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Managing Public Debt in the Post-COVID-19 Era: A Focus on Local Debt

Management and Policy Implications in China

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Abstract

In the context of the global COVID-19 pandemic, the profound impact on the world economy, especially in the field of public debt, has become obvious. The health crisis has triggered extensive and profound policy measures to combat the epidemic on a global scale, including large-scale financial support and economic stimulus plans. These actions have directly led to a significant increase in public debt levels, raising concerns about debt sustainability, economic stability, and the future direction of fiscal policy. Under this trend of influence, this article pays special attention to China, the world's second-largest economy. By studying the credit spread of local urban investment bonds issued in China, the aim is to comprehensively analyze the evolution and management of China's public debt during and after the epidemic, and further examine the impact of this process on China's economic stability.

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1 Introduction

The exploration of the relationship between public debt and the economy finds its roots in the representatives of the classical economic school, with David Ricardo standing out as a prominent figure. In his work, " *Essay on the Funding System,*" Ricardo delved into the financing mechanisms of national debt, emphasizing the pivotal role of the public debt market in attracting funds. His reflections laid the groundwork for subsequent studies on the relationship between debt and resource allocation and raised concerns about the potential consequences of excessive dependence on debt and inadequate resource allocation.

John Stuart Mill, in *"Principles of Political Economy,"* further examined the impact of national debt on the economy, highlighting the potential stimulative effect of moderate debt on economic growth. However, Mill also issued a caution about the potential risks of inflation and economic instability arising from excessive reliance on debt, providing valuable information for future research on the relationship between debt and the economy.

In his systematic study, *"The Theory of Public Finance,"* Richard Musgrave explored public finance theory, including the role of public debt. He underscored the importance of government debt financing in balancing public finances and promoting economic development, providing a theoretical foundation for understanding the relationship between debt and fiscal policy.

James M. Buchanan, one of the founders of public choice theory, delved into the ethical and economic aspects of public debt in *"Public Principles of Public Debt."* Introducing the concept of the "debt nonscaling effect," Buchanan emphasized that an increase in debt levels does not always proportionally lead to economic growth. This theory serves as a reminder to exercise caution when considering the impact of debt size on the economy in debt decision-making, avoiding potential negative effects.

Against the backdrop of the global COVID-19 pandemic, the profound impact on the world economy, particularly in the realm of public debt, has become evident. The health crisis triggered extensive and profound policy measures worldwide to combat the pandemic, including large-scale fiscal support and economic stimulus plans. These actions directly led to a significant increase in public debt levels, raising concerns about debt sustainability, economic

stability, and the future direction of fiscal policies.

In this global context, our focus shifts to the impact of the COVID-19 pandemic on public debt, with special attention to China, the world's second-largest economy. China, initially severely affected by the outbreak and swiftly implementing stringent control measures, has navigated a complex process of pandemic control and economic recovery. This study aims to comprehensively analyze the evolution and management of local public debt in China during and after the pandemic, further examining the impact of this process on China's economic stability.

The structure of this paper is as follows:

In Chapter 2, this paper will give an overview of the impact of COVID-19 on the global public economy, and focus on the implementation of fiscal policies and public debt in various countries, as well as some problems left over from the impact of the post-COVID-19 epidemic. At the same time, the situation in various countries will be slightly compared with the data in China, leading to the third chapter.

In Chapter 3, it summarizes the reasons for China's economic growth during the COVID-19, introduces the development profile and development model of China's land finance, and leads to the related concepts of China's urban investment bonds and urban investment companies, and introduces in detail the attributes and characteristics of urban investment bonds as implicit public debt.

In Chapter 4, this paper mainly discusses the impact of the COVID-19 on urban investment bonds as local implicit debt by focusing on the study of the credit spread of the issuance of urban investment bonds and other government-related factors. This chapter introduces the strength difference-in-difference model to explore the implicit guarantee of the Chinese government for urban investment bonds through variable selection of local economic level and local government debt level. It introduces the COVID-19 impact variable to study its impact on the spread of urban investment bonds, to explore the impact of COVID-19 pandemic on local debt in China.

2 Navigating Economic Challenges: Public Debt, Global Pandemic Impact, and Post-Pandemic Realities

2.1 Public Debt: A Systematic Review

Public debt refers to the process by which a country, region, or government institution raises the necessary funds by issuing various debt instruments, such as government bonds and treasury bills, to financial markets and domestic or international creditors. These debts are typically used to meet the government's fiscal needs, including but not limited to covering budget deficits, supporting project investments, providing public services, addressing emergencies, and improving infrastructure.

Specifically, the key characteristic of public debt lies in the financial agreement between the government as the debtor and the lenders, where the government commits to repay the borrowed funds and pay the corresponding interest at some point in the future. This financial instrument is realized through the government debt market, where investors become creditors by purchasing bonds and other debt instruments, forming the fundamental structure of public debt.

The scale and management of public debt involve various considerations. First, the government must determine the total amount of borrowing, usually influenced by factors such as fiscal policy goals, economic conditions, and development needs. Second, the purpose of the debt affects the type and maturity of the debt; for example, debt used for infrastructure construction may differ in nature from debt used to cover budget deficits. In addition, the government must consider the repayment schedule, the cost of the debt, and the potential impact of the debt on the economy.

Public debt management refers to the process in which the government effectively allocates and regulates the funds borrowed, to achieve fiscal goals, promote economic development, and safeguard national interests. This field involves debt planning, issuance, regulation, and repayment, intending to ensure the sustainability and effective utilization of public debt.

It also plays an important role in the finances of various countries, playing multiple roles. First, by borrowing funds, the government can compensate for fiscal deficits, support national infrastructure construction, and social welfare projects, and promote economic growth. Secondly, debt can be used to respond to emergencies such as natural disasters or health crises, providing the necessary financial support to the country, which is the provision of debt instruments.

First, the use of debt instruments has an impact on a country's monetary policy. The government raises funds through the issuance of debt instruments, which can lead to changes in the money supply. If the government increases debt financing, it can trigger an increase in the money supply, thereby affecting the implementation of monetary policy. The central bank may need to consider the impact of debt on inflation and economic growth when implementing monetary policy to ensure the stability of the money supply.

Second, the use of debt instruments can also affect the level of inflation. When the government uses debt instruments to finance large-scale expenditures, it increases money circulation and may trigger inflation. High inflation may lead to currency depreciation, which in turn affects people's purchasing power and cost of living. Therefore, the scale and use of debt instruments are crucial to controlling inflation.

Meanwhile, public debt also has an impact on the interest rate structure. The issuance of government debt may affect the bond market, thereby changing interest rate levels. High-scale debt issuance may lead to an increase in interest rates as the supply of bonds in the market increases. This has an impact on the overall economic environment and people's borrowing costs, and due to changes in interest rate structures, individuals and businesses may face different financing costs, which in turn may affect their borrowing and investment behavior, potentially having a significant impact on the real estate market, consumer loans, and corporate investment. This will be emphasized in subsequent discussions of the situation in China.

2.2 An Overview of the Global Economy Situation During the Pandemic

At the beginning of 2020, COVID-19 caused an incredible global panic and severely damaged the global economy. According to the WEO forecast for April 2020, the COVID-19 pandemic has led to a sharp decline in global economic activity, and some countries are experiencing even more severe economic downturns. Emerging markets and developing economies have had to adopt strict lockdown measures due to the rapid deterioration of the pandemic, resulting in more severe disruptions of economic activities than predicted.

Furthermore, the global economy has experienced a deep recession simultaneously. According to the April 2020 World Economic Outlook, GDP in the first quarter generally fell short of expectations, especially in emerging markets and some developed economies, where the economic contraction in the second quarter was more severe. Although China opened most of its economy in early April, other countries have generally experienced significant declines in consumption and service production. This characteristic reflects a combination of multiple factors, including voluntary social distancing, lockdown measures, sharp loss of income, and weakened consumer confidence, leading to reduced investment by companies and a widespread impact on total demand.

The labor market has also been severely affected, with a decrease in global working hours, especially for low-skilled workers who cannot work from home. The income loss of different genders also shows differences and low-income women have suffered greater impacts. Global trade decreased by nearly 3.5% in the first quarter of 2020, reflecting the impact of weak demand, a collapse in cross-border tourism, and intensified trade restrictions. The overall trend shows a decrease in inflation, particularly in developed economies where it has fallen by approximately 1.3 percentage points since the close of 2019. In emerging market economies, there's been a parallel decline of 1.2 percentage points in inflation.

Therefore, to deal with the crisis caused by COVID-19, the governments of the world have declared huge amounts of financial assistance to provide economic assistance to temporarily laid-off workers to prevent large-scale unemployment, as well as to provide financial support to enterprises and ensure continuous supply of credit, avoiding broader bankruptcies. However,

these measures have assisted, they have also led to a rapid increase in the proportion of public debt to GDP in various countries, raising concerns about public debt sustainability because most developed economies have implemented significant measures such as issuing more loans and increasing government guarantees to ensure the implementation of social security, this has significantly increased the pressure on public debt in various countries, which can be seen in Figure 2.1.
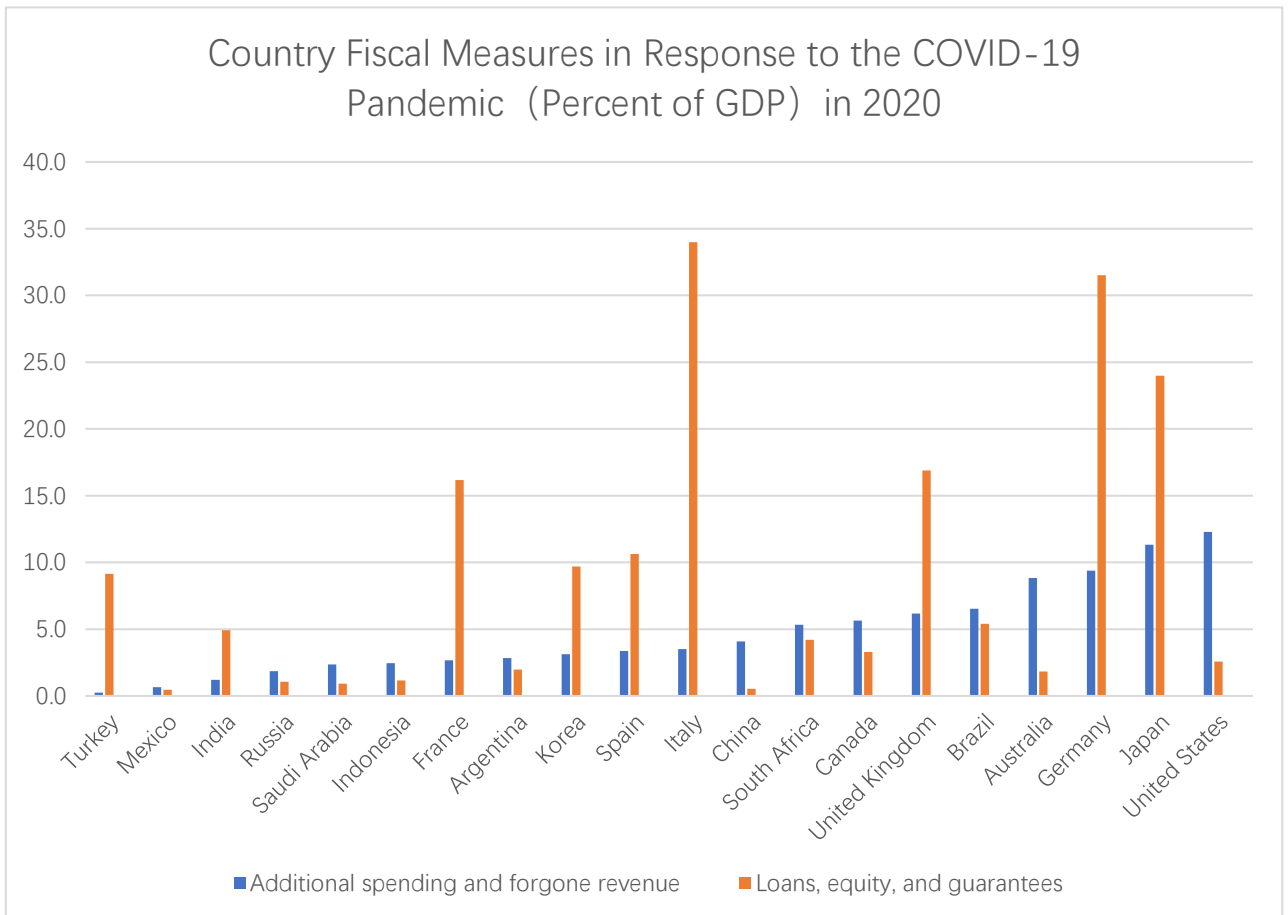

Figure 2.1 Country Fiscal Measures in Response to the COVID-19 Pandemic in 2020

Source: National authorities and IMF staff estimates

In the year 2021, a similar scenario persists, leading to a persistent high proportion of global public debt to GDP across various governments. This proportion, as reported in the April 2020 World Economic Outlook, approached nearly 100%. Furthermore, it is anticipated that this level will persist throughout the years 2021 and 2022.

The following Table 2.1 indicates the general government fiscal balance and gross debt to GDP ratios in various countries mainly including developed economies and emerging markets and developing economies.

Developed economies, exemplified by the United States, Japan, Germany, France, Italy, and others, are confronted with the arduous task of reconstructing their fiscal buffers during the phase of economic recuperation. Their debt-to-GDP ratio has far surpassed the magnitude of GDP itself, reaching approximately 110% to 250%. Conversely, emerging markets and developing economies, such as China and India, have exhibited discernible disparities in terms of their policy responses and recovery processes, attributed to variations in their financial capabilities. Notably, their fiscal deficits are generally estimated to hover around 7% throughout the year 2021.

However, it is crucial to acknowledge that the debt situation and fiscal deficit of low-income developing countries, for instance, Nigeria, may initially appear commendable. Such countries demonstrate a fiscal deficit amounting to roughly 5% of their GDP, coupled with a public debt-to-GDP ratio of approximately 48%. Nevertheless, these seemingly favorable figures are largely attributable to the challenges they encounter in terms of financing constraints.

It shows that China's gross debt rate has maintained a moderate level in both 2020 and 2021, roughly comparable to the situation in developed economies such as Germany. However, as a member of emerging markets and developing economies, China's ability to maintain data in this dimension is closely related to the surge in implicit debt behind it, and problems will gradually emerge after the pandemic. This will be further explored in subsequent chapters.

General Government Fiscal Balance			Gross Debt	
	2020	2021	2020	2021
Turkey	-5.3	-5.9	39.5	40.2
Mexico	-4.5	-3.3	61.0	59.9
India	-12.8	-11.3	89.4	90.1
Russia	-4.0	-1.1	19.3	18.0
Saudi Arabia	-11.3	-3.5	32.5	30.0
Indonesia	-5.9	-6.2	36.6	41.9
France	-9.2	-9.3	115.1	117.2
Korea	-2.2	-2.9	47.9	51.8
Spain	-11.0	-8.6	120.0	120.1
Italy	-9.5	-11.1	155.8	157.8
China	-11.2	-8.3	66.3	70.3
South Africa	-12.0	-9.2	77.1	77.5
Canada	-10.9	-7.4	117.8	111.0
United Kingdom	-13.5	-11.7	103.7	107.0
Brazil	-13.4	-6.3	98.9	91.8
Australia	-9.6	-8.7	58.1	62.6
Germany	-4.5	-7.2	69.7	73.0
Japan	-10.7	-9.2	254.6	256.5
United States	-14.7	-13.3	133.6	134.5
Nigeria	-5.8	-5.5	35	32.9

Table 2.1：General Government Fiscal Balance and Gross Debt 2020-2021 (% of GDP)

Source: IMF staff estimates and projections

The following Figure also shows the proportion of government debt in GDP of several major countries, including Canada, China, France, Germany, Italy, Japan, the United Kingdom and the United States, from 2018 to 2022. Data show that the proportion of government debt to GDP in most countries has increased in the past five years, especially in 2020, the proportion of many countries has increased significantly. Among them, Japan's debt accounted for the highest proportion of GDP, reaching 261.3% in 2022, while China's debt ratio was relatively low, but increased from 56.7% in 2018 to 77.1% in 2022. The debt ratio of Canada and the United States is also increasing year by year, reaching 106.6% and 121.4% respectively in 2022. These data reflect the increased debt levels of governments in response to economic challenges, especially the impact of the new crown outbreak.

General Government Debt（% of GDP）

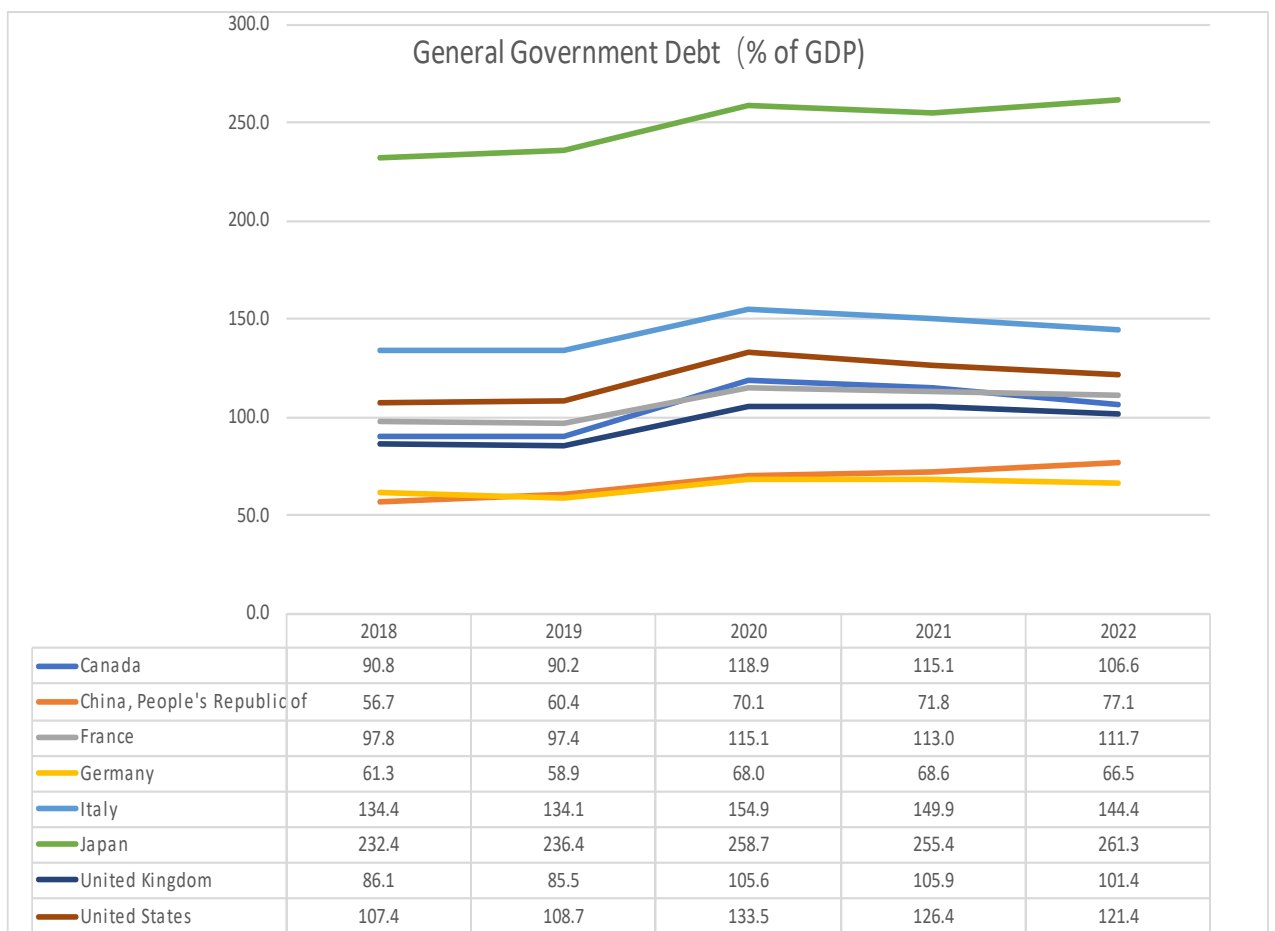|	2018	2019	2020	2021	2022
Canada	90.8	90.2	118.9	115.1	106.6
China, People's Republic of	56.7	60.4	70.1	71.8	77.1
France	97.8	97.4	115.1	113.0	111.7
Germany	61.3	58.9	68.0	68.6	66.5
Italy	134.4	134.1	154.9	149.9	144.4
Japan	232.4	236.4	258.7	255.4	261.3
United Kingdom	86.1	85.5	105.6	105.9	101.4
United States	107.4	108.7	133.5	126.4	121.4

Figure 2.2 General Government Debt (Percent of GDP)

Source： National authorities and IMF staff calculates

2.3 After The Pandemic： The Situation is Still Not Optimistic

Following several waves of the COVID-19 pandemic, a discernible deceleration in the global health situation has been observed during the latter half of 2022. Nevertheless, it would be imprudent to underestimate the profound economic repercussions unleashed by the COVID-19 pandemic on nations across the globe. Compounding this already formidable predicament, the onset of the Russo-Ukrainian war in early 2022 has exerted varied degrees of influence upon the economic and energy sectors of nations, thereby undeniably exacerbating the arduousness entailed in the world's economic recovery endeavors. Consequently, the convergence of these multifaceted crises has necessitated a comprehensive reassessment of global economic priorities and policies.

After the slowdown of the COVID-19 pandemic in 2022, problems in various countries began to emerge gradually. Except for the United States, which was able to save due to private households receiving fiscal transfer payments during the pandemic, and the minor impact of energy issues caused by the Russia-Ukraine war on it, which resulted in its GDP maintaining a positive growth rate of 0.2% higher than pre-pandemic projections consistent with pre-pandemic predictions between 2020 and 2022, all other countries experienced a much lower actual GDP than pre pandemic predictions due to the soaring energy prices, rising interest rates, and currency depreciation caused by the war, which can be seen in Figure 2.2. (IMF employees calculated the pre-pandemic forecast)

However, as we can see in the figure for China, although it is also less affected by the Russia-Ukraine war, due to the significant link between China's public debt and local urban investment infrastructure, during the outbreak of the pandemic in 2020, the Chinese government relaxed policies to stimulate urban investment and financing, and advanced economic development space for the next few years to ensure economic stability - this issue ultimately began to emerge in 2022, indirectly leading to the malicious expansion of local debt, especially implicit debt (which will be discussed in detail in subsequent chapters), Finally, it led to a serious crisis in China's real estate industry, resulting in GDP output is 4.2 percentage points lower than pre pandemic forecasts.

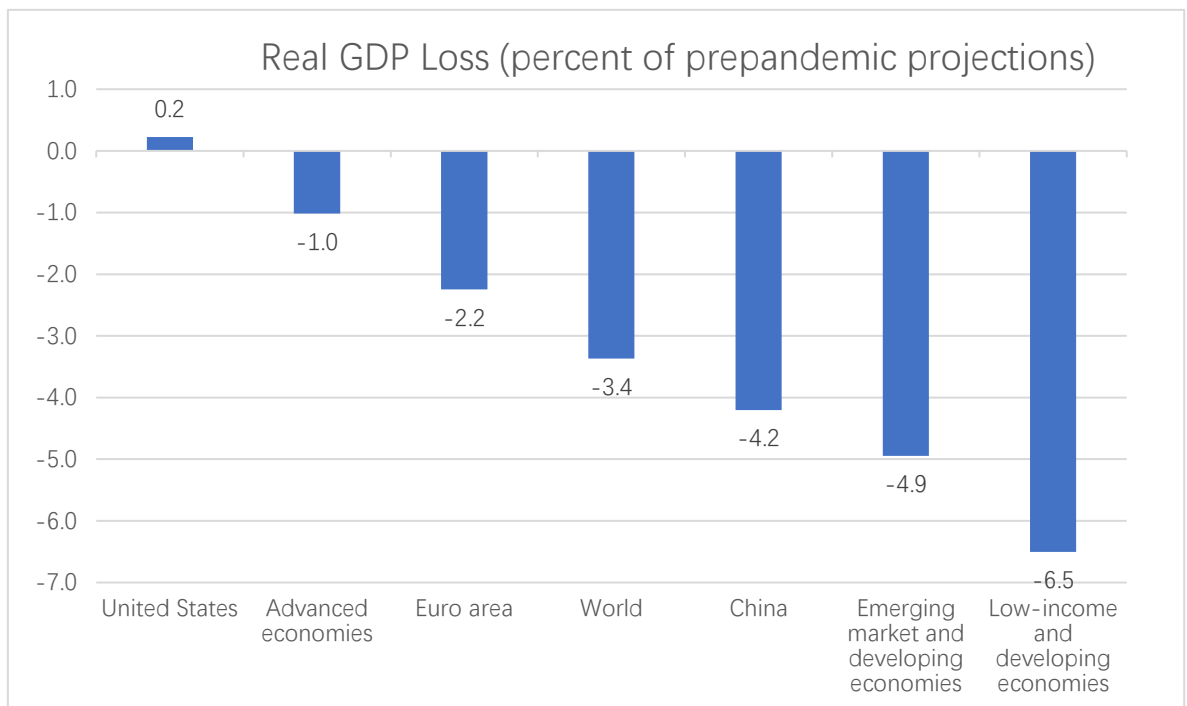Real GDP Loss (percent of prepandemic projections)

Figure 2.3 Real GDP Loss from pandemic 2020-22

Source: IMF staff estimates and projections

In contrast, the global pandemic has exerted a profound influence on the labor market in various regions. As reported in the October 2023 edition of the International Monetary Fund's World Economic Outlook, the impact of the pandemic further constricted the financial capacity of most emerging and developing economies due to their weak social security systems. Consequently, the employment rate and labor participation rate in these economies plummeted significantly below their levels before the pandemic. Conversely, developed economies such as the euro area capitalized on their robust financial strength and implemented targeted policies to facilitate the retention of a substantial pool of human resources by enterprises. This strategic approach not only saved businesses from incurring substantial turnover costs but also fostered the expansion of employment opportunities, as evidenced by the supporting graphical data.
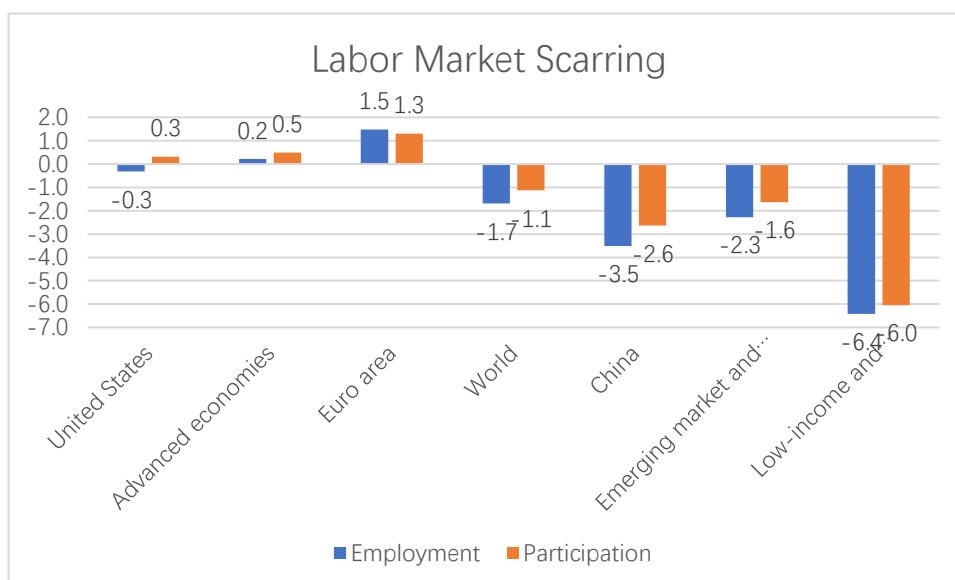
Figure 2.4: Labor Market Scarring from the Pandemic 2020-22

Source: IMF staff estimates and projections

However, this Figure also points out that China's employment rate and labor participation rate have shown negative growth. Due to the slowdown of China's economic growth caused by the impact of the pandemic, the production and operation of enterprises are difficult, and the ability to absorb employment has declined. Many enterprises are facing problems such as production stagnation, reduced orders, and tight funds, resulting in job losses or layoffs. In particular, some small, medium-sized, and micro enterprises and private enterprises are more affected. As the main platform and channel for youth employment in China, this directly contributed to the soaring youth unemployment rate in China during the pandemic, which was more than 20% at one time.

On the other hand, due to the impact of COVID-19, many young people in China are more cautious and pickier about the employment environment and conditions. They prefer to choose jobs with strong stability, high income, good welfare, and good development prospects. Such jobs are often scarce resources and there is fierce competition in the job market. At the same time, due to the enrollment expansion policy of higher education implemented in China in recent years, the enrollment scale of colleges and universities continues to expand, resulting in the explosive growth of the number of college graduates. However, under the impact of the pandemic, the number of new jobs did not increase at the same time and even showed negative growth. This has led to a serious imbalance between supply and demand between college graduates and jobs. Meanwhile, because most of the young people in China have received

higher education, most of them are not willing to engage in physical labor that has nothing to do with their majors during their university years and instead choose to continue studying their academic qualifications, which further reduces the labor participation rate in China.

Hence, it is evident that despite the improvement in the health crisis caused by the COVID-19 pandemic in the latter part of 2022, the global economic recovery remains challenging due to the combined impact of the pandemic and the Russo-Ukrainian conflict. The repercussions, such as soaring energy prices and currency devaluation affecting various sectors, along with decreased labor participation and increased unemployment rates, have hindered the growth of real GDP.

During the pandemic, the public debt ratios of many countries surged to 100%. While public debt is projected to continue rising, except for major economies like the United States and China, other countries are expected to see a decrease of approximately 0.5 percentage points annually. This indicates that governments are starting to scale back unconventional financial aid, with public debt and deficits decreasing from peak levels as fiscal policies gradually normalize.

Despite some progress, there are still many challenges that need to be addressed, creating a somewhat pessimistic outlook. The ongoing conflicts and geopolitical tensions have added further uncertainty to the global economic landscape, making it difficult for countries to recover and regain stability fully. The need for continued cooperation and coordination among nations has become even more crucial to address these complex challenges and work towards a more sustainable and inclusive economic recovery. It is clear that the road ahead will be filled with obstacles, but with concerted efforts and effective policies, there is hope for a brighter future.

3 How China Achieves Development During the COVID-19: A General Review

3.1 Growth Trends of China during the Pandemic

In 2020, China faced the huge impact of the epidemic and the complex and severe domestic and international environment. Through coordinated epidemic prevention and control, it effectively curbed the spread of the epidemic, ensured the rapid resumption of normal economic and social operations, and implemented active fiscal and prudent monetary policies to ensure the stability of the supply chain, making it one of the few economies to achieve positive growth in 2020, when the epidemic was most severe, As we can see in the figure3.1, the growth rate remains at 2.2% and demonstrated a strong recovery with a growth rate of 8.4% in 2021.
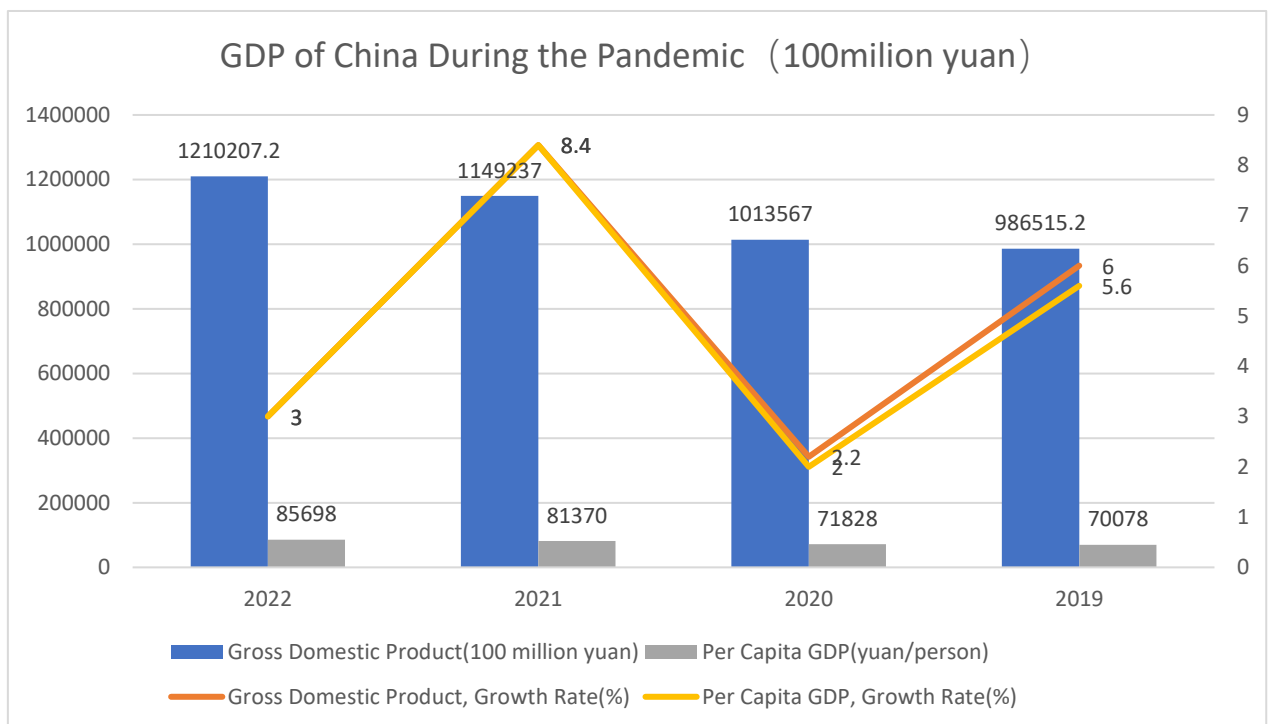

Figure 3.1 GDP of China During the Pandemic

Source: National Bureau of Statistics of China

According to the 2020 accounting data released by the National Bureau of Statistics of China in January 2021, grain production has reached a new high in terms of production. The added value of industries above the designated size nationwide increased by 2.8% compared to

the previous year, and the high-tech manufacturing and equipment manufacturing industries grew rapidly. The national service industry production index remained unchanged from the previous year, and the modern service industry showed a good growth trend. In terms of social demand, which can also be referred to the following table3.1, the total retail sales of consumer goods in the whole year were 391981 billion yuan, a decrease of 3.9% compared to the previous year; In the fourth quarter, the growth rate of total retail sales of consumer goods accelerated by 3.7 percentage points compared to the third quarter. Throughout the year, fixed assets investment increased by 2.9% over the previous year, and investment in high-tech industries and social fields grew rapidly. The total import and export of goods for the whole year increased by 1.9% compared to the previous year, and the trade structure continued to optimize.

Table 3.1 Monthly year-on-year growth rate of total retail sales of consumer goods(%)

Source: National Bureau of Statistics of China

However, in 2021, China chose to reduce public investment and overall fiscal support to control the size of its deficit and stabilize its finances, resulting in a 0.3 percentage point decrease in China's GDP growth forecast for 2021. Some of the expenditure reduction measures it has taken can still be obtained from the data released by the National Bureau of Statistics of China. For example, in the figure3.2 below, China's public health expenditure has gradually shifted its payment focus from the government to society since 2020, although in 2022, a new

round of social health pressure caused by the relaxation of epidemic control measures in China has led to a re-increase in government health expenditure.
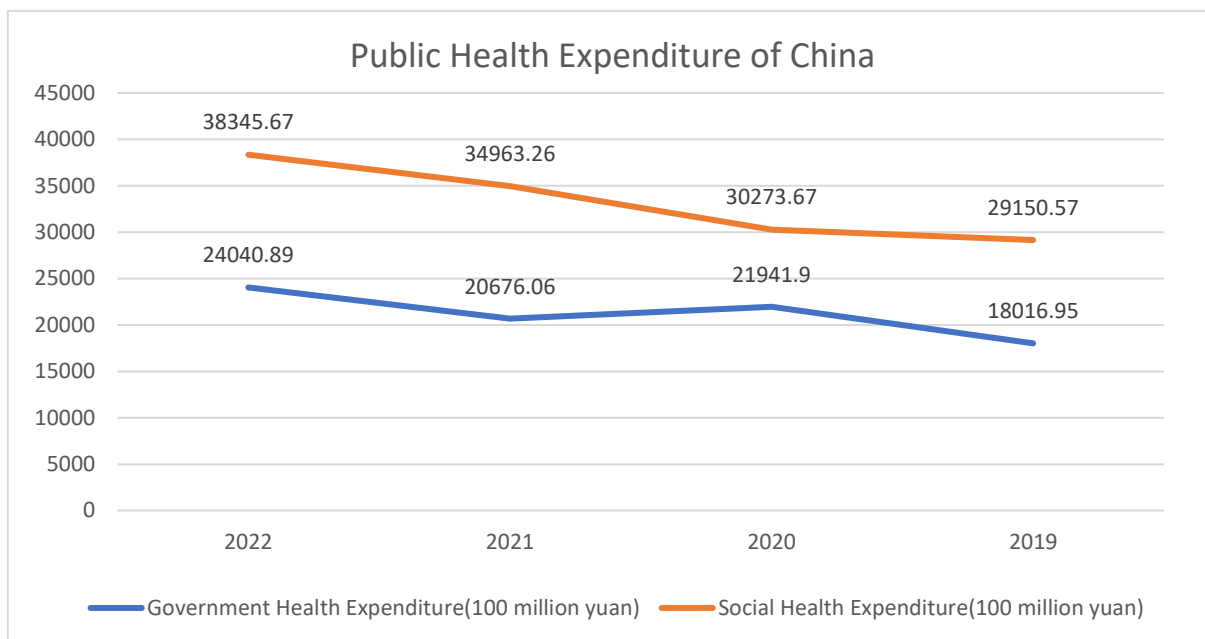

Figure3.2 Public Health Expenditure of China

Source： National Bureau of Statistics of China

However, the COVID-19 Pandemic has seriously impacted one of the pillars of China's economy, the real estate industry. During the pandemic, the transaction volume of China's real estate has been severely affected and the recovery has been slow. In terms of first-hand housing, due to the rapid spread of the epidemic, over 95% of newly added housing sources in cities have encountered "zero supply", resulting in a steep decline in first-hand housing transaction volume. In terms of second-hand housing, the market transaction volume in February 2020 was almost zero for three consecutive weeks, and since March, it has remained in a relatively low state of transaction volume.

Such low transaction volume naturally hinders the cash flow of Chinese real estate companies, directly leading to a sharp decline in their debt repayment ability. According to calculations, in 2020, domestic bonds of Chinese real estate companies matured by 590.2 billion yuan, and overseas bond issuances matured by 213.6 billion yuan (data source: Ping An Securities Research Institute). Severe financial constraints have led to the inability to complete houses, a large number of economic lawsuits, and financial disputes caused by outstanding debts, which has further depressed China's real estate industry and entered a phase of negative

growth since 2021.(which can be seen in figure 3.3) This has increased the pressure on the government to sell land, making the already fragile public finances even more fragile after experiencing the pandemic's impact. In addition, the increase in China's unemployment rate mentioned in Chapter 2.3 has also led to a sudden slowdown in China's economic growth after the COVID-19 Pandemic and has posed serious challenges for local governments in repaying local public debts.
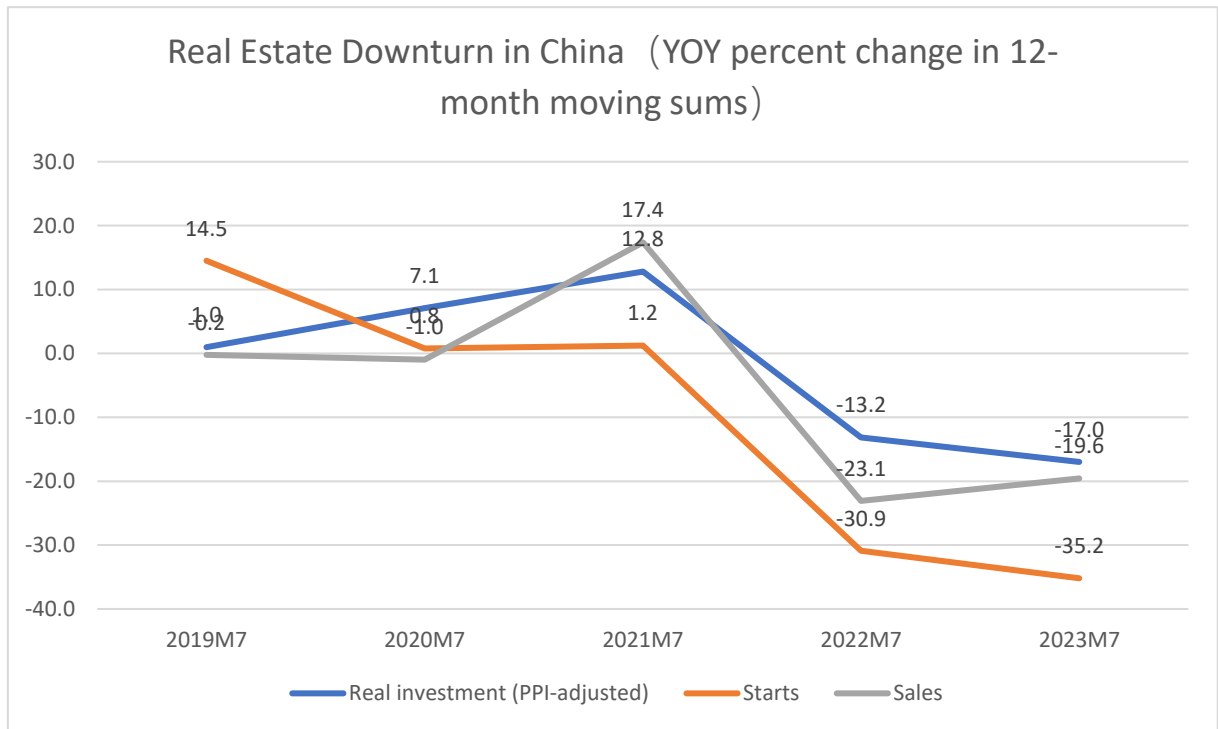

Real Estate Downturn in China（YOY percent change in 12-month moving sums）

Figure3.3 Real Estate Downturn in China（YOY percent change in 12-month moving sums）

Source： IMF staff calculates

3.2 Behind China's Development: Land Finance and CT Bonds

3.2.1 Evolution of Fiscal Decentralization and Land Finance in China

After trial implementation in the 1980s, China officially implemented the fiscal contracting system in 1988. The basic idea of this system is for the central government to plan and allocate the income and expenditure of various provincial-level financial units. Local finance ensures that in addition to the income submitted to the central finance, the increased income can be retained for self-use in a certain proportion. The central government will provide less or no subsidies for income shortfall caused by income decline.

This measure was a successful experiment by the central government of China at that time on the local decentralization system. Under this fiscal decentralization system, local governments could not only obtain fiscal revenue beyond the contracted base through regional competition but also stimulate the development of rural enterprises in China. In Naughton's view, at that time, Chinese state-owned enterprises, which were mainly focused on heavy industrial products, manufactured domestic light industrial products that were in a long-term supply shortage. This enables township enterprises, mainly based on light industrial products, to develop rapidly with the support of local governments and have almost no competitors.

However, after nearly a decade of policy implementation, China's central government finance has encountered great difficulties, as under this decentralized system, the central government is unable to concentrate local fiscal revenue effectively. As a large amount of new fiscal revenue comes from local finance, it squeezes the share of the central government finance. Therefore, in 1994, China reformed its finances again, with a focus on re-regulating taxation. For example, a unified value-added tax rate of 17% was re-established, and according to official legal documents in 1994, the central government took 75% of the value-added tax share, leaving only 25% to local governments. This proportion was changed to 60% taken by the central government and 40% taken by local governments in 2002.

This reform has strengthened the central government's macroeconomic regulation capacity, ensuring the financial support needed for a series of reforms in other fields and other key construction projects in China. However, it has significantly reduced the available financial resources of local governments without changing their focus on economic development, forcing them to seek other ways to increase their fiscal revenue.

For local governments, one approach is to attract investment and expand the investment scale, thereby increasing the production scale. Because the income of value-added tax is directly linked to the production scale. On the other hand, it can also absorb low-skilled agricultural labor left idle due to land deprivation to provide employment, increase the development of the tertiary industry, and thus increase other related taxes. Although this has led to an excessive emphasis on production over consumption, it has also made China a manufacturing powerhouse.

Another important measure is land finance. According to China's institutional regulations, urban land belongs to the state, while rural land belongs to the collective. To convert rural land into construction land, it is necessary to first acquire land and turn it into state-owned land. After the reform of the tax-sharing system, local governments have the power to transfer state-owned land, but the income from land transfer is relatively low. In 1998, the revised Land Management Law of the People's Republic of China stipulated that to convert agricultural land into construction land, it must be expropriated and then converted into state-owned land. As a result, local governments gained a monopoly on construction land and restricted the conversion of agricultural land into construction land. And in the same year, China began the era of commercial housing and real estate, and since then, the value of Chinese land has rapidly appreciated.
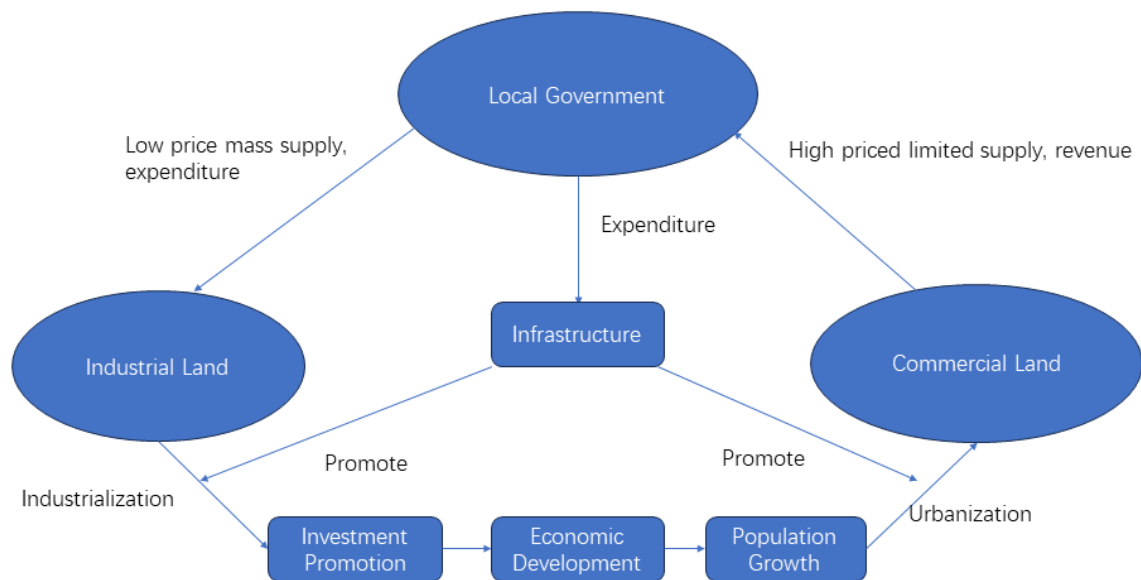
Figure 3.4 Land Finance Development Model of Local Government

Figure 3.4 illustrates the basic operational model of land finance for local governments in China. Firstly, local governments sell a large amount of land at low prices for industrial construction and invest heavily in infrastructure to promote the industrialization process. In this process, due to the local economic development brought about by the investment attraction required for industrialization, the local population grows rapidly, which promotes the local urbanization process and also leads to a rapid increase in land value, especially with further infrastructure investment from the local government. On this basis, local governments get tax profit from land monopolies by restricting the supply of commercial land and continuously raising land prices.

As shown in Figure 3.5 below, the prices of industrial land in China are generally maintained at a relatively low level. In contrast, commercial and residential land has rapidly increased every year, especially since the tax-sharing reform in 2002. According to the statistics, the average transaction price of industrial land in 2000 only increased by approximately 85% by 2018. However, the price of commercial land has increased by nearly 5 times, and the price of residential land has increased by nearly 7 times.
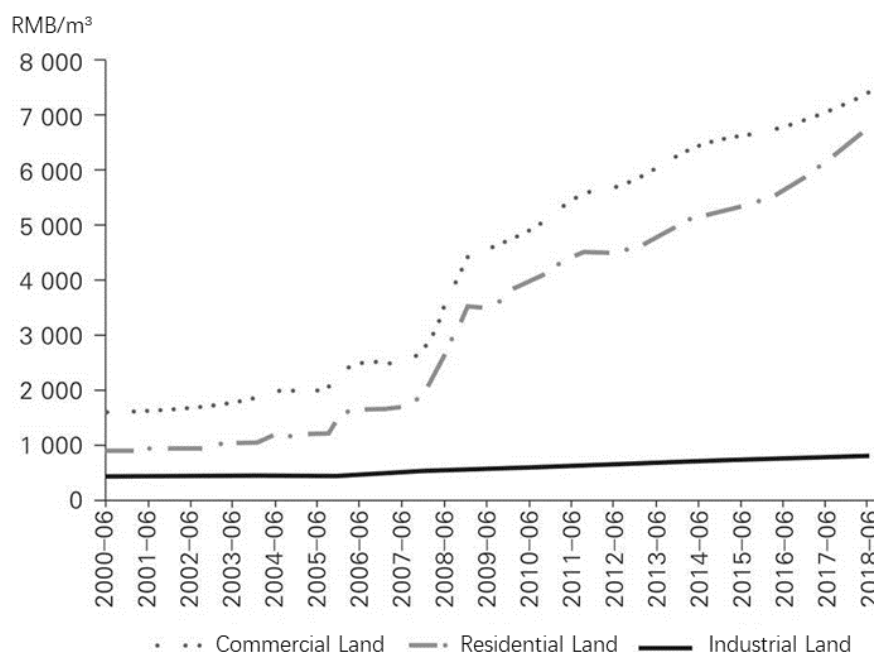
Figure 3.5 Quarterly Average Transaction Price of Land Transfer in 100 Key Cities in China

Source: Wind Database

Land revenue is a vital component of local finances, providing a steady income for the government. This revenue is crucial for funding public services and infrastructure projects that benefit the community. By collecting land revenue, the government can generate funds to support economic development and enhance residents' quality of life.

An important advantage of land revenue is that it gives local governments more financial control. Unlike other revenue sources that may be influenced by external factors, land revenue is entirely under the control of the local government. This autonomy allows local authorities to make financial decisions that best serve their constituents, without depending on outside funding.

Because of its key role in local finances, land revenue is often known as "Land Finance". This term emphasizes the significant impact of land revenue on the financial systems of local governments. By utilizing land revenue as a primary income source, local authorities can establish a strong financial system to support various public expenses. In this way, land finance is essential for the financial health and sustainability of local governments.

3.2.2 Land Finance and Urbanization

As mentioned in the previous chapter, China's use of land finance to expropriate a large amount of land for development and then sell it is leading to large-scale urban construction, which has been the fundamental driving force behind China's rapid urbanization in the past two decades. This model is not only limited to the fiscal sector but also widely involves the financial sector.

The General Provisions on Loans formulated by the People's Bank of China strictly limit the qualifications of borrowers, excluding the qualification of local governments as borrowers. However, the Budget Law in the 1995 version stipulates that local governments are not allowed to issue bonds (the revised 2014 version allows provincial-level local governments to issue bonds), which makes it impossible for local governments to obtain additional financing. Especially after the 1998 Asian financial crisis, infrastructure pressure increased, and local governments urgently needed additional means to expand financing.

Therefore, if local governments want to borrow money for investment, they need to establish specialized companies. Most of these companies are state-owned sole proprietorships, collectively referred to as "Local Government Financing Platforms". But they are also known as "Cheng Tou Gong Si" (from now on referred to as CT co, Urban Investment and Development Companies) due to their names containing a large number of words such as "Construction Investment" or "Investment and Development".

At the beginning of its establishment, this type of company undertook most of the local government financing tasks. As the main body of the financing platform, they obtained loans from banks through mutual guarantees (i.e. several large government companies guaranteed loans with capital), financial guarantees (endorsed by local government finance departments), and land mortgages.

On the contrary, the local government allocates the land use rights for the projects that CT companies need to construct and develop after obtaining loans. These land uses include both public welfare construction land and some non-public welfare commercial and residential land used for commercial development as well.

(Bilion Yuan)	Financial funds from Gov	Financial funds		
	Financial appropriations	Financial guaranteed loans	Land mortgage loan	Total
2003	0.42	0.247	0.2	0.867
Jan-Sept 2024	0.1	0.076	0.34	0.516
Total	0.53	0.323	0.54	1.393
Proportion	38%	23%	39%	100%

Table 3.1 Composition of Fund Development Sources for Shaoxing CT Company (2003-2004)

Source: Zhou Feizhou.(2012). Yi Li Wei Li: Cai Zheng Guan Xi Yu Di Fang Zheng Fu Xing Wei

Table 3.1 shows the composition of the funding sources for CT Company established by the local government of Shaoxing County after the tax sharing system reform. We can see that only about one-third of the funds are directly injected from the government's finances, and the remaining two-thirds of the funds are sourced through financing methods. Among the sources of financing, about 40% come from government-guaranteed loans, while the remaining 60% come from land mortgage loans.

Such kind of financial approach, combined with land policies, demonstrates that local governments not only rely on financing in urban development and infrastructure construction, but also mainly rely on land mortgage financing methods in land acquisition, new area development, and other construction aspects. In this way, financial funds also provide support for the land acquisition, development, and transfer process of local governments, enabling them to quickly expand the scale of land development and accumulate a large amount of land transfer income for urban construction. This process has facilitated the rapid urbanization process in various parts of China.

The process of urbanization can be mainly divided into three parts. As shown in Figure 3.6, agricultural land is requisitioned by local governments and converted into urban construction

land, bringing a large amount of land income to local governments. Local governments use this as capital to invest in CT Company for financing, attracting larger-scale funds to enter the process of land development and urban construction.

Figure 3.6: China's urbanization model
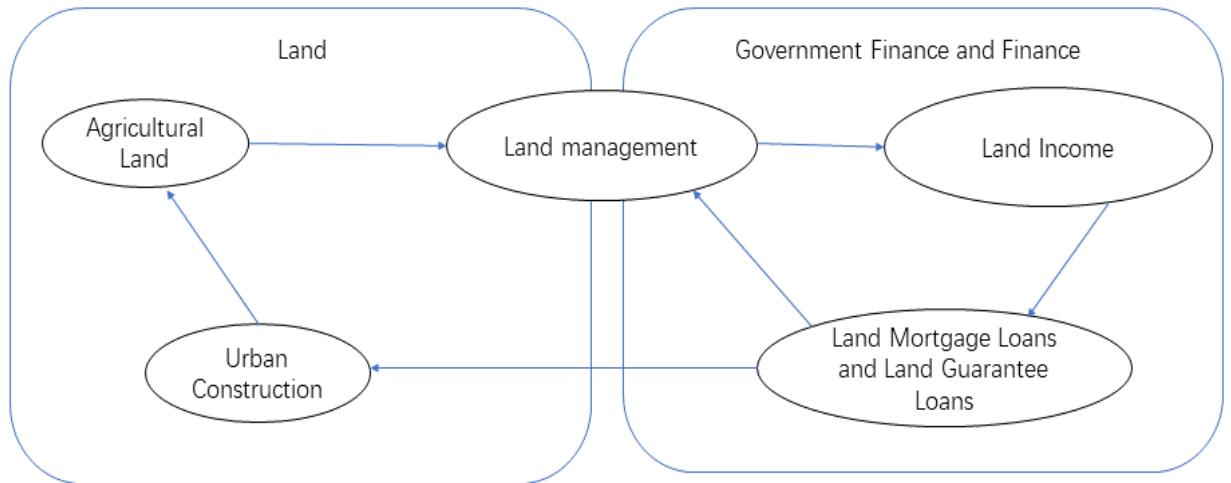
This circular model of land income - bank loans - urban construction - land acquisition has brought a virtuous cycle to the fiscal revenue of local governments, while greatly promoting industrialization and urbanization. However, it has also laid the groundwork for CT Company's snowball-like debt accumulation in the financing process and ultimately ignited the fuse in the COVID-19 pandemic.

3.2.3 Behind the Development of Land Finance: CT Companies and CT Bonds

As mentioned in previous chapters, after the tax-sharing reform in 1994, local governments in China faced financial difficulties and were in the early stages of rapid urbanization, requiring a large amount of financial allocation. To solve the problem of funding sources for large-scale urban construction, local governments have chosen to introduce bank funds in the process of developing urban construction. Due to the limited legal participation of local governments from directly participating in the financing, CT Company was established.

This model was first invented by the China Development Bank in 1998 to handle urban construction in Wuhu City, Anhui Province. In this model, the government obtains loans from banks through CT company and packages all urban construction and development projects that will incur losses and profits to CT company for loan financing. At the same time, the local government uses the income obtained from land finance and fiscal budget to repay debts. This became the standard model for Chinese CT companies after 2003.

The types of companies in this category are usually very diverse, covering state-owned enterprises such as investment and financing platforms, as well as research and design institutes. They are relatively easy to obtain financing due to their national background or government endorsement.

However, the bank loans obtained by CT companies often come from urban commercial banks under the control of local governments. The funds of these banks often come from short-term deposits, which do not match the long-term loans required for urban construction projects and are prone to risks. Urban commercial banks also often raise funds in the capital market to ensure their capital stability, which further increases the risk.

Therefore, CT Company also adopts the form of issuing bonds for financing. This kind of bond is usually called "Quasi-Municipal bond", but its name "CT bond" is more familiar (from the Chinese word "Chen Tou", the urban investment) This type of bond is usually a public issuance of corporate bonds and medium-term notes, and its main business is mostly local infrastructure construction or public welfare projects. From underwriters to investors, those involved in the bond issuance process consider it as a local government bond issuance.

There are two main reasons why it is considered as government financing. Firstly, although the raised funds are usually invested in capital-intensive, long-term investment return periods, and public good nature municipal projects, the operation mode of enterprise bonds is completely applied from bond initiation to design approval, issuance, circulation, and repayment. This is a method of local governments borrowing the shell of enterprises to achieve their purpose of raising municipal construction funds. On the one hand, local governments give great preferential treatment to issuing enterprises in bond issuance plans, and meanwhile, they provide various policies such as hidden guarantees, development permits, and tax incentives to bond issuers. Once there are redemption issues, local governments have a strong responsibility to repay on their behalf. Therefore, the issuance of CT bonds has a strong government influence.

And also, CT companies also have typical characteristics of government financing platforms. Firstly, they often obtain a large amount of land use rights from local governments, obtain valuable land assets, and with their own operating income and government subsidies, they can easily leverage bank loans for financing. Therefore, their profitability will to some extent rely on government subsidies, forming a strong government background. Secondly, through a series of government authorizations and capital injections, CT companies have obtained implicit guarantees from the local government. This guarantee not only facilitates CT companies in borrowing and financing a large amount but also allows their issued bonds to receive high credit ratings in the market. Although the Guarantee Law of the People's Republic of China stipulates that the government cannot provide guarantees for financing platforms, the market often tends to believe that CT companies will find it difficult to go bankrupt due to the government's continuous injection of assets into these CT companies, so the risk coefficient is very low.

Regarding the market's risk assessment of CT bonds, it can be seen from Figure 3.7 that as of the outbreak of the epidemic in 2020, the proportion of AAA-grade CT bonds was 23.17%, with an issuance of 1552.9 billion yuan. CT bonds ranging from AAA to AA - grade accounted for nearly half of the total issuance, with the issuance of 3260.8 billion yuan. However, other sub-rated bonds have been affected by the epidemic and have increased in proportion from 51.34% in 2020 to 58.63% during the two years since the outbreak of the COVID-19 Pandemic.

This is due to the impact of the epidemic, some CT companies have also experienced problems such as poor management and decreased solvency.
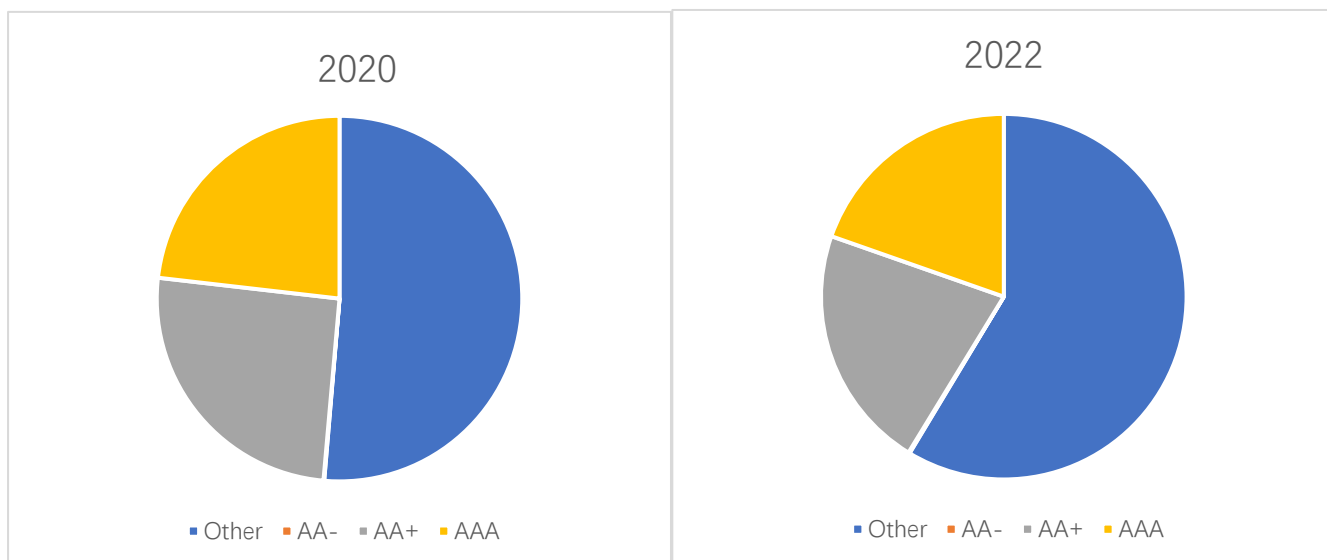
Figure 3.7 CT bonds stock during the COVID-19 Pandemic period

Source： Wind Database

However, CT bonds linked to a government background in China are not easily classified as the public debt of local governments. As mentioned earlier in Chapter 2.2, the global outbreak of the COVID-19 pandemic has had a significant impact on the financial situations of governments worldwide, resulting in an increase in public debt issuance. As a result, while the debt-to-GDP ratios of different countries have risen, China has maintained a relatively steady debt-to-GDP ratio between 70% and 77%. This is because China's local government debt is transparently and directly managed, without taking into account CT bonds issued by CT companies when they take on government financing responsibilities. It is important to note that this latter category has been particularly affected by the COVID-19 pandemic.

CT bonds are not only different from local public bonds issued by various Chinese governments in terms of issuing institutions, scale, maturity, and interest rates but also have a wide variety of varieties. This mainly includes short-term financing bonds (within 12 months), Medium-Term Notes (MTN), corporate bonds (publicly issued or non-public issued), corporate bonds, Private Placement Notes (PPN), as well as newly added Project Revenue Notes (PRN)

and Exchangeable Bonds (EB) in 2022. From Table 3.2 below, it can be seen that China's CT bonds are currently mainly composed of corporate bonds and medium-term notes, accounting for 40.47% and 22.96% respectively as of the end of 2022, accounting for more than 60% of all CT bonds.

Type	Quantity	Quantity Proportion (%)	Balance(Billion Yuan)	Balance Proportion (%)
Enterprise Bond	2518	13.42	1673.7	12.39
General Enterprise Bond	2518	13.42	1673.7	12.39
Corporate Bond	7594	40.47	5691.7	42.13
General Corporate Bond	1224	6.52	1181.7	8.75
Private equity bonds	6370	33.95	4510	33.38
Medium-term notes	4309	22.96	3415.2	25.28
General MTN	4309	22.96	3415.2	25.28
Short-term Financing Bond	1203	6.41	798.9	5.91
General short-term Financing Bond	356	1.9	244.7	1.81
Ultra Short-term Financing Bond	847	4.51	554.2	4.1
Private Placement Notes	3115	16.6	1918	14.2
Exchange Bonds	2	0.01	1.8	0.01
Private Revenue Notes	23	0.12	10	0.07
Total	18764	100	13509.3	100

Table 3.2: Composition and quantity of CT bonds in China at the end of 2022

Sources: Wind Data Base

Since the onset of the COVID-19 pandemic, Chinese CT bonds have emerged as pivotal government-backed financial instruments renowned for their high quality within the market. Amidst the economic downturn induced by the pandemic, these CT bonds have assumed a significant role as government financing platforms, thereby mitigating the adverse effects to a considerable extent. Nonetheless, this heightened reliance on CT bonds as a mechanism for economic stabilization has inadvertently exacerbated the inherent repayment risks stemming from the operational inadequacies of CT companies, a trend that has been escalating since the aftermath of the 2008 financial crisis.

4. Chinese Local Debt under the Impact of the COVID-19: A Study on CT Bond Spread

4.1 A Review of The Impact of COVID-19 on CT Bonds

Since the outbreak of the COVID-19 Pandemic in 2020, China's economy and society have suffered unprecedented impacts and challenges, and the overall economic system is running at a low speed.

From January to May 2020, the general public budget revenue and general public budget expenditure of local governments in China decreased by 10.4% and 3.1% year-on-year, respectively. The difference between these two ratios continued to expand the gap of local fiscal revenue and expenditure in China. According to table 4.1 below, it is not difficult to see that in the first quarter of 2020, China's overall local fiscal revenue generally showed a negative growth trend, with Hubei Province, as the source of the outbreak, falling by 47%. Jiangsu Province and Zhejiang Province, which represent China's economically developed regions, have also experienced varying degrees of income decline. However, due to the different economic structures of these developed provinces and the large differences in the forms of fiscal revenue, the decline in these provinces dominated by the digital economy is relatively small, with a decline of less than 10%, while the rest of the provinces in general condition maintain a decline of about 10%.

Province	Changes in general public budget revenue(%)	Changes in general public budget expenditures (%)
Guangdong	-8.4	-7.70
Jiangsu	-9.0	-0.43
Zhejiang	-5.10	-13.20
Shandong	-10.10	-6.40
Hubei	-47.60	-14.10
Sichuan	-12.70	-10.80

Table 4.1： Fiscal revenue and expenditure status of some local governments in China in the first quarter of 2020

Source： Compilation of China's Internet public data and China's local government's Ministry of Finance public data

As mentioned before in Chapter 3.2, a large part of China's local finance revenue comes from land finance. However, the downturn of China's real estate market due to the impact of COVID-19 has led to a significant decrease in land transfer revenue. In the first half of 2022, land transfer revenue was 2,362.2 billion yuan. , another decline of 31.4% compared to 2021. This is because, on the one hand, in order to attract investment, local governments deliberately lowered the transfer price of industrial land and lowered land acquisition compensation, which harmed the interests of farmers; on the other hand, local governments controlled the supply scale of commercial and residential land, causing real estate prices to rise rapidly, causing It is very difficult for low- and middle-income people in cities to buy houses. The impact of the epidemic has led to a downturn in the overall economy, a decline in per capita income, and a further decline in purchasing power.

The decrease in land transfer income further weakens the ability of local governments to handle local CT debts. Correspondingly, CT companies lack sufficient financial support from local governments in accounts receivable collection, subsidies, and debt resolution, making them more prone to liquidity risks and possible defaults on public market bonds.

Generally speaking, under the impact of the COVID-19 pandemic, the investment and financing situation in various parts of China has become increasingly tense. Local governments have also been impacted by their own finances, and their solvency and bankruptcy risks have increased. CT company relies on assets authorized by the local government or government credit for financing. The scale of CT bonds issued by CT company is large, which is highly consistent with the local government's public debt in terms of scale change, capital investment direction, repayment source, and due repayment pressure. However, CT bonds are not included in the public debt. This makes CT bonds the main hidden debt in China's local government's public debt, and further soars under the impact of covid-19. In just three years of the epidemic, the debt ratio of local governments in China has increased by nearly 70% (See Table 4.2)

Annual	Local government explicit debt balance	CT debt balance	Local government debt ratio
2017	16.47	29.29	204.47%
2018	18.39	35.28	212.81%
2019	21.31	40.96	225.62%
2020	25.66	48.15	247.44%
2021	30.47	52.82	280.44%
2022	35.06	57.48	316.48%

Table 4.2: The level of local government debt in China from 2017 to 2022 (in trillions of yuan)

Source: Chinese Ministry of Finance, Wind Database

In conclusion, the outbreak of the COVID-19 has greatly increased China's local debt risk and fiscal revenue and expenditure tension, and has had an extremely adverse impact on the profitability of urban investment infrastructure business. Especially in the areas with the most severe epidemic, the local financial situation is even worse, and the impact on urban investment infrastructure business is more severe, with a higher risk of defaults on public market bonds.

4.2 The Reason for Studying The Spread

As mentioned in the previous chapter, the impact of the COVID-19 Pandemic on the local government finances in China cannot be underestimated. During the pandemic, local government tax revenue decreased; With the continuous downturn of China's real estate industry, the land transfer revenue in various regions has significantly decreased, and the tax revenue in each region has also shown a significant decline, leading to a decrease in local government revenue and an increasing debt risk. Most local governments in China, in order to evade regulation, use CT companies to issue CT bonds to raise funds, accumulating a large amount of implicit debt, which exacerbates the risk of local debt. As one of the risk assessment tools, credit spread can evaluate the credit status of local governments and their financing platforms, help investors and market regulatory agencies understand the default risk and market preferences of CT bonds, and help understand the views and expectations of market participants on the local economy, government financial policies, and macroeconomic environment, providing decision-making reference for market investors.

In analyses of CTbonds' spreads, researchers like Qi Tianxiang et al. (2012) introduced a new variable, which is whether the government provides a certain guarantee for its bond issuance. They found that the government's guarantee of bonds has a greater impact on bond credit spreads. Further exploration by Wang Li and Chen Shi (2015) delved into the correlation between local government guarantees for bond issuance, the credit crisis of financing platforms, and the prices of these bonds. Their findings revealed that when the local economic growth rate is low, government guarantees do not affect bond yields. Still, when the local economy gradually improves, government guarantees can reduce yields. Shi Zhen (2018) used the AHP method to assess the repayment capacity of CT bonds and analyzed it from three perspectives: the actual debt level of local governments, the guarantee capacity of governments in the eyes of investors, and the ability of PPP to reduce or even liquidate CT debt. Zhang Xueying and Jiao Jian (2019) discussed the potential impact of government guarantees on the credit spreads of CT bonds. They ultimately discovered that although this influence exists superficially and can reduce spreads, the degree of effectiveness varies due to differences in the level of bond issuance. Additionally, unforeseeable factors such as sudden credit crises can diminish the

extent of this impact. Finally, Liang Qi (2019) introduced the factor of government guarantees in the exploration of risk premiums existing in bonds. This further investigates the impact of newly issued regulations on CT bonds on the risk premiums of relevant bonds.

4.3 Research Hypothesis

4.3.1 The impact of government debt level on the spread of CT bond issuance

In the previous text, we have explored to some extent the impact of local governments on CT debt. Therefore, this article argues that investors have already anticipated the invisible guarantee of local governments when investing in CT bonds, so the spread of CT bond issuance to some extent includes this guarantee. This implicit guarantee refers to whether the local government can handle the situation and help the CT platform repay its debts if it cannot repay on time and forms a crisis of trust. The higher the debt level of local governments, the greater the debt pressure they need to bear. Local governments' implicit guarantee ability will weaken, and the credit risk of CT bonds will also become higher. In this process, the credit spread of CT bond issuance will expand. Therefore, based on the level of government debt, we make the following hypothesis about the implicit guarantee ability of the government.   (Wang Xiaoyan et al., 2019; Fei Fan et al., 2020; Gao Jie et al., 2020; Shen Xiaoping et al., 2020)

Hypothesis 1: The lower the level of local government debt, the stronger the implicit guarantee ability of local governments, and the smaller the spread of CT bond issuance.

4.3.2 The impact of local economic strength on the spread of CT bond issuance

Also as mentioned earlier, the main profit model of China's land finance is derived from land transfer and taxation in the process of high-speed urbanization. The promotion of urbanization has brought certain promoting effects to the local economy, and also stimulates the development and improvement of urban infrastructure construction. Provinces with high urbanization rates have relatively complete economic and social development, high local economic strength, and a relatively relaxed financing environment. However, the acceleration of urbanization construction has led to the expansion of CT bonds, exacerbating the risk of local

government debt and having a certain impact on local economic growth. (Chen Haoyu and Liu Yuan, 2019). Therefore, we make the following hypothesis.

Hypothesis 2: The higher the level of urbanization and the higher the local economic level, the smaller the spread of CT bond issuance.

4.3.3 Impact of COVID-19 on CT bond spread issuance

The COVID-19 has exacerbated the contradiction between the financial revenue and expenditure of local governments in China, forcing them to invest a lot of money in public health and epidemic prevention, while reducing the profits of CT companies and increasing the pressure on issuance. Therefore, the more severe the impact of the epidemic on regions, the greater the impact on CT companies and the greater the credit risk of CT bonds. (Zhong Ninghua et al., 2021).

However, during the COVID-19, the corresponding policies and measures issued by the Chinese government formed a strong hedging effect. The main points are as follows: Firstly, macroeconomic policies are loose. Affected by the epidemic, the Chinese economy is facing a huge impact. The central bank has implemented an expansionary monetary policy to cope with the impact, further strengthening policy countercyclical adjustments, and marginal easing measures such as interest rate and reserve requirement cuts to ensure ample liquidity. The market has adjusted its expectations for monetary easing, resulting in a significant narrowing of interest rates. Secondly, financial support has been increased. Regulatory authorities have successively issued multiple financial regulatory policies to assist in epidemic prevention and control, support enterprises in applying and issuing bonds, reduce audit restrictions on CT bonds, improve the refinancing environment of CT platforms, and increase the market recognition of CT bonds. Thirdly, local governments support policies. Due to the impact of the COVID-19 Pandemic, local governments have invested a large number of funds in epidemic prevention and control, while other aspects also require financial support, so there will be a funding gap for the government in the short term. Local governments are under more pressure to introduce various loose policies to support CT platform debt issuance, enhance the government's implicit guarantee and intervention willingness, and drive local economic development.

Based on the series of regulatory measures taken by the Chinese government mentioned above, the following hypothesis is made here：

Hypothesis 3: The impact of COVID-19 on the credit spread of CT bonds is negative, that is, the greater the impact of COVID-19, the smaller the spread of CT bonds.

4.4 Variable Selection and Model Setting: Using the Strength DID Model

The sample data selected in this paper covers CT bonds issued from 2017 to 2022. This paper uses the macro data of each city from the China Urban Statistical Yearbook, Wind Data Base, and the official data of the Department of Finance and the Bureau of Finance, uses the financial data and bond debt data of the CT platform from Wind Data Base, and the COVID-19 data involved in this paper is from the China Health Commission.

This article processed the target data as follows: Firstly, since the interest rates of non-fixed rate bonds may fluctuate under certain circumstances, it is difficult to reflect the actual interest rates at specific time points. Therefore, floating rate bonds and progressive rate bonds were excluded; Secondly, because bond issuing platform companies generally have subject ratings of AA or below, this article excludes CT bonds with subject ratings below AA; Thirdly, CT bonds with an issuance period of less than 3 months have been excluded; Fourthly, missing data was removed. (Li Mengqi,2023)

4.4.1 Variable Selection

Dependent variable selection

The dependent variable selected in this article is the credit spread during the issuance of CT bonds. Chinese scholars have various approaches to constructing credit spread variables. Qin Fengming (2016) used bank loans as the risk-free interest rate, while Wang Xuguo (2019) used Shibor as the risk-free interest rate. This paper follows the practice of Wang Weiqing et al. (2020 and Yang Gang et al. (2022) and other scholars on the credit spread of CT bonds. The calculation method is the coupon rate at the time of issuance of CT bonds and the yield to maturity of treasury bond bonds of the same maturity.

The rate is denoted as R, and the risk-free rate is denoted as r. The specific calculation is as follows:

$$Spread = R - r$$

Explanatory variable selection: the COVID-19 pandemic variable

On January 20, 2020, the State Council of China held an executive meeting to deploy the prevention and control of COVID-19. Therefore, this paper takes January 20, 2020, as the time point for the outbreak of COVID-19. For the samples before this time, Post takes 0; After this, take 1 as the Post for the samples. With the release of the "dynamic clearing", the sustainability of COVID-19 has become increasingly obvious. It is difficult to accurately reflect a region's actual situation by relying only on the cumulative number of people infected with COVID-19.

Therefore, we will record the number of newly infected individuals in the issuance of CT bonds last month as N, and the number of permanent residents (in tens of thousands) as P. The calculation formula is as follows(Li Mengqi,2023):

$$Suffer = \ln(\frac{N}{P} + 1)$$

Next, we introduce the explanatory strength variable in the strength DID model, whose calculation formula is as follows:

$$DiD_{it} = Suffer * Post$$

Control variable selection

Local economic strength variables

This article uses the per capita GDP (abbreviated as pGDP) and fiscal self-sufficiency rate (abbreviated as Coverage) as variables to measure local economic strength for cross-regional comparison. It uses data from the previous year of CT bond issuance. Among them, the regional population in per capita GDP is based on the number of permanent residents in the region; The fiscal self-sufficiency rate (Coverage) is defined as the ratio of local government general public budget revenue (abbreviated as Revenue) to local government general public budget

expenditure (abbreviated as Expenditure), measuring the coverage of local government's fiscal revenue and expenditure. (Hu Yue, 2018; Shen Xiaoping et al., 2020; Wang Weiqing et al., 2020; Fei Fan et al., 2020)

Therefore, we have:

$$Coverage = \frac{Revenue}{Expenditure}$$

Local government debt level variables

This article uses the relative scale of local government bond balances to measure the level of local government debt, including general and special bond balances. This article uses the debt ratio (GDPDebt) and the broad debt ratio (FiscalDebt) to measure the level of local government debt. The broad debt ratio adds the year-end CT bond balance to the local government bond balance, and all use the data from the previous year of CT bond issuance.

Among them, the debt ratio (GDPDebt) is the balance of local government bonds (abbreviated as Gov Blance) divided by GDP, so we have:

$$GDPDebt = \frac{Gov\ Blance}{GDP}$$

The broad debt ratio (FiscalDebt) is the sum of the balance of local government bonds (Gov Blance) and the balance of CT bonds (CT Blance) divided by the financial resources of local governments (abbreviated as Resources). The financial resources of local governments include the sum of general public budget revenue, transfer revenue, government fund revenue, and state-owned capital operation revenue of local governments. (Shen Xiaoping et al., 2020; Chen Zhigang and Wu Guowei, 2022; Hu Cailong and Wei Jianguo, 2022)

Therefore, the calculation formula is as follows:

$$FiscalDebt = (Gov\ Blance + CT\ Blance)/Resources$$

Other issuance factor variables

The specific issuance factors of different CT bonds will have a certain impact on their issuance costs. This article selects the issuance period and amount of CT bonds to describe. Regarding financing platform factors, different CT platforms have other qualifications, which can also lead to different credit spreads on bond issuance. This article selects five variables from the previous year's CT platform: log of total asset size (lnAsset), asset-liability ratio (LOAR), return on total assets (ROA), cash ratio (CashRatio), and total asset turnover rate (TATO) for analysis. (Wang Weili, 2017; Wang Xiaoyan et al., 2019; Yan Xiaodong, 2019; Zhang Shaohua et al., 2022)

（All variable selections are shown in Table 4.3）

Variable type	Category	Variable identification	Variable definition
Dependent variable		Spread	Spread= R - r
Explanatory variables	COVID-19	Post	Whether there has been a pandemic: January 20, 2020 is the time point. Samples before this date will have a post value of 0; After this, take 1 as the post for the samples.
		Suffer	Suffer= $\ln[f(N/P+1)]$
Control variable	Local economic strength variables	pGDP	Last year's per capita domestic production index=GDP/permanent resident population
		Coverage	Coverage=Revenue/Expenditure
	Local government debt level	GDPDebt	GDPDebt=(Gov Blance)/GDP
		FiscalDebt	FiscalDebt=(Gov Blance+CT Blance)/Resources
	Debt factors	Duration	Issuance period(annual)
		Amount	Issuance scale(100 million yuan)
	Financing platform factors	InAsset	The logarithm of the total assets of the CT company in the previous year
		LOAR	Last year's CT platform asset liability ratio
		ROA	Return on total assets of CT platforms in the previous year
		TATO	Total asset turnover rate of CT platform in the previous year
		CashRatio	Cash ratio of CT platform in the previous year

Table 4.3 Variable Selection

4.4.2 Model settings

In this article, we introduce the continuous generalized double difference model (or Strength Difference-in-difference Model) to study the impact of COVID-19 on the credit spread of CT bond issuance in China and explore the effects of China's local government's implicit guarantee capacity for CT debt on the credit spread of CT bond issuance.

In this model, we employ the COVID-19 impact variable (Suffer) multiplied by the Post variable, two dummy variables, to capture the extent of the overall COVID-19 impact on credit spreads. In the model, DID_{it} denotes the difference between the treatment group and the control group, reflecting the changes induced by the epidemic impact. The subscript i denotes CT bond sample individuals, while the subscript t indicates the year of CT bond issuance. β represents the impact of the epidemic on CT bond credit spreads. The remaining control variables are $pgdp_{it}$, $coverage_{it}$, $gdpdebt_{it}$, $fiscaldebt_{it}$, $duration_{it}$, $amount_{it}$, $lnasset_{it}$, loa_{it}, roa_{it}, $tota_{it}$, and $cashratio_{it}$, respectively representing GDP growth rate, government debt coverage, GDP debt ratio, fiscal debt ratio, bond duration, bond amount, natural logarithmic assets, asset-liability ratio, total asset return rate, total asset turnover rate, and cash ratio. α is the intercept term, δ_t is a fixed time effect, λ_i represents regional fixed effects, ϵ_{it} is the error term.

Therefore, following the aforementioned approach, the model is now constructed as follows:

$$
\begin{aligned}
Spread_{it} = {}& \alpha + \beta \times DID_{it} + \gamma_1 \times pgdp_{it} \\
& + \gamma_2 \times coverage_{it} + \gamma_3 \times gdpdebt_{it} \\
& + \gamma_4 \times fiscaldebt_{it} + \gamma_5 \times duration_{it} \\
& + \gamma_6 \times amount_{it} + \gamma_7 \times inasset_{it} + \gamma_8 \times loa_{it} \\
& + \gamma_9 \times roa_{it} + \gamma_{10} \times tota_{it} + \gamma_{11} \times cashratio_{it} \\
& + \delta_t + \lambda_i + \epsilon_{it}
\end{aligned}
$$

4.5 Empirical analysis

4.5.1 Describe statistical analysis

The descriptive statistics of the variables in this article are listed in Table 4.4. Among them, the average spread of credit spreads for CT bond issuance, which serves as the dependent variable, is 2.457%, with a minimum value of 0.849% and a maximum value of 7.029%. From this, it can be seen that there are significant differences in the credit spread of different CT bond issuances.

Among the factors of local economic strength, the maximum per capita gross domestic product (pGDP) is 490000 yuan, the minimum is 13000 yuan, and the maximum and minimum coverage rates of fiscal self-sufficiency are 108.5% and 7.2%, respectively. The maximum values of the two variables differ greatly, indicating a significant difference in economic strength among different regions.

Among the factors affecting the level of local government debt, the average debt to equity ratio (GDPDebt) is 20.25%. The average broad debt to equity ratio (fiscalDebt) is as high as 587.01%, indicating that after adding CT debt scale to local government debt, the debt pressure on Chinese local governments is relatively heavy.

Regarding debt factors, the issuance period ranges from 0.01 to 28 years, with an average period of 3.62 years; The maximum issuance scale of Amount is 7.767 billion yuan, the minimum scale is 100 million yuan, and the average is 715 million yuan.

In terms of the factors of financing platforms, there is a significant difference in the maximum values of total asset size (lnAsset), asset liability ratio (LOAR), return on total assets (ROA), total asset turnover ratio (TATO), and cash ratio (CashRatio) among CT platforms. The operating and financial conditions of each CT financing platform also differ significantly.

Variable	Obs	Mean	Std.Dev.	Min	Max
spread	18265	2.457	1.252	-.849	7.029
suffer	18265	.007	.072	0	2.575
pgdp	18265	114000	64084.85	13200.19	490000
coverage	18265	63.274	22.386	7.235	108.567
gdpdebt	18265	20.258	8.568	1.594	78.842
fiscaldebt	18265	587.011	422.551	.988	13391.34
duration	18265	3.62	2.227	.019	28
amount	18265	7.153	4.534	.1	77.67
lnasset	18265	24.34	.997	15.909	27.474
loar	18265	57.017	12.038	0	108.112
roa	18265	1.406	1.165	-12.259	60.831
tato	18265	.068	.064	0	1.755
cashratio	18265	1.181	70.482	0	8878.133

Table 4.4 Table of Describe Statistical

4.5.2 Correlation testing： Using the Pearson correlation

Before conducting the regression, this article conducted a preliminary judgment on the correlation of each variable through the Pearson correlation test. Table 4.5 shows the correlation between all variables in this article. This article correlates significantly with the dependent, explanatory, and control variables.

From the statistical table of correlation analysis, we can see that there is a significant negative correlation between the explained variable CT debt credit issuance spread and the explanatory variable COVID-19 impact variable (Suffer), which preliminarily verifies that the stronger the impact of COVID-19 mentioned in the research hypothesis, the smaller the CT debt credit issuance spread.

In the control variables, there is a significant negative correlation between per capita Gross Domestic Product (pGDP), fiscal self-sufficiency rate (Coverage), and CT bond issuance credit spread (Spread) in the local economic strength variable; At the same time, there is a significant positive correlation between the debt ratio (GDPDebt), the generalized debt ratio (FiscalDebt), and the credit spread of CT bond issuance in the variables of local government debt level.

In addition, the correlation coefficients between the explanatory variable and the control variable are all below 0.5, ensuring the rationality of the variables.

	spread	suffer	pgdp	coverage	gdpdebt	fiscaldebt	duration	amount	lnasset	loar	roa	tato	cashratio
spread	1												
suffer	-0.041***	1											
pgdp	-0.444***	0.039***	1										
coverage	-0.383***	-0.00100	0.838***	1									
gdpdebt	0.253***	-0.00700	-0.345***	-0.328***	1								
fiscaldebt	0.123***	-0.014*	-0.040***	-0.00100	0.150***	1							
duration	0.185***	0.028***	-0.163***	-0.116***	0.053***	-0.041***	1						
amount	-0.202***	0.00900	0.031***	0.041***	0.056***	-0.00900	0.139***	1					
lnasset	-0.350***	0.026***	0.114***	0.060***	0.139***	0.068***	-0.236***	0.370***	1				
loar	-0.171***	0.025***	0.193***	0.185***	-0.075***	0.028***	-0.206***	0.063***	0.326***	1			
roa	0.075***	-0.015**	-0.096***	-0.027***	-0.024***	-0.066***	0.038***	-0.030***	-0.170***	-0.088***	1		
tato	0.048***	0.0120	-0.041***	-0.020***	-0.035***	-0.044***	-0.023***	-0.058***	-0.118***	0.099***	0.294***	1	
cashratio	0.00600	-0.00100	-0.013*	-0.00800	0	-0.00700	0.023***	-0.00500	-0.054***	0.00400	-0.039***	-0.0110	1

Table 4.5 Correlation Test Results

*P<0.1, ** p<0.05, *** p<0.01 indicate significance at 90%, 95%, and 99% confidence levels, respectively.

4.5.3 Correlation testing： The VIF Testing

In this section, the variance inflation factor (VIF) method is used for collinearity testing to verify the existence of multicollinearity in the benchmark regression model. Generally speaking, when the VIF value of the variance inflation factor is below 5, it indicates that the model does not exhibit significant multicollinearity. According to Table 4.6, it can be found that the average VIF coefficient of the benchmark regression in this article is less than 2, and the maximum VIF coefficient is also less than 5. Therefore, there is no obvious multicollinearity.

Variable	VIF	1/VIF
pgdp	3.610	0.277
coverage	3.380	0.296
lnasset	1.500	0.665
amount	1.250	0.801
loar	1.210	0.825
gdpdebt	1.210	0.827
duration	1.180	0.850
roa	1.140	0.878
tato	1.140	0.879
cashratio	1.060	0.946
fiscaldebt	1.040	0.965
Mean VIF	1.610	

Table 4.6 The Result of VIF Testing

4.5.4 Benchmark Regression Analysis

Table 4.7 shows the regression results of the strength difference-in-difference model based on the relationship between the intensity variable of the COVID-19 impact and the credit spread of CT bond issuance. Among them, the first column mainly displays the dummy variable DID, which is the relationship between the explanatory variable and the dependent variable (Spread). In contrast, the second column introduces the remaining control variables to discuss the relationship between each variable and the explanatory variable (Spread).

From the regression results in Table 4.7, it can be seen that under the 99% confidence level interval, the impact variable and the post variable of the COVID-19 are still significantly negative, which indicates that after the COVID-19. However, the development of the real economy has stagnated, and the local economic strength has been weakened. The debt risk has increased, and the situation of epidemic prevention and control in China at this stage is more optimistic than that in other countries due to the strong containment measures taken by China. In addition, the loose monetary policy issued by the People's Bank of China and the strong financial support policy of the central government have improved the audit restrictions and financing environment of CT debt, making the market not pessimistic about the risks hidden behind CT debt, but optimistic about its strong government background attribute. So as a whole, the greater the impact of COVID-19, The situation where the issuance credit spread actually narrows.

In addition, according to Table 4.7, at the 99% confidence level interval, the per capita Gross Domestic Product (pGDP) and fiscal self-sufficiency rate (Coverage) in local economic strength variables have a significant negative impact on the credit spread of CT bond issuance. In terms of government debt level variables, the debt to GDP ratio (GDPdebt) and the broad debt to GDP ratio (fiscaldebt) have a significant positive impact on the credit spread of CT bond issuance.

These results indicate that in areas with higher local economic strength, the funds available for land infrastructure investment are more abundant, the government's land fiscal revenue is higher, and the implicit guarantee ability for CT bonds is stronger. The credit risk of CT bonds is relatively low, and the corresponding issuance credit spread is smaller. On the contrary, the

lower the local economic strength, the more severe the funding gap for local governments. Especially with the implementation of various tax reduction and fee reduction policies and policies to help small and medium-sized enterprises overcome difficulties during the epidemic, the local government's fiscal tax revenue is further reduced. Therefore, the maturity and repayment risk of CT bonds as a source of financing is higher, and the issuance credit spread of CT bonds is higher.

Meanwhile, the variable of local government debt level indicates that the higher the local government debt level, the greater the financing pressure on infrastructure, and the market will pay more attention to the performance of CT bonds issued by platforms. It also indicates that the higher the default risk of CT bonds issued, the greater the credit spread on issuance. On the contrary, the lower the debt level, the more relaxed the financing environment, the higher the solvency of local governments, and the lower the issuance credit spread.

Furthermore, it can be seen from Table 4.7 that both the issuance period (Duration) and issuance size (Amount) of the debt itself have a significant impact on the credit spread of CT bond issuance at a 99% confidence level. The results indicate that the longer the issuance period of CT bonds, the higher the default risk borne by the investors of their bonds, and the larger the credit spread. The longer the issuance scale of CT bonds, the larger the circulation range of their bonds, the more people participate in the bond trading, the higher the trading frequency, the stronger the bond liquidity, and the smaller the credit spread of the issuance. The regression coefficient of asset liability ratio (LOAR) in CT platform variables is significantly positive; The regression coefficient between total asset size (lnAsset) and cash ratio (CashRatio) is significantly negative; The return on total assets (ROA) and total asset turnover (TATO) do not have a significant impact on the credit spread of CT bond issuance. When the asset liability ratio of CT platform is high, the greater the risk that CT platform needs to bear when using creditors for operation, and the widening of the issuance credit spread; When the CT platform has a large economic volume and strong short-term solvency, the bonds issued by the platform are more easily recognized by the market, the credit risk of CT bonds is reduced, and the credit spread of issuance is narrowed.

VARIABLES	(1) m1 spread	(2) m2 spread
did	-0.1613***	-0.0801**
	(0.041)	(0.033)
pgdp		-0.1028***
		(0.008)
coverage		-0.1394***
		(0.012)
gdpdebt		0.2104***
		(0.007)
fiscaldebt		0.0856***
		(0.004)
duration		0.0188***
		(0.001)
amount		-0.0091***
		(0.001)
lnasset		-2.9290***
		(0.075)
loar		0.0010***
		(0.000)
roa		0.0031
		(0.002)
tato		0.0473
		(0.040)
cashratio		-0.1372***
		(0.011)
Constant	1.1731***	11.2097***
	(0.003)	(0.240)
Observations	17,970	17,970
R-squared	0.158	0.454

Table 4.7 Benchmark Regression Results

Standard errors in parentheses, *p<0.1, ** p<0.05, *** p<0.01, respectively, indicate significance at 90%, 95%, and 99% confidence levels.

4.5.5 Parallel trend test

Figure 4.1 shows the parallel trend test of the DID model. Among them, the local economic level (using the pGDP variable) is used as the benchmark for classification. The mean of all data for this variable from 2017 to 2021 is calculated, and the sample is divided into experimental groups based on below the mean and control groups based on above the mean. The main reason is to observe the trend of the issuance credit spread over time in different regions with different local economic levels. And also take the average of the credit spread samples for better observation.

The results showed that the average CT bond credit spread between the experimental and control groups showed a nearly parallel trend in different years. Specifically, from 2017 to 2021, the average spread values of the experimental and control groups showed similar trends. In the parallel trend test, we did not observe significant differences in CT debt credit spreads between the experimental group and the control group, which means that before the outbreak of COVID-19, the trends of the two groups were parallel, in line with the parallel trend hypothesis of the DID model. Therefore, in the subsequent DID analysis, we can attribute the observed effects to the impact of the COVID-19, rather than other factors.
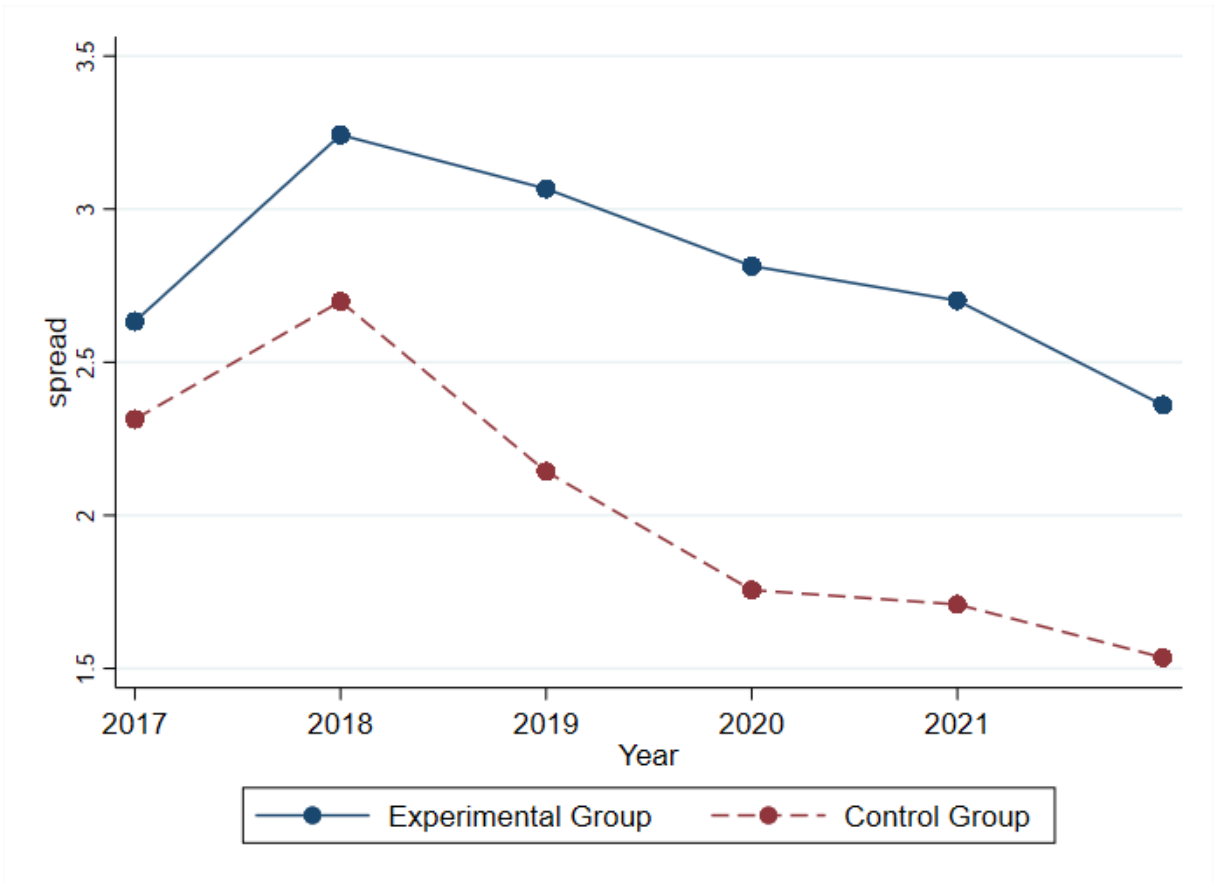
Figure 4.1 Parallel Trend Test Results

4.5.6 Placebo test

Figure 4.2 shows a placebo test for the causal effect of credit spread on CT bond issuance. The CT bond issuance spread model was subjected to 500 permutations using a placebo test method. The CT bond credit spread model was re-estimated for each rearrangement, and the causal effect coefficients after rearrangement were recorded. The robustness of the causal effect was evaluated by comparing the true causal effect coefficients with the distribution of the rearranged coefficients.

The simulation results show that the causal effect coefficient of the spread of CT bond issuance is within the distribution range after rearrangement. The actual causal effect coefficient (-0.0801) overlaps with the rearranged coefficient distribution, indicating good robustness of the model estimation results. The kernel density plot shows that the coefficient distribution after rearrangement is mainly concentrated near zero and forms a consistent distribution feature with the true coefficients.

The placebo test results indicate that the causal effect of CT bond issuance spread is robust and reliable, consistent with the true effect.
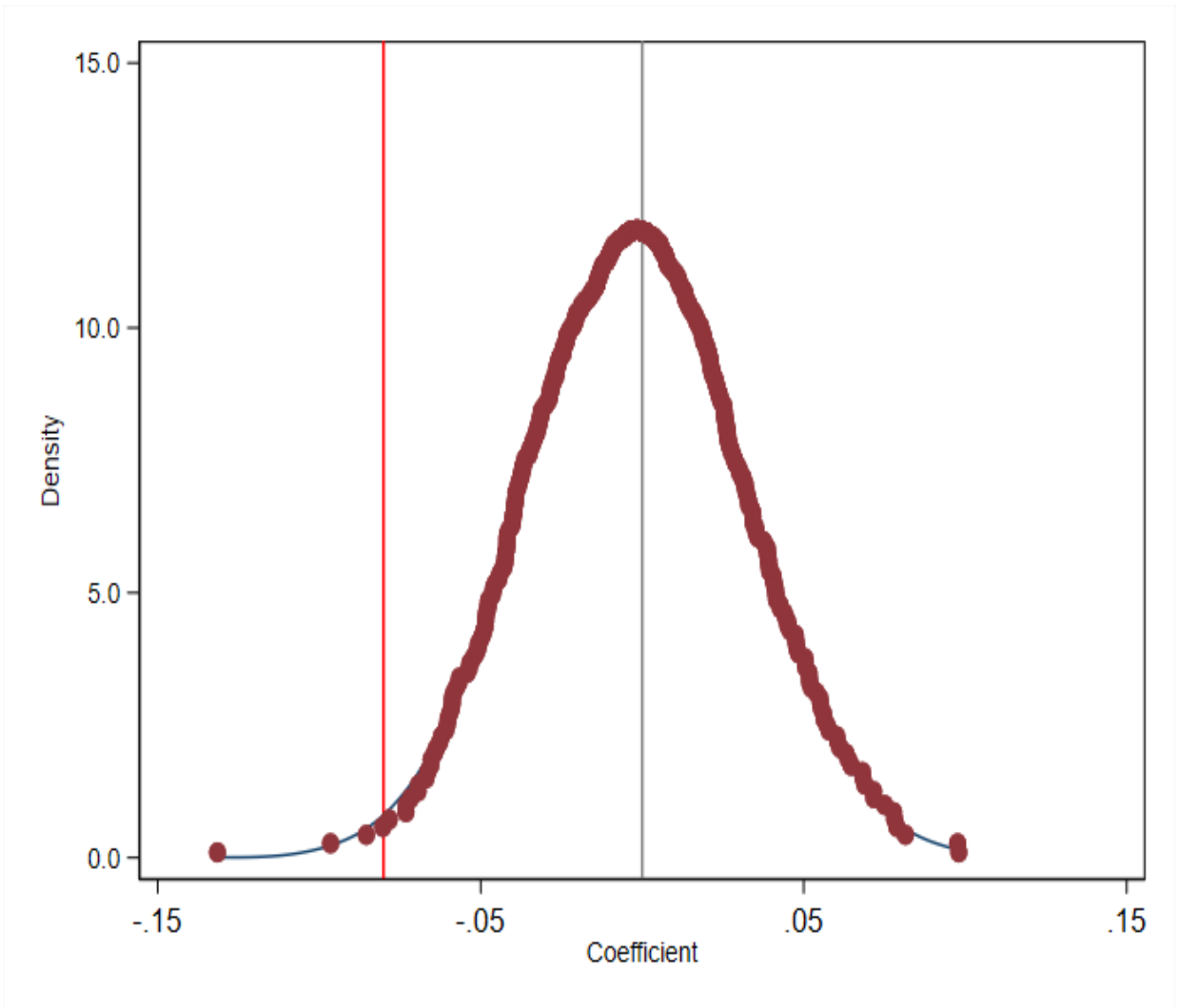
Figure 4.2 Placebo Test Results

5 Conclusion

In this study, CT bonds issued from 2017 to 2022 were mainly selected as the research object. The strength DID model is introduced to explore the impact of the COVID-19 and its impact on the credit spread of CT bond issuance. It also introduces variables of local economic strength and local government debt level to explore the impact of government implicit guarantee ability on the credit spread of CT bond issuance.

Based on the assumptions made earlier and the analysis results, we can draw the following conclusion:

First, the COVID-19 can significantly affect the credit spread of CT bond issuance. Due to a series of loose quantitative policies and financial support measures taken by the Chinese government after the outbreak of the COVID-19, a strong policy hedge has been formed. According to the empirical analysis results, the treatment group (regions receiving policy intervention) performs better in terms of CT debt credit spreads than the control group (regions not receiving policy intervention). This indicates that policy interventions have effectively reduced the uncertainty of implicit guarantees from local governments, increased investor confidence in CT bonds, and thus reduced credit spreads. Meanwhile, this means that policy interventions are effective in reducing the credit spread of CT bonds. This can serve as an indicator for evaluating policy effectiveness, indicating that policy measures have a positive impact on the market. And this can also promote a positive response of the market to policy intervention, making it more optimistic.

Secondly, the stronger the local economic strength, the stronger the implicit guarantee ability, and the smaller the credit spread of CT bond issuance; The higher the debt ratio and broad debt ratio, the higher the level of local government debt, the weaker the implicit guarantee ability, and the larger the credit spread of CT bond issuance. This indicates that both the local economic strength variables representing the government's implicit guarantee ability and the local government debt level variables have a significant impact on the issuance credit spread. The variable of local economic strength conforms to the positive correlation proposed in the hypothesis, while the level of local government debt conforms to the negative correlation.

However, although the COVID-19 has strengthened the government's ability to guarantee CT debt, the excessive intervention has also hidden behind the scenes the problems caused by the impact of COVID-19 epidemic, such as the deepening of the contradiction between local fiscal revenue and expenditure, the reduction of the economic benefits of CT platforms and other risk problems. Especially under the conditions of stagnation in the development of the real economy, the interruption of enterprise capital flow, the delay of infrastructure construction in progress, and unexpected settlement payments have led to problems such as concentrated debt maturity, deteriorating profits, liquidity shortage under the difficulty of refinancing, and a significant increase in credit resource runs and default risks on the CT platform. Therefore, local governments in China should reduce their interference with CT platforms, promote their market-oriented transformation, gradually strip them of the implicit government credit, actively guide the market-oriented transformation of CT platforms, introduce social capital to reform and restructure some CT platforms, gradually strip CT platforms of their government financing functions, and reduce their dependence on local governments.

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