect.

However, data limitations have affected the analysis for certain regions. Originally, the study considered seven regions, but due to high incidence of missing data, only five regions are included in the final results. Notably, data from the Northeast region is limited to only one province, Liaoning province, which may affect the robustness of the findings for this region.

In the East region, which includes economically developed provinces or city such as Shanghai and Jiangsu, the coefficients for $\ln \mathrm{MB}$ and $\ln \mathrm{MB}^2$ are significant and follow the expected pattern. This indicates that increased bond issuance initially promotes GDP growth, but with diminishing returns at higher levels of issuance. This region's well-developed financial markets and infrastructure likely enhance the effectiveness of municipal bonds as an economic stimulus tool.

In contrast, the Northeast region, represented by only one province due to data limitations, shows insignificant coefficients for both $\ln \mathrm{MB}$ and $\ln \mathrm{MB}^2$. This suggests that municipal bond issuance does not significantly impact GDP growth in this region. The economic challenges and structural issues faced by the Northeast, such as industrial decline, may limit the effectiveness of municipal bonds.

The North region shows mixed results, with a positive but not statistically significant coefficient for $\ln \mathrm{MB}$ and a negative coefficient for $\ln \mathrm{MB}^2$. This suggests some level of diminishing returns but with less clarity compared to other regions. The variability in economic conditions and policy implementations across cities in this region could contribute to these mixed results.

The Central region displays a positive coefficient for $\ln \mathrm{MB}$, though it is not statistically significant, and a negative coefficient for $\ln \mathrm{MB}^2$. This pattern suggests potential benefits from bond issuance, albeit with diminishing returns.

However, the lack of statistical significance indicates that other factors might be influencing economic growth more strongly in this region.

The Southwest region presents a unique case with a negative coefficient for $\ln \mathrm{MB}$ and a positive coefficient for $\ln \mathrm{MB}^2$. This atypical pattern could be due to the region's unique economic structure and development stage, where the initial impact of bond issuance might be less effective, but larger issuance levels eventually contribute positively to growth.

Overall, the regional analysis underscores the importance of considering geographic and economic heterogeneity when assessing the impact of municipal bond issuance. The significant regional differences highlight that a one-size-fits-all approach to municipal bond policy may not be effective. Policymakers should tailor bond issuance strategies to the specific economic conditions and development needs of each region to maximize the positive impact on economic growth.

In summary, while municipal bond issuance generally promotes GDP per capita growth, the effectiveness and optimal levels of issuance vary significantly across different regions in China. These findings suggest the need for region-specific strategies in municipal bond policy to enhance their effectiveness as a tool for economic development. The results also highlight the importance of addressing data quality issues to ensure comprehensive and reliable regional analysis.

5.3 Lagged Effect

The analysis of the lagged effects of municipal bond issuance on GDP per capita growth explores how the impact of bonds unfolds over different time horizons. The regression results, detailed in Tables 5 to 9, examine these effects across var-

Table 4: Regression Results

	All Regions	Northeast	East	North	Central	Southwest
lnMB	0.2037***	-0.0181	0.2649***	0.0334	0.0977	-0.0606
	(0.0476)	(0.0153)	(0.0470)	(0.0327)	(0.0550)	(0.0562)
lnMB^2	-0.0137***	0.0010	-0.0175***	-0.0033	-0.0075	0.0047
	(0.0032)	(0.0018)	(0.0035)	(0.0033)	(0.0047)	(0.0044)
gdppc	0.0000129***	0.0000159***	0.0000083***	0.0000091***	0.0000031	0.0000140***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
TO	-0.0000376*	-0.0006868***	0.000065	0.0003938**	-0.000188	-0.0029581*
	(0.0000)	(0.0002)	(0.0001)	(0.0002)	(0.0002)	(0.0012)
Edu	0.1556*	0.1837	-0.0239	-0.0575	-0.7597	-1.1586
	(0.0799)	(0.4799)	(0.0987)	(0.5275)	(1.0528)	(0.6946)
GovExp	-0.0306**	-0.0470	-0.0065	0.0101	0.1208	0.1723
	(0.0152)	(0.0612)	(0.0069)	(0.0679)	(0.1741)	(0.1053)
FDI	0.0038*	0.0241	0.0035	-0.0038	0.0038	0.0203**
	(0.0015)	(0.0131)	(0.0040)	(0.0059)	(0.0140)	(0.0053)
lnEmployee	0.0450***	-0.1010	0.2766***	-0.5041**	0.0590*	0.2270**
	(0.0049)	(0.0724)	(0.0907)	(0.1290)	(0.0331)	(0.0953)
lnLandPrice	0.0005	-0.0035	-0.1807**	0.1602	0.0101	0.0689
	(0.0132)	(0.0975)	(0.0580)	(0.0893)	(0.1225)	(0.0389)
lnPopulation	-0.0520***	-0.6325	-0.1729	-0.3042	-1.7261***	-0.7658***
	(0.0077)	(0.3175)	(0.1278)	(0.3827)	(0.2602)	(0.1609)
Intercept	10.2805***	19.5506***	14.0735***	12.8887	36.8958***	21.8962***
	(0.2139)	(4.3830)	(1.8994)	(5.9789)	(3.5633)	(2.4161)
Observations	938	76	547	62	134	119
σ_α	0.1794	0.3794	0.1593	0.7014	0.5832	0.4723
σ_e	0.0716	0.0340	0.0721	0.0395	0.0439	0.0316
ρ	0.8625	0.9920	0.8301	0.9968	0.9944	0.9955

Note * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

This table presents the regression results of the regional difference analysis.

ious time lags, specifically $s = 2$, $s = 3$, $s = 4$, $s = 5$, and $s = 6$ years. Despite the modeling approach, many key variables show statistical insignificance, primarily due to data limitations from the first dataset of municipal bonds, which has a very high incidence of missing data, leading to only 32 observations.

In Table 5, which includes all control variables, the coefficients for $\ln \mathrm{MB}$ and $\ln \mathrm{MB}^2$ are statistically insignificant across all time lags. This suggests a weak direct relationship between municipal bond issuance and GDP per capita growth over the examined periods. The insignificance is likely a reflection of the limited dataset, with only 32 observations due to a high incidence of missing data.

Comparing these results to the models without the MB and MB^2 terms (Tables 6 and 7 in the appendix), we observe a consistent pattern of insignificance. The adjusted R^2 values improve slightly when excluding the bond variables, indicating that other economic factors might play a more substantial role in influencing GDP growth in the short term.

Interestingly, Trade Openness (TO) and Foreign Direct Investment (FDI) display mixed results. In several models, particularly in Table 7, TO is negatively significant, suggesting that higher trade openness might be associated with lower GDP growth in the short term. This could reflect the economic adjustments cities undergo when increasing their trade activities. Similarly, the significant negative coefficients for FDI in some models indicate potential capital outflows or other economic shifts that temporarily suppress GDP growth.

The control variables, such as Government Expenditure ($GovExp$), Education Expenditure ($Education$), and Fixed Asset Investment (FAI), also show mixed and mostly insignificant results. This further underscores the challenges in capturing the true economic impacts of these factors given the data quality

issues.

Relating these findings to the previous two models (OLS and fixed effects), the primary analysis (Tables 1, 2, and 3) indicated a significant, though diminishing, impact of municipal bonds on GDP per capita growth. The regional difference analysis (Table 4) highlighted significant regional disparities, suggesting that geographic and economic heterogeneity plays a crucial role in determining the effectiveness of municipal bonds. However, the lagged effect analysis shows that the temporal impact is less clear, likely due to the short time frame and limited data quality.

Overall, the analysis of lagged effects reveals that the temporal impact of municipal bond issuance on GDP per capita growth is complex and context-dependent. The statistical insignificance of many key variables in this analysis suggests that data limitations significantly influence the findings. Future research should focus on improving data quality and extending the dataset to include more observations over a longer period, enhancing the robustness and reliability of the analysis.

Comparing these findings to the models in the appendix (Tables 8 and 9), we see that while municipal bonds play a role, their impact may be overshadowed by other economic variables and regional factors. The consistently low R^2 values when focusing solely on municipal bond variables highlight the need for a better approach.

In summary, while municipal bonds have a theoretically significant role in economic growth, the current data and models do not provide strong empirical support for their lagged effects. Improved data collection and more sophisticated modeling techniques are necessary to uncover the true dynamics of municipal

bond impacts over time.

Table 5: Lagged Effect Analysis by OLS Regression

	s = 2	s = 3	s = 4	s = 5	s = 6
Constant	0.2154	0.2186	0.3241**	0.2909	0.2686
ln MB	0.0102	0.0068	0.0103	0.0071	0.0044
$\ln \text{MB}^2$	-0.0006	-0.0003	-0.0009	-0.0007	-0.0003
TO	-0.0211	-0.0115	-0.0113	-0.0122	-0.0110
FDI	-1.1619***	-0.6852**	-0.7152**	-0.6149**	-0.5088
FAI	0.0039	-0.0068	-0.0016	-0.0131	-0.0088
GovExp	-0.0680	-0.2820	-0.2644	-0.2314	-0.1563
Education	-0.8983	0.8970	0.9937	0.9297	0.6546
ln Population	0.0021	0.0091	0.0027	0.0065	0.0066
ln LandPrice	-0.0025	-0.0227	-0.0236	-0.0261	-0.0257
R-squared	0.607	0.692	0.720	0.735	0.737
Adjusted R-squared	0.446	0.565	0.605	0.626	0.629
Observations	32	32	32	32	32

Note * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

6 Drawbacks and Limitation

This study, while providing valuable insights into the impact of municipal bond issuance on local GDP growth in China, faces several limitations.

One major limitation is the high incidence of missing data, especially for municipal bond issuance. This issue is particularly acute in the first dataset, leading to a significantly reduced sample size of only 32 observations. This small sample size affects the robustness and generalizability of the findings. Moreover, the availability of data for control variables varies across cities and years, resulting in incomplete datasets that necessitate interpolation and may introduce bias. Besides, the temporal scope of the datasets also presents a challenge. The second dataset, used for the primary and regional difference analysis, spans from

2014 to 2022, while the first dataset, used for the lagged effect analysis, covers a broader range but contains more missing data. The relatively short time frame of the second dataset may not fully capture long-term trends and the lagged effects of municipal bond issuance on economic growth. Additionally, the COVID-19 pandemic, which began in 2020, may have dramatically influenced the results. The pandemic's economic disruptions and the overall decline in China's economy in recent years are factors that could impact the findings.

Model specification is another concern.

The regression models include various control variables to capture different aspects of economic activity. However, the potential for omitted variable bias remains, as not all factors influencing GDP growth are included. The presence of multicollinearity among the control variables may also affect the reliability of the estimated coefficients. Furthermore, the quality of the datasets is relatively low, which may introduce additional inaccuracies and biases into the analysis. Besides, the regional heterogeneity of China's economy is considered in the regional difference analysis by dividing the country into seven regions. However, data limitations resulted in the exclusion of some regions and a focus on only five. The findings for certain regions, particularly the Northeast, are based on limited data, which may not accurately represent the broader regional dynamics. Lastly, endogeneity concerns are not fully addressed in this study. Municipal bonds may be issued in response to anticipated economic conditions, leading to reverse causality. Future research should employ instrumental variable techniques or other methods to address endogeneity and provide more robust causal inferences.

7 Future Direction

Future research on the impact of municipal bonds on local economic growth in China could explore several promising avenues. Incorporating more years of data could help to observe the long-term effects of municipal bonds, providing a clearer understanding of their persistent impacts on economic growth. Additionally, investigating the differential effects of municipal bonds across various sectors and regions can offer insights into which areas benefit the most, leading to more targeted and effective policy measures.

Considering the broader economic context, such as the current economic slowdown in China, is crucial. Understanding how these conditions affect the efficacy of municipal bonds will be essential for designing resilient financial strategies. Employing advanced econometric techniques in future studies could address potential endogeneity issues and provide more robust causal inferences regarding the impact of municipal bonds on economic growth. Moreover, exploring the wider socio-economic effects, including impacts on employment and income distribution, can provide a more comprehensive view of the benefits and drawbacks of municipal bond issuance.

8 Conclusion

This study has examined the impact of municipal bond issuance on local GDP growth in China, employing a panel dataset covering 298 cities from 1996 to 2022. The empirical analysis, including both OLS and fixed effects regressions, reveals a nuanced relationship between municipal bonds and economic growth. While initial increases in municipal bond issuance appear to stimulate GDP growth, the marginal benefits diminish at higher levels of issuance. This suggests

the existence of an optimal issuance level beyond which additional bonds may not significantly contribute to economic growth.

Regional differences play a crucial role in determining the effectiveness of municipal bonds. The analysis indicates significant variability across different regions, highlighting the need for tailored policy approaches that consider regional economic conditions and developmental stages. This finding underscores the importance of avoiding a one-size-fits-all strategy when utilizing municipal bonds as an economic tool.

The study also faced several limitations, including high incidences of missing data, particularly in the municipal bond dataset, and the short time frame covered by some data sources. These limitations suggest that the results should be interpreted with caution and that future research should strive to overcome these data challenges.

In light of the current economic slowdown and the complex dynamics uncovered, policymakers should consider the specific regional contexts and the diminishing returns of bond issuance when designing financial strategies. By addressing these factors, municipal bonds can be more effectively leveraged to promote sustainable local economic growth.

Overall, this research contributes to the understanding of municipal bonds' role in China's economic landscape and provides a foundation for future studies to build upon. By exploring the identified future directions, researchers can further elucidate the conditions under which municipal bonds can best serve as instruments of local economic development.

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Appendix

Regression without MB and MB^2

Table 6: Lagged Effect Analysis by OLS Regression (7 variables)

	S = 2	S = 3	S = 4	S = 5	S = 6
Constant	0.1403	0.1629	0.2577	0.2489	0.2379
	(0.191)	(0.154)	(0.150)	(0.138)	(0.125)
TO	-0.0233	-0.0132	-0.0132	-0.0133	-0.0119
	(0.018)	(0.014)	(0.014)	(0.013)	(0.012)
FDI	-0.8084**	-0.4097	-0.4247	-0.4408	-0.3689
	(0.357)	(0.288)	(0.280)	(0.259)	(0.233)
FAI	0.0170	0.0036	0.0089	-0.0068	-0.0036
	(0.068)	(0.055)	(0.053)	(0.049)	(0.044)
GovExp	0.1561	-0.1143	-0.0686	-0.1087	-0.0652
	(0.408)	(0.329)	(0.320)	(0.295)	(0.266)
Education	-1.9400	0.0899	0.1300	0.4086	0.2408
	(2.154)	(1.738)	(1.689)	(1.560)	(1.406)
ln LandPrice	-0.0035	-0.0235	-0.0242	-0.0264	-0.0261*
	(0.020)	(0.016)	(0.016)	(0.015)	(0.013)
ln Population	0.0068	0.0127	0.0068	0.0090	0.0085
	(0.012)	(0.010)	(0.009)	(0.009)	(0.008)
R-squared	0.511	0.620	0.647	0.710	0.717
Adjusted R-squared	0.368	0.509	0.545	0.626	0.634
Observations	32	32	32	32	32

Significance levels: $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$. Standard errors in parentheses.

Table 7: Lagged Effect Analysis by OLS Regression (5 variables)

	S = 2	S = 3	S = 4	S = 5	S = 6
Constant	0.1122	0.0713	0.1635	0.1484	0.1372
	(0.166)	(0.139)	(0.136)	(0.129)	(0.118)
TO	-0.0206	-0.0292**	-0.0298***	-0.0321***	-0.0300***
	(0.013)	(0.011)	(0.010)	(0.010)	(0.009)
FDI	-0.7422**	-0.4989	-0.5181	-0.5534**	-0.4736
	(0.339)	(0.284)	(0.278)	(0.264)	(0.241)
FAI	0.0239	-0.0149	-0.0103	-0.0291	-0.0248
	(0.065)	(0.054)	(0.053)	(0.051)	(0.046)
GovExp	-0.1808	-0.0125	0.0430	0.0610	0.0733
	(0.185)	(0.155)	(0.152)	(0.144)	(0.131)
ln Population	0.0066	0.0075	0.0014	0.0031	0.0027
	(0.011)	(0.009)	(0.009)	(0.008)	(0.008)
R-squared	0.493	0.577	0.602	0.653	0.654
Adjusted R-squared	0.396	0.496	0.526	0.587	0.587
Observations	32	32	32	32	32

Significance levels: $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$. Standard errors in parentheses.

Variables with MB and MB^2

Table 8: Lagged Effect Analysis by OLS Regression (7 variables)

	S = 2	S = 3	S = 4	S = 5	S = 6
Constant	0.2061	0.1086	0.2132	0.1610	0.1430
	(0.155)	(0.132)	(0.128)	(0.129)	(0.118)
ln MB	0.0102	0.0061	0.0096	0.0062	0.0036
	(0.013)	(0.011)	(0.011)	(0.011)	(0.010)
$\ln \text{MB}^2$	-0.0006	-0.0001	-0.0007	-0.0005	-0.0002
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
TO	-0.0227**	-0.0217**	-0.0226**	-0.0235**	-0.0226**
	(0.011)	(0.009)	(0.009)	(0.009)	(0.008)
FDI	-1.1630***	-0.7508**	-0.7761**	-0.6974**	-0.5847**
	(0.344)	(0.293)	(0.284)	(0.286)	(0.263)
GovExp	-0.0760	-0.4232	-0.4022	-0.4025	-0.3184
	(0.366)	(0.312)	(0.302)	(0.304)	(0.280)
Education	-0.7866	2.0435	2.1676	2.2657	1.9605
	(1.779)	(1.514)	(1.466)	(1.478)	(1.357)
ln Population	0.0015	0.0048	-0.0019	0.0017	0.0017
	(0.010)	(0.009)	(0.008)	(0.008)	(0.008)
R-squared	0.606	0.659	0.686	0.692	0.688
Adjusted R-squared	0.491	0.560	0.594	0.603	0.598
Observations	32	32	32	32	32

Significance levels: $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$. Standard errors in parentheses.

Table 9: Lagged Effect Analysis by OLS Regression (5 variables)

	S = 2	S = 3	S = 4	S = 5	S = 6
Constant	0.2193	0.1070	0.2090	0.1557	0.1368
	(0.154)	(0.132)	(0.128)	(0.129)	(0.118)
ln MB	0.0046	0.0016	0.0063	0.0033	0.0020
	(0.012)	(0.010)	(0.010)	(0.010)	(0.009)
$\ln \text{MB}^2$	0.0004	0.0005	-0.0003	-0.0002	-0.000006
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
TO	-0.0228**	-0.0266***	-0.0274***	-0.0283***	-0.0265***
	(0.010)	(0.008)	(0.008)	(0.008)	(0.007)
FDI	-0.9897***	-0.7592***	-0.8182***	-0.7542***	-0.6552***
	(0.319)	(0.272)	(0.265)	(0.268)	(0.245)
ln Population	-0.0011	0.0046	-0.0015	0.0022	0.0025
	(0.010)	(0.008)	(0.008)	(0.008)	(0.008)
R-squared	0.576	0.631	0.657	0.662	0.660
Adjusted R-squared	0.494	0.561	0.592	0.597	0.595
Observations	32	32	32	32	32

Significance levels: $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$. Standard errors in parentheses.