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Monetary policy shocks and resource misallocations in the Periphery: Evidence from Chinese provincial bond yields

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ABSTRACT

We examine the effects of monetary expansions in the center on the excess yields of government bonds in the periphery. We show that the excess yields widen, and the widening is larger, the larger the misallocation of resources in the periphery. Specifically, we examine a panel of over 2500 local Chinese government bonds in 31 provinces, and find that the expansion of Chinese money supply surprisingly raises the excess yields of local bonds over Chinese sovereign bonds, and the gap is larger, the higher the degree of misallocation or other institutional failures in the province. By treating Chinese provinces as small emerging market open economies, we can draw implications for periphery countries in a common currency area, of an expansion in money supply in the center. Our results suggest that the increase in global liquidity post the 2009 and Covid-19 crises can lead to future fragility in the periphery countries.

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1. Introduction

In this paper, we focus on the question of whether positive monetary shocks in the center can sow the seeds of a future financial crisis in the periphery. We investigate this question by analyzing an unique data set on Chinese provinces and local government entity bond returns. We show that an expansion in the Chinese sovereign—or center—money supply tends to widen the spreads between riskier local provincial government entity bonds and Chinese sovereign bonds. Local bonds are bonds issued either by the local government or by enterprises owned by local governments (local SOEs). This widening of spreads is most pronounced in local bonds issued in provinces with a high degree of existing capital misallocations, of a large concentration of both local and national state-owned enterprises, or of institutional shortcomings such as local corruption. We interpret the widening spreads of local bonds over the sovereign bond as misallocation rises as indicative of increasing default probabilities of provincial governments and local public enterprises.

We measure the rise in the riskiness of the Chinese local bond market by the increase in the interest rate spread of Chinese local bonds over Chinese sovereign bonds. Using Chinese provincial data, we can thus examine the pure effects of liquidity shocks on widening bond spreads, abstracting from currency movements.

In recent years, many emerging market decision makers have complained about the effects of monetary policies in the major, industrialized countries (see [Gourinchas, 2018](#) for a review). When the U.S. Federal Reserve, for example, loosens,

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the dollar depreciates, weakening the emerging market economy. The rise in U.S. aggregate demand may not fully offset the contractionary effects of the emerging market currency appreciation. Rey (2016), however, has proposed a counterargument that the appreciation of emerging market currencies, by strengthening the balance sheets of their firms, will encourage leverage and credit growth, and may actually be stimulating in the short-run. In fact, as currency movements and capital inflows reinforce each other, expansion in credit may actually be excessive, counterintuitively, sowing the seeds of future financial fragility and crisis. While the work of Gourinchas, Rey, and others were written in response to the large increase in global liquidity post the 2009 crisis, similar spillover effects on emerging markets apply with equal or greater force after the massive increase in global liquidity during Covid-19.

Many earlier papers (Bevilaqua et al., 2020) have examined the impact of domestic or foreign monetary shocks on the spread between corporate and sovereign bonds. Very few papers have examined how such shocks impact the interest rate spread between local bonds (provincial or state) and sovereign bonds. Our use of regional or provincial data--among which nominal exchange rates are fixed-- allows to us to control for the effects of currency movements. We find that the spread between Chinese local bonds and sovereign bonds widens after a positive monetary shock. Doing a careful "difference-in-difference" analysis, we interpret these widening spreads between local entity bonds and sovereign bonds as indicative of increasing resource misallocations at the provincial level.

We find that expansionary monetary policies in Beijing, the center, that cause a surge in liquidity in the provinces can exacerbate the allocation of resources in these provinces. This may lead to future financial fragility and ultimately a rise in defaults of the debt issued in the provinces. This rise in default probabilities shows up in the widening yields. Using our estimates and some reasonable assumptions about local bond recovery rates, we show that on average, a 10 percent increase in Chinese real M2 growth raises the default probabilities on Chinese local bonds by 0.42 percent.

Our findings using Chinese provincial data provide lessons for peripheral economies in common currency areas such as Greece, Spain, and Portugal that face a sudden surge in liquidity. Using Spanish and Portuguese data, Gopinath et al. (2017) and Reis (2013) find that a surge in liquidity raises the misallocation of capital and lowers future firm profitability among Spanish and Portuguese firms. These results are surprising in light of say, Uribe and Yue (2006) who show that the spread between emerging market interest rates and U.S. interest rates falls with a loosening of U.S. monetary policies, implying that a rise in global liquidity lowers risk in peripheral markets. To the best of our knowledge, our paper is the first to estimate the rise in resource misallocations by the increase in the spreads between Chinese regional, local entity bonds and sovereign bonds.

The use of regional data such as the data on U.S. states, Japanese prefectures, or Chinese provinces to examine questions in international macroeconomics not only has a long history, but is rapidly growing (Dekle, 1996; Kalemli-Ozcan, 2010; Bau and Matray, 2020). Regions within a country approximates a monetary union and by using such data, we can control for the confounding effects of exchange rates and country level policies and institutions, thereby enabling us to isolate the pure liquidity or lending effects of the monetary expansion on emerging economies. In applying our results of Chinese provincial data to countries in a currency area, we interpret the provinces in China as akin to separate economies. There is enough variation among Chinese provinces in provincial per capita GDPs to classify them along a spectrum of center and peripheral economies. In 2019, Beijing had a per capital GDP of over 5 times that of Gansu province, the poorest province. In the same year, Germany's per capital GDP was about 2 times that of Greece.

We examine four indicators that may influence the misallocation of capital within a Chinese province. First, we use the extent of past capital misallocations in the province using the standard Hsieh and Klenow (2009) measure. Second, we use the prevalence of state-owned enterprises both local and national within the province. Third, we use the extent of political corruption within the province. We find that as a province's indicator of misallocation or institutional deficiencies rise, the spread between the bonds of entities located in the province and the sovereign bond increases. Fourth, we use the misallocation of capital measure between State and Non-State Owned firms within a province constructed by Brandt et al. (2013).

This paper contributes in the following three ways. First, we adopt a "difference-in-difference" specification in which the various effects of the monetary shock on bond spreads between provinces with high- and low-degrees of misallocation are made explicit. Second, for robustness, we employ eleven different measures of the monetary shock. Four of them are employed in the text: 1) Real M2 growth; 2) Real M2 growth "purged" from the endogeneity of the reaction function of the monetary authorities; 3) Monetary shocks estimated from high frequency financial market data; and 4) Monetary shocks adding additional variables to control for the provincial shocks the PBoC may be responding to. Estimation employing the remaining 7 measures of the monetary shock are in the Online Appendix. Third, by treating Chinese provinces as open economies, we assess whether an expansion in money supply or liquidity in the center raises economic inefficiencies in the periphery economies.

The rest of this paper is organized as follows. Section 2 describes the development and data sources of Chinese local bonds. Section 3 summarizes the Chinese monetary policy tools. The linkage between monetary policy, misallocation and bond spreads is discussed in Section 4. Section 5 discusses the empirical framework, while the panel regression results are presented in Section 6. Section 7 concludes.

1.1. Literature review

Recently, there has been a reconsideration of the benefits of financial integration. While financial and banking integration may offer output and consumption gains in the short-run, in the longer- run, such integration may invoke resource misal-

locations and economic crisis (See [Rose, 2012](#)). [Cesa-Bianchi et al. \(2017\)](#) present a simple model that relates capital inflows caused by say, an international monetary expansion to domestic asset prices, exchange rates, and economic performance. In particular, attention has been paid to the role of banks, especially, government-owned or government-influenced banks in the misallocation of capital inflows, potentially leading to sudden stops ([Cetorelli and Goldberg, 2010](#); [Dekle and Lee, 2015](#); [Eichengreen, 2010](#)).

Cross-border credit supply shocks can also raise real estate prices, attract capital and lead to a misallocation of resources away from productive physical capital to overvalued real estate, and eventually lead to a bust, problem loans, and economic recession. These international liquidity shocks can arise from spillovers of monetary shocks from one country to another ([Rey, 2016](#)). Partially offsetting these liquidity effects are the emerging market central banks endogenously lowering their interest rates to decrease capital inflows ([Kalemli-Ozcan, 2020](#)).

Papers on the Chinese economy that relate to this paper are by [Bai, Hsieh, and Song \(2016\)](#). [Ang, Bai, and Zhou \(2016\)](#), [Chen, He, and Liu \(2017\)](#), and [Spiegel et al. \(2019\)](#). [Ang, Bai, and Zhou \(2016\)](#) focus on how real estate values and political corruption affect the excess returns on local construction (or “Chengtu”) bonds, or local bonds collateralized by real estate. [Chen, He, and Liu \(2017\)](#) focus on the consequences of the 4-trillion stimulus package in 2009 and its effect on the Chinese local bond market, while not being concerned about the effects of the stimulus on the excess yields of local bonds as in this paper per se. While our sample includes the 2009 stimulus episode, we are also concerned with the entire period up to 2016, when Chinese monetary policy was more normalized. [Bai et al. \(2016\)](#) is another paper contributing to the important policy literature on how institutional shortfalls in the Chinese economy may result in lower future economic growth and how expansive fiscal and monetary policies may exacerbate this decline in growth. [Spiegel et al. \(2019\)](#) emphasize the role of the soft-budget constraint of Chinese state-owned enterprises in how monetary policies can influence the misallocation of capital. None of these papers examine how Chinese monetary policies can affect the spread between local bonds and central government bonds and how those changing spreads indicate the extent of misallocation within a province.

There is also by now a large literature on how the “misallocation” of capital results in lower productivity (see [Restuccia and Rogerson \(2017\)](#), for a review). Much of this literature uses Chinese accounting data from manufacturing censuses ([Hsieh and Klenow, 2009](#)). However, accounting data are prone to measurement errors, which may result in biases, especially when measuring changes. It would be much better to have a market based measure of the effects of changes in capital misallocation that are immune from the measurement errors ([Bils, Klenow, and Ruane, 2017](#)).

In this paper, we provide such a market based indicator of misallocation.¹ We examine the excess yields of local bonds, that is, the yield to maturity of local bonds exceeding that of central government bonds. We examine how changes in money interacted with indicators of “misallocation” impact the excess yields of the bonds issued by public entities in that locality.

2. Chinese local bonds

Chinese local bonds issued by local government entities can be divided into local state-owned enterprise (LSOE) bonds and local government (LG) bonds directly issued by the local governments.² The local state-owned enterprise bonds can in turn be divided into local construction (or “Chengtu”) bonds and other local state-owned enterprise bonds.

Local SOEs (LSOE) are companies that are at least partially owned by the local governments and engage in businesses that provide private goods to the market such as mining, finance, automobiles and clothing. Our data set includes all SOEs not owned by the central government, and Chengtu bonds. These firms can issue bonds as well as borrow directly from the banks. Chengtu bonds are issued by local government financing vehicles (LGFV) through which Chinese municipalities raise funds to add to the budget transfers they receive from the central government. These bonds must be collateralized by local government assets such as land use rights, toll highways, and subway systems. LGFVs may be started to finance specific projects such as constructing industrial zones or building a road, or to finance an unspecified set of infrastructure projects. LGFVs may also be started to finance social services projects such as education, healthcare, and poverty programs in municipalities. Chengtu bonds expanded substantially from 2010. This expansion was related to the change in regulations in 2009,

¹ [Gilchrist et al. \(2013\)](#) also relates frictions to misallocations in interest rate spreads between firm debt and U.S. Treasury debt.

² Total borrowing by the Chinese government comprises over 50 percent of Chinese GDP ([Asian Development Bank, 2015](#)). In China, unlike in industrialized countries, local government debt is larger than central government debt. Borrowing by Chinese local governments is about 30 percent of Chinese GDP. The size of Chinese local government debt is over USD \$3 trillion, which makes it one of the largest debt levels in the world. Global investors are concerned about Chinese local government debt not only because of their size, but also because of their riskiness. As Chinese economic growth slowed after 2009 and further after 2015, many local governments engaged in debt-fueled spending to stimulate their local economies. Much of this spending was in construction and in land development, and there is belief that the consequent land price appreciations were not always underpinned by economic fundamentals ([Wu, Gyourko, and Deng, 2015](#)). If land prices collapse, the return on these local government investments would be small or negative, and local governments would have trouble paying back their debt. There are also other cases in which Chinese local governments either directly or indirectly engaged in investment projects that yield small or negative economic rates of return ([Hsieh and Song, 2015](#)). Among the components of the Chinese local government debt, only the local bonds issued by the Chinese local government entities, including the bonds issued by both the local governments and the local SOEs, are traded on the exchanges and can be evaluated based on market information. Although financial information in China, in general, is not transparent to the general public, institutional investors like commercial banks could have more detailed information that allows them to price the risk of local bonds more accurately. Given that over 92% of domestic bonds traded in the market (end 2016 figure) were held by these institutional investors, the market information on excess yields should reflect the risk of default. Other local debt, such as local government borrowing from Chinese commercial banks, are hidden from public view. In this paper, we focus on the risk in the Chinese local bond market, specifically on the rise in the risk of local bonds in response to a change in Chinese monetary policies.

whereby to combat the global financial crisis, the central government encouraged the local governments to establish and borrow through LGFVs.

To curtail rampant infrastructure spending and land price appreciations in recent years, the central government, starting from 2010, passed laws to prohibit local governments from guaranteeing Chengtu borrowing from all sources, including from bond issuance. Local governments were required to secure approval before investing in infrastructure projects. Consequently, Chengtu bond issuance started to decline from 2015.

LGFV and LSOE bonds are not explicitly guaranteed by the local or central governments. There is uncertainty whether LGFV and LSOE bonds are even implicitly insured by the governments, although there have been many cases where failing LSOEs received capital injections from the governments. While the central government has also in the past been willing to step in with new budget laws and debt swap programs to ease the LGFV debt burden, the central government has announced with increasing urgency that this support will not continue.

The Budget Law of 1994 made it illegal for local governments to run budget deficits, but to combat the 2008 global financial crisis, the central government started to allow local governments to use all sources of funds, including bank borrowing, land sales and budgetary revenues to fund local investment projects. Gradually, local governments were also allowed to issue bonds. Initially, these bonds were issued by the central government (by the Ministry of Finance) on behalf of the local governments, but since 2011, specific local governments have been allowed to issue their own bonds.³ Again, whether these bonds are explicitly guaranteed under all states of nature by the central government is unclear. Presumably, the state of the central government guarantees is stronger for LG bonds issued before 2014. Since 2015, the central government has required that LGFV bonds issued for social welfare purposes or to supply public goods must be classified as LG bonds instead of Chengtu bonds. This requirement also contributed to the decline in the issue of Chengtu bonds relative to the issuance of local government bonds starting in 2015.

Close to 45 percent of Chinese local bonds are traded on the interbank exchanges, where the dominant participants are the Chinese commercial banks. Thus, most of the local bonds reside on the balance sheets of the Chinese commercial banks. The rest of the stock of local bonds are traded on the listed exchanges of Shanghai and Shenzhen and on the Over the Counter (OTC) market.⁴ Participants in these markets include Chinese commercial banks and insurance companies and institutional investors, including foreign investors.

In the mid-2010 s, China's debt burden expanded over 2.5 times of its economy. Scholars suggest that the country's difficulty in controlling debt is political. Local governments and stakeholders of state-owned enterprises benefit immensely from government-subsidized loans and these groups form the backbone of the Chinese Communist Party (Wall Street Journal, July 8, 2017).

2.1. Chinese local bonds and sovereign risk

Given that the financing of Chinese local governments is increasingly dependent on local bonds, much attention has been recently paid to Chinese local bonds, especially to Chengtu bonds. The entire stock of Chinese local bonds accounts for more than a half of the stock of total Chinese local government debt.⁵ The bulk of local government debt is in the form of bank loans, mostly from Chinese commercial banks.

The scale of local government debt is huge. Unlike in other major countries, where central government debt is larger than local government debt, in China, while central government debt comprises a little over 20 percent of Chinese GDP, local government debt comprises over 30 percent of GDP.

Since commercial banks and their affiliates, such as trust companies, are also the largest holders of Chinese local bonds, a collapse in Chinese local government finances will have severely negative consequences on the Chinese economy, through their effect on commercial bank balance sheets. Since commercial loans to Chinese local governments are not traded and priced to market, we can only indirectly infer the aggregate distress on the Chinese commercial banking system from a Chinese local bond collapse, by observing the risk in the Chinese bonds that are traded on the exchanges. Widening spreads on the Chinese local bonds may serve as an early warning signal of rising Chinese sovereign market risk.

2.2. Chinese local Bonds: Data sources

Market prices and yields to maturity (YTM) exist only for the local bonds traded on the interbank, listed, and OTC markets. We obtain data for bonds traded on the markets from WIND, a commercial data service widely used by financial market participants. As noted by [Ang, Bai and Zhou \(2016\)](#), market liquidity in the Chinese local bond markets was low until 2007.

³ Since 2011, some selected local governments could issue bonds in their own names under the "Pilot Measures for Local Self-issued Bonds" program, in which the bonds were serviced by the Ministry of Finance. Since 2014, local governments could directly serviced their bonds.

⁴ In China, transactions on the OTC market can be conducted at the counter of commercial banks. There are very few bonds traded in the OTC market. In our sample, only 9 local bonds are traded over the counter.

⁵ In 2013, of the total local government debt, around 10% were LG bonds, and 20% were LSOE bonds (including Chengtu bonds) ([Asian Development Bank, 2015](#) and WIND). According to the latest estimate by [Chen, He and Liu \(2017\)](#), the share of local bonds has increased to more than half of the total local government debt by 2016.

Therefore, we choose our sample to cover the relatively liquid period from 2007 to end-2016. The WIND data only include bonds that have yet not reached maturity. Matured bonds are excluded from the sample.

Table 1 depicts the outstanding stock of Chinese local bonds by year (from WIND). Of the state-owned firms, only those that accessed the bond markets to borrow are included in our sample.⁶ In the interbank and exchange markets, Chengtu bonds started to become larger than LSOE (non-Chengtu public-owned firms) bonds by 2010. By 2012, trade in Chengtu bonds dominated the LSOE bonds. Trades in bonds issued by LSOEs have remained small players on the bond markets.

Starting in 2012, trade in general obligation bonds issued by local governments grew rapidly. This expansion of LG bonds mostly reflects the loosening of regulations by Beijing to allow local governments to issue bonds directly to finance their local operations. Initially, only the provinces with strong local budget positions like Shanghai, Guangdong, Shandong and a few others issued their own bonds. Gradually, the scheme allowing local governments to issue bonds directly has been widened. The expansion of LG bonds also reflects the fact that local governments that used to issue bonds through LGFVs have switched to issuing them directly.

The outstanding balances and the remaining maturity lengths of Chinese local bonds by province in end-2016 are summarized in **Table 2**. Coastal provinces with high provincial GDPs such as Jiangsu and Zhejiang tend to have large amounts of SOE bonds traded on the markets. In all provinces, Chengtu bonds comprise the bulk of the SOE bonds. The balances in local government bonds are also higher in the provinces with high provincial GDPs. All provinces have at least some local government bonds outstanding. In our sample, the average remaining maturity of local bonds is about 5 years.

We are primarily interested in the “Excess Yields” of local bonds, defined as the spread between the “Yield to Maturity (YTM)” of the local bonds and the yield on Central government bonds. Among other variables, the prices and the calculated yields to maturity are available daily for each bond. For each bond, we average the YTM over every month. We subtract from this monthly YTM, the monthly yield on 5-year central government bonds to obtain the excess yields for each local bond.⁷

The excess yields for all the local bonds traded on the interbank and listed exchanges have the widest variation in the excess yields (**Chart 1**). From the 10th to the 90th percentiles, the excess yields range from 1 to 4 percentage points. This suggests that market participants are not viewing Chinese local bonds as substitutes for Chinese sovereign bonds and those Chinese local bonds are not homogeneous. Moreover, market participants view central government guarantees of the local bonds as imperfect. Chinese local bonds earn different rates of return, depending on their risk characteristics.

Chart 2 shows the excess yields of the local government general obligation bonds traded on the three markets. Despite being backed by the tax and revenue generating capacity of the local governments, there is still substantial variation in the excess yields (of about 1 percent) across provinces. Some rich provinces like Shanghai have had until a few years ago, negative excess yields, owing to their strong financial position, even relative to the central government. Given that since 2015, the local government bonds have started replacing bonds issued by LGFVs, it is important to include the local government bonds in the estimation sample, to capture the risk faced by the provinces and China overall.

For the excess yields of the local SOE bonds, which includes the Chengtu and other LSOE bonds, the median spread of these bonds relative to the 5-year Chinese sovereign bond reached their highest point in 2012, as trading in these bonds expanded and the risk associated with these bonds became more widely known (**Chart 3**). The variation in the excess yields of the SOE bonds is typically significantly above 4.5 percent.

3. Recent Chinese monetary policy regimes

The People's Bank of China (PBoC) uses multiple monetary policy instruments. These policy instruments include changing the central bank lending and commercial bank reserve requirement ratios, the setting of bank deposit and lending rates, the establishment of annual quantitative targets for credit and money (M2) growth, and more recently, the setting of short-term money market instruments such as the 7-day repo rate.

Traditionally, the PBoC has been highly reliant on administrative and quantity based policy tools. Until 1998, the PBoC strictly controlled the total credit growth of the entire commercial banking system. In 1998, the PBoC officially switched to controlling M2 growth, which, given the level of bank reserves, is akin to controlling total credit growth. At the beginning of each year, the PBoC, in concert with the central government, plans the rate of M2 growth for the coming year. The PBoC then adjusts the rate of M2 growth quarterly, in response to new information, primarily to inflation and GDP, but also to other indicators. Recently, open market operations have been the primary instrument used in adjusting M2.⁸

In addition to official controls on the growth of M2, post-1998 the PBoC has continued to rely on quantitative lending quotas to commercial banks. These quotas were implicit, and were known as “window guidance” (**Chen, Funke, Losev, and Tsang, 2020**). In practice, in addition to implicit PBoC lending quotas to commercial banks, this guidance also included “moral suasion” or applying pressure to banks to adjust their lending, both in the aggregate and to specific sectors, so that PBoC money supply and credit goals are met.

⁶ The sample includes all enterprise bonds issued by local SOEs and those Chengtu bonds classified as company bonds in Wind. The bond classifications of local SOE bonds and company bonds are based on the ChinaBond classification system. (ChinaBond is a subsidiary of China Central Depository & Clearing).

⁷ We calculate excess yields off the 5-year government bond, since as noted above, the maturity of local bonds center at around 5 years.

⁸ In carrying out its open market operations, the PBoC purchases and sells short-term central government bonds and bills issued by the PBoC. Central bank bills were issued by the PBoC in 2002 to deal with the inadequate supply of government bonds at the time. In addition, high quality bonds issued by SOEs and by private corporations are sometimes used in open market operations.

Table 1
Amount of Outstanding of Chinese Local Bonds by Year (RMB billion, year-end figures).

	A) Local SOE Bonds		B) Local Government Bonds	
of Which Chengtu Bonds				
2007	64.2	n.a.	n.a.	
2008	94.7	5.7	n.a.	
2009	168.9	62.2	n.a.	
2010	365.5	228.1	n.a.	
2011	671.3	469.6	n.a.	
2012	1,496.3	1,198.8	420.6	
2013	2,457.4	2,061.1	1,045.5	
2014	3,777.7	3,312.6	2,245.5	
2015	4,578.0	4,057.0	12,110.7	
2016	6,469.4	5,895.1	27,138.9	

Source: Wind.

Note: n.a. means data not available.

Table 2
Amount of Outstanding and Remaining Maturity of Chinese Local Bonds by Province (End 2016).

	A) Local SOE Bonds			B) Local Government Bonds		
of Which Chengtu Bonds						
	Amount of Outstanding (RMB billion)	Average remaining Maturity (months)	Amount of Outstanding (RMB billion)	Average remaining Maturity (months)	Amount of Outstanding (RMB billion)	Average remaining Maturity (months)
Anhui	269.6	51.6	256.1	53.7	811.6	65.6
Beijing	244.8	50.3	209.4	54.3	2,207.2	50.6
Chongqing	310.6	46.4	306.1	47.2	567.8	68.3
Fujian	187.5	52.0	181.7	52.6	844.9	70.2
Gansu	42.2	51.3	40.6	52.7	294.7	64.3
Guangdong	265.1	66.5	207.7	62.0	1,257.6	66.5
Guangxi	125.6	50.1	112.4	50.2	640.4	68.3
Guizhou	241.2	59.6	234.1	60.4	1,370.3	66.7
Hainan	50.2	44.2	14.4	40.8	164.7	70.0
Hebei	130.9	52.7	113.1	53.6	900.8	59.1
Heilongjiang	98.9	43.9	96.3	44.1	512.6	65.7
Henan	183.2	48.7	157.9	49.9	964.5	66.4
Hubei	253.1	60.3	241.7	61.4	946.3	65.3
Hunan	461.3	59.0	444.1	60.3	1,358.8	64.8
Inner Mongolia	104.1	46.7	90.3	49.7	1,010.8	68.1
Jiangsu	973.9	47.9	938.0	48.7	2,204.1	66.2
Jiangxi	207.5	53.9	200.7	54.8	613.3	66.2
Jilin	49.1	43.5	47.9	43.1	375.6	69.9
Liaoning	267.8	49.1	250.2	50.6	1,159.4	66.8
Ningxia	26.2	49.3	12.1	67.1	191.5	68.3
Qinghai	14.6	43.2	12.0	41.8	205.7	66.5
Shaanxi	126.7	45.7	103.3	46.8	746.8	66.1
Shandong	396.2	50.9	340.1	51.2	1,611.2	67.3
Shanghai	117.4	39.7	83.5	42.1	943.5	62.3
Shanxi	116.7	51.5	69.0	46.9	399.4	69.6
Sichuan	254.3	53.2	248.8	53.9	1,342.6	67.3
Tianjin	187.8	53.9	176.6	56.1	488.1	69.0
Tibet	10.9	80.7	10.9	80.7	4.7	67.6
Xinjiang	130.9	48.6	119.4	49.0	489.8	66.9
Yunnan	152.3	41.0	140.3	41.7	926.7	66.2
Zhejiang	469.0	49.4	436.8	51.6	1,583.5	64.7
Aggregate	6,469.4	51.2	5,895.1	52.2	27,138.9	66.1

Source: Wind.

Much attention has been paid to the PBoC's recent gradual moves to more market-oriented monetary policies. Since 2013 and 2015, the PBoC has in principle allowed commercial banks to set their own lending and deposit rates. In 2013, the PBoC has provided liquidity on a short-term basis through repurchase agreements, thereby making the 7-day repo interest rate the de facto indicator of the PBoC's monetary stance (McMahon et al., 2018).

Still, it is the view of some that the PBoC has continued to exercise quantitative controls on money supply and credit. Under the guise of macroprudential policies, since 2011, the PBoC— after reviewing a wide range of criteria such as capital

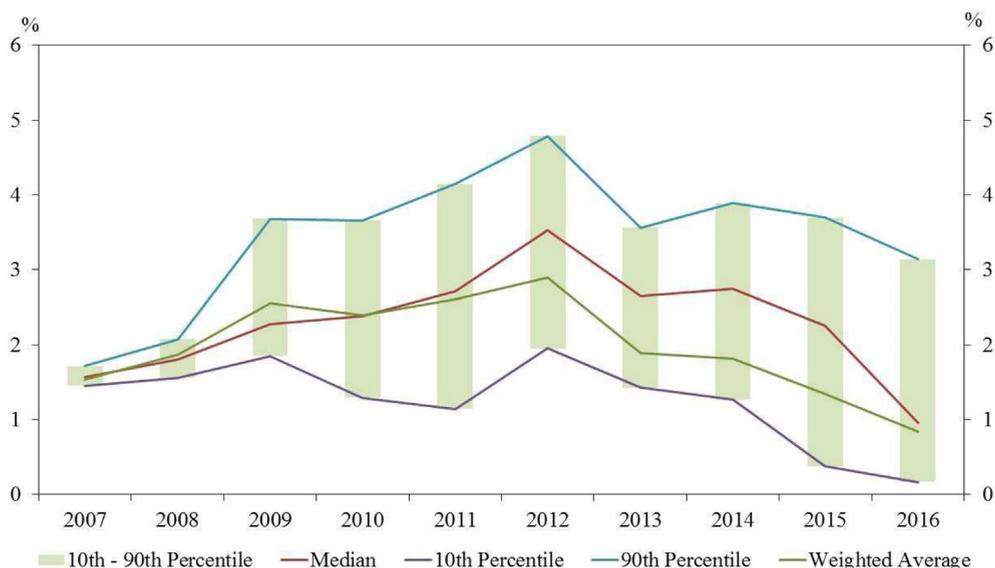


Chart 1. Excess Yields of the local bonds (LG Bonds and LSOE Bonds) in the Secondary Market by Year. Source: Author's calculation based on data downloaded from Wind. Note: The weighted average is weighted by the issuance amount of the bonds.

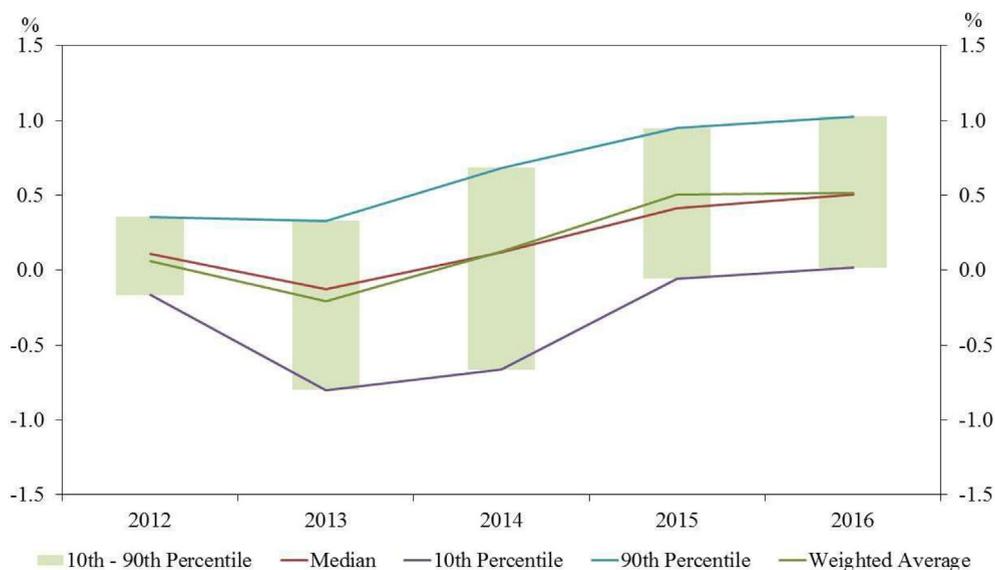


Chart 2. Excess Yields of the LG Bonds in the Secondary Market by Year. Source: Author's calculation based on data downloaded from Wind. Note: The weighted average is weighted by the issuance amount of the bonds.

adequacy, asset growth, and liquidity of the banking system— has been putting sharp brakes on the growth of bank credit and loans.

Chart 4 depicts the year-on-year growth rates in nominal money supply and in nominal credit. At the onset of the international financial crisis in early 2009, both money and credit grew very sharply for about a year. The growth in money and in credit slowed during 2010 and decreased sharply in 2011. The sharp slowdown in M2 growth in 2011 reflects the PBoC's (and the Chinese government's policy) of curtailing the sharp increase in property prices by cutting back credit. The trend growths in M2 and in total credit have returned to more "normalcy" (that is, what prevailed pre-2008) since 2011.

As the Chart shows, actual growth in M2 is sometimes way off from the M2 growth targeted at the beginning of the year. Between April 2009 and January 2010, the actual growth in M2 was much higher than the M2 growth targeted for the coming year in January 2009. This of course is the result of the PBoC's aggressive response to the global financial crisis. As the

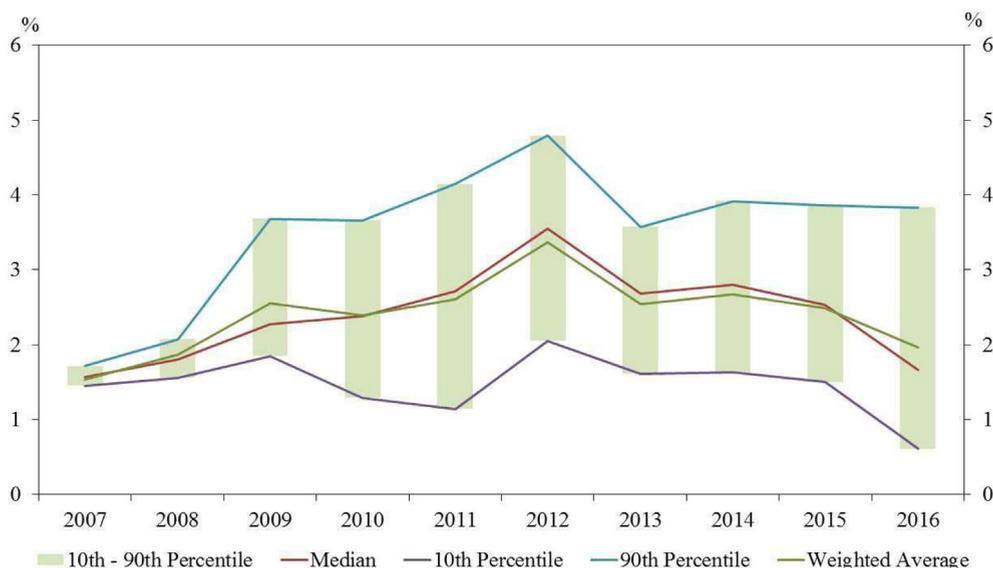


Chart 3. Excess Yields of the LSOE Bonds in the Secondary Market by Year Source: Author’s calculation based on data downloaded from Wind. Note: The weighted average is weighted by the issuance amount of the bonds.

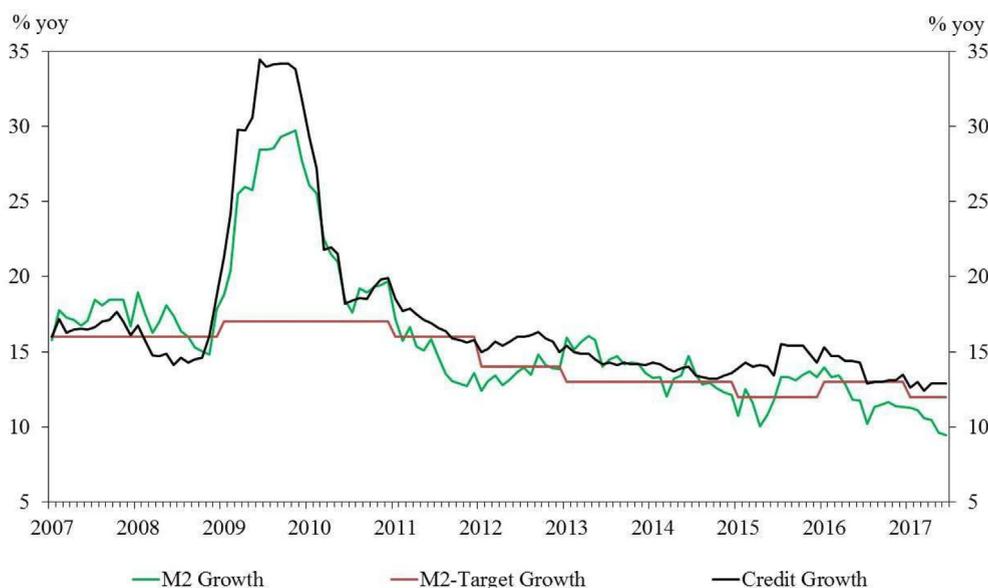


Chart 4. Growth in China’s Money Supply and Credit. Sources: People’s Bank of China and Wind.

crisis dissipated for China, the PBoC sharply cut back on its growth of M2. Nominal credit behaves very similarly to nominal M2.

4. Monetary Policy, Misallocation, and rising bond spreads

Our empirical work is guided by recent studies that show how a financially constrained commercial bank helps facilitate the financing of capital by entities. In theory, intervention in financial markets by the central bank affects the quantity and distribution of assets of the commercial banks (Gertler and Karadi, 2011; Kurtzman and Zeke, 2017). As part of the change in the distribution of assets from an increase in central bank injection of reserves, commercial bank loans to non-financial institutions such as firms and local public entities increase.

Our bond market data covers three local public entities that raise funds in the Chinese bond markets: the local governments, the local government financing vehicles, and the other local state-owned enterprises.

The funds raised from the bond markets, together with commercial bank borrowing by these three entities, are used to fund local real investment projects such as land development, housing, factories, bridges and roads.

Fig. 1 outlines the scheme linking changes in M2 with the bond issuance by the three local public entities and their local real investment projects. Suppose that the PBoC increases M2 by performing open market operations, buying short-term bills from commercial banks for an increase in reserves. When the PBoC injects reserves into the commercial banking system, lending by commercial banks to local governments could increase. While abbreviated from Fig. 1, Chinese commercial banks can also lend directly to local government financing vehicles and local state-owned enterprises. In addition, commercial banks can open accounts on behalf of clients and lend to “trust” companies and other non-bank financial institutions. Besides the increased lending, the commercial banks use their increased reserves from the PBoC monetary injection to buy bonds from the local government, LGFVs and other local SOEs on the exchanges. As noted above, trust companies, other non-bank financial institutions and foreign financial institutions participate in these bond markets as well.

The local government, LGFVs, and other local SOEs use partly the proceeds from the bank borrowing and the issuing of bonds to fund investment projects. How should the funds be allocated to different investment projects? For efficiency, in a perfectly competitive private market setting, the return on capital investments should be equalized among projects. If the marginal productivity of capital is higher in project 1 compared to project 2, then capital should be allocated to project 1 until the returns to capital in the two projects are equated. If they are not equated, then there is some inefficiency and capital is misallocated.

There is now a huge literature on how the misallocation of capital and other resources causes efficiency and productivity to be lower than otherwise (for a review, see Restuccia and Rogerson, 2017). There are many reasons why capital and other resources may be misallocated. Capital and other resources may be misallocated because of the tax code and regulations; market frictions such as those in the capital market; discretionary behaviour by the government that penalize specific firms and reward others—so-called “crony capitalism”; or a combination of the above reasons and more.

Given that these are local government entities, profit maximization may not be their primary criterion for choosing investment projects. Their goal may be increasing social welfare, such as maintaining social stability, which may be compromised if there is widespread unemployment. For example, during the global financial crisis, the goal of the local government was the maintenance of the number of jobs in the locality. The goals that are not oriented towards profit maximization, combined with a multitude of regulatory constraints and capital market imperfections, imply that an increase in M2 in China may lead to misallocation of capital. Given that it is difficult to pin down what is causing the increase in the misallocation of capital when money supply increases in China, we examine three indicators that may affect misallocation within a province: 1) the past misallocation of capital in the province; 2) the prevalence of state-owned enterprises in a province; 3) and the extent of public corruption in a province. The details will be explained below.

We need to relate how the misallocated investment by the local government entities results in widening bond spreads. If central government guarantees of Chinese local bonds were perfect, then there will be no spreads between the bonds. The existence of cross-bond and cross-provincial spreads imply imperfect guarantees of the bonds.

In the sovereign debt literature, widening bond spreads are related to a rising risk of default. For example, in Aguiar and Gopinath (2006), when a debt of a country rises, default probabilities rise and interest rates rise in tandem. It is straightforward to write sovereign debt models where a negative TFP shock—a rise in misallocation—will result in increasing bond spreads. Of course, the underlying assumptions of sovereign debt models differ from the situation in Chinese provinces. In sovereign debt models, countries are cut off from further borrowing if they default, but it is unclear what punishments provinces will face if they fail to pay back bond holders.

In China, for example, in the 2016 bankruptcy of Dongbei (North-eastern) Special Steel, the second largest local SOE in Liaoning province, the main reason for the bankruptcy was the excess capacity and overproduction. There were also defaults in several bonds (at least nine bonds) issued by Dongbei Steel.⁹ After nearly a year of negotiations between creditors and the bankrupt Dongbei Special Steel, an agreement on restructuring was reached. Under the agreement, Dongbei Special Steel will fully repay every unsecured creditor holding no more than RMB 500,000. For the creditor holding debt more than this amount, they can choose to receive either a repayment in cash with 22.09% of debt principal or a debt-for-equity swap.¹⁰ Thus, clearly for holders of Dongbei Steel bonds, the bankruptcy of that local SOE led to capital losses.

Here, we make the reasonable assumption borrowing from the sovereign debt literature that a rise in provincial bond spreads reflect the increasing probability that the government bonds issued in the province will default, and that the default probabilities rise as the local governments make more “misallocated” investments.¹¹

⁹ China's Dongbei Special Steel defaults for the ninth time in 2016, restructuring looms”, Reuters, September 26, 2016. <https://www.reuters.com/article/us-china-debt-dongbei/chinas-dongbei-special-steel-defaults-ninth-time-in-2016-restructuring-looms-idUSKCN11W16K>.

¹⁰ “Steel Company's Restructuring Draws Creditor Ire”, Caixin, August 28, 2017. <https://www.caixinglobal.com/2017-08-28/101136917.html>.

¹¹ Actual default rates are very low; only 0.44% LSOE bonds defaulted over the 7 years in our sample. The first default in LSOE bonds occurred in 2015, and there has yet to be any defaults in LG bonds. However, default rates are rising, and these rising default rates can be seen in the rising spreads of local bonds.

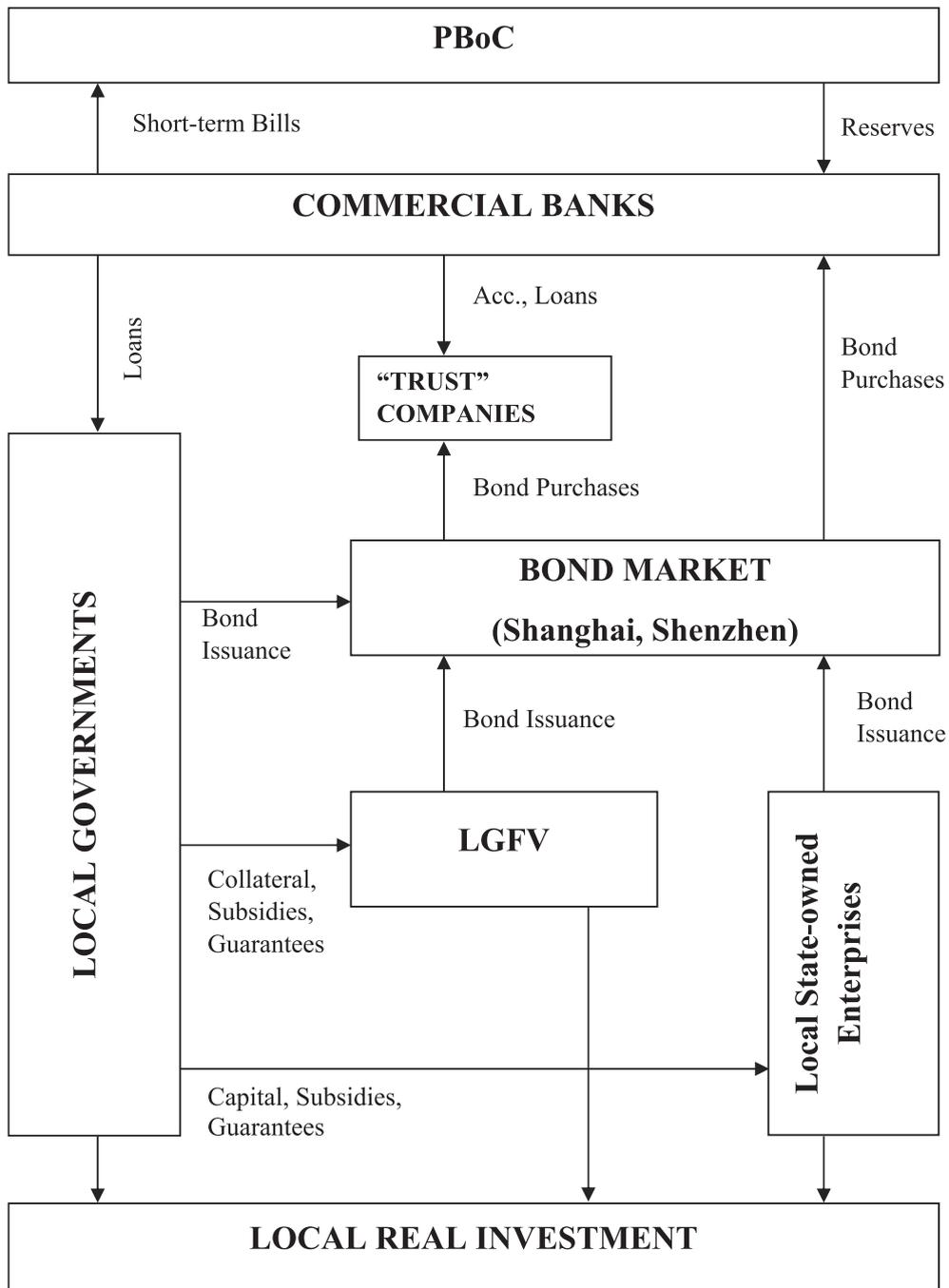


Fig. 1.

5. Empirical framework

We adopt the “difference-in-difference” framework in a panel data setting to estimate how the extent of “misallocation” within a province will influence the impact of M2 changes on the excess returns of local bonds (LB) (Angrist and Pischke, 2009).¹²

¹² In the language of the micro-econometric quasi-experimental literature, assume that there are two provinces, one with misallocation and the other without, and that in all other characteristics, the two provinces are the same. Inject both provinces with a positive monetary shock. If the province with the misallocation experiences a larger increase in spreads, then we attribute this increase in spreads to the distortion.

Our baseline specification is the following:

$$ExRet_{itk} = \beta M2_t + \varphi M2_t * Mis_k + \alpha_k + u_{itk} \quad (1)$$

where $ExRet_{itk}$ is the excess return of LB i in province k in month t ; $M2_t$ is the year-on-year growth in monthly M2; Mis_k is an indicator of “misallocation” in province k ; α_k is the fixed effect for province k ; and u_{itk} is an unobserved error term. We expect the sign of β to be positive. Normally, a rise in liquidity (M2) is expected to narrow the spread between a liquid bond (Chinese sovereign bonds) and a relatively illiquid bond (Chinese local bonds), as the rise in market liquidity stimulates trading in local bonds.

However, our misallocation story results in a widening of spreads. A rise in M2 stimulates Chinese bank lending relatively more to firms that have a high degree of past misallocation, which results in more misallocation, a rise in default probabilities, and an increase in excess bond yields. The main hypothesis being tested is that: $\varphi > 0$. That is, the greater the index of misallocation in the province, the higher the excess returns of the bonds issued in the province.

In most of our specifications below, we omit time varying control variables. This is because we could not find provincial control variables that are plausibly exogenous, uncorrelated with the error term, u_{itk} . Monthly dummies, however, are included to control for the seasonal effects.

6. Measures of Chinese monetary policies

As mentioned, the actual conduct of Chinese monetary policy is even today uncertain and rather opaque. Thus, rather than focusing on one measure, we use *four* measures for China’s monetary policy in the text, and relegate the other *seven* measures to the Online [Appendix](#). First, we use the real growth in M2, controlling for the natural increase in M2 demand owing to the rise in the cost of living (measure 1). This measure subtracts the aggregate CPI inflation rate from the nominal M2 growth rate. Since we are interested in the “bank lending” channel of monetary policy on excess yields, that is, the change in the supply of M2, we need to net out from our measure of M2, the natural increase in the demand for M2.

Measure 2 addresses the endogeneity in the supply of M2 by the PBoC, owing to the central bank’s reaction function. Like all central banks, the PBoC responds countercyclically to economic shocks. Suppose there is some aggregate shock that lowers the GDP of province k , and raises the bond spreads in province k . If this negative shock is correlated with a decline in aggregate GDP, then the PBoC may respond countercyclically by expanding the money supply. We may see a positive relationship between the level of misallocation in province k and in the expansion of M2, when this relationship is driven by the initial negative GDP shock.

Specifically, we address the possible endogeneity of M2 by taking a measure of M2 that is purged from countercyclical effects. [Chen, Ren, and Zha \(2017\)](#) estimate a model where M2 depends on Chinese aggregate CPI inflation and GDP and perform an in-sample forecast using the model. The residual between this forecast and the actual M2 process is by construction, orthogonal to Chinese CPI inflation and real GDP. We estimate a linear version of their model, estimating the growth of M2 on the quarterly lagged growth in M2, lagged quarterly inflation, and lagged quarterly GDP growth and taking the residual. This is our measure 2.

For measure 3, we use a measure of monetary shocks that affect short-term interest rates. As mentioned, since about 2015, the actual conduct of monetary policy in China has removed interest rate controls, and reoriented policy from a reliance on quantitative measures such as M2 to managing short-term interest rates (mainly the 7-day repo rate). Here we exploit Chinese high-frequency financial market data to identify monetary policy shocks. Following [Gertler and Karadi \(2015\)](#) and [Kamber and Mohanty \(2018\)](#), we construct a time-series of monetary policy surprises, using daily changes in interest rates during short windows around policy decisions by the PBoC. The announcement dates by the PBoC are from [Kamber and Mohanty \(2018\)](#) and overall, during our sample period, there are 107 daily announcements. We calculate the movements in the one-year interest rate swap (IRS) contracts centered on the Chinese 7-day interbank repo rate over a daily window around these announcement dates and use this as our measure of monetary shocks. Since its liberalization in 2006, the liquidity in this market has increased and this market today has enough activity and volume to be able to extract a market response at the daily window. We use the impact of these policy surprises on the changes in the one-year interest rate swap for the 7-day repo rate as measure 3.

Finally, for our measure 4, we address the endogeneity concern in another way. To capture the provincial shocks that the PBoC may be responding to, we add additional control variables to (1). We add provincial GDP, provincial real estate investment (divided by provincial GDP), and the number of people that died of natural disasters in the province during that month. In addition to GDP growth, the Chinese government has been especially concerned about excessive real estate investment, believing that they are a result of speculation. Since local bonds are sometimes collateralized by real estate, a rise in real estate investment in addition to possibly directly raising excess yields, owing to increased risk, may also induce a monetary response by the PBoC. Also, natural disasters cause local property damage, possibly leading to changes in bond excess returns, and the response by the PBoC. We proxy the severity of the natural disaster by the number of people who died from the natural disaster in that month. Finally, while not necessarily affecting monetary policy, we include the budget surplus of

the provincial government (divided by provincial GDP) as an additional control variable, since a deficit prone province is more likely to have difficulties paying off its bond borrowing, affecting its credit worthiness.¹³

7. Misallocation measures

From Hsieh and Klenow (2007) we know that if capital and labor were allocated efficiently among firms within a province, then TFP for all the firms within a province will be the same. The intuition is that in markets without distortions, resources, say capital, will be allocated from low TFP firms to high TFP firms, driving down the marginal product of capital of high TFP firms until all TFPs are the same.

If a firm has persistently high TFP, then it must mean that there are barriers for capital and labor to flow to the high TFP firms; that is, capital and labor are misallocated. There is too much capital and labor allocated to low TFP firms and too little capital and labor allocated to high TFP firms. It can be shown that a rise in the variance of TFP will lower aggregate TFP in province k by a factor proportional to:

$$\text{var}(\log TFP_{jk}).$$

For the “misallocation” variables, in most specifications, we separately include *four* measures for the extent of “misallocation” within provinces. For our first measure, we use the index of provincial level misallocation calculated by Jin, Li and Guo (Jin et al., 2016). They used the annual Chinese Industrial Enterprise database, a widely used Chinese census of individual firms, to calculate the variance of revenue based TFP ($\text{Var}_k(TFP_{jk})$) for all of the surveyed firms j within each province annually from 1998 to 2007. Jin et al. (2016) then take the average from 1998 to 2007 of the revenue based TFPs, and we use this average as our measure of “misallocation.”

For our second measure for “misallocation,” we use the share of a province’s GDP accounted for by State-owned enterprises in 2007 (Fan, Wang, and Zhang, 2007). In China, market inefficiencies are higher in provinces with a high output share of state-owned enterprises. These enterprises do not necessarily respond to market signals. In a model calibrated to the Chinese economy, Dekle and Vandebroucke (2012) show that as the state-owned share of the economy contracted, China became more efficient in its allocation of resources. A rise in the state-owned enterprise- provincial output ratio should raise the local bond excess yields.

In the usual “difference-in-difference” framework, the misallocation variable, Mis_k in Equation (1) is constant over time. However, for our second and third measures, we can obtain the misallocation variables that are changing annually. In some specifications, we thus additionally include time-varying misallocation variables than correspond to Mis_{kt} as further robustness checks. Thus, as an extension for measure 2, we include the proportion of firms that are State-owned that varies annually but lagged for one year (to reduce the collinearity with the contemporaneous error term).

For our third measure for “misallocation,” we use a measure of public corruption. We compile a list of individual officials in graft investigations published on the CCDI (China Central Commission for Discipline Inspection) website. We simply use the sum of those investigated officials between November 2012 and December 2016 as our measure of the qualitative severity of local political risk.¹⁴ We find, for example, that during this period Hubei province had the most investigated officials with 63. Beijing was third with 51 investigated officials.

Plausibly, what may affect the severity of corruption in a province may not be the total number of investigated officials, but the degree of corruption correcting for the economic size of the province. As an additional robustness check, we use the provincial corruption index estimated by Chen, Schneider, and Sun (2018). The index was estimated by a “multiple indicators and multiple causes (MIMIC)” model. The dependent variable in their model is the number of corruption cases per 10,000 public officials in the province. Provincial GDP is controlled for in the estimation. This provincial corruption index varies annually, and as in measure two, lagged for one year.

For our fourth measure for misallocation, we use the cross-provincial measure of capital misallocation adopted by Brandt et al. (2013). Our results using this measure are depicted in Table A7 in our Online Appendix. Their measure uses provincial level data to calculate the misallocation of capital between State and non- State enterprises.

Table 3 summarizes the variables used in the estimation. Note that importantly, all unobserved fixed effects are controlled in our estimations. The fixed effects estimator adopted here controls for these provincial differences that impact the provincial excess returns that persist over time, making our coefficient estimates β and ϕ unbiased.

¹³ Chinese provincial GDP, real estate investment, and government budget surpluses are from China Data Online. The provincial data are only available yearly, so we assume identical monthly values over the year. The number of deaths per province is from EM-DAT, the International Disaster Database. From EM-DAT, the date of the natural disaster occurring to the Chinese province is available. We assume that all deaths occurred in the month that the disaster happened.

¹⁴ Ang, Bai, and Zhou (2016) show that this measure of provincial level corruption interacted with the level of real estate investment within the province raises the excess bond yields for Chengtu bonds, which are mostly used for construction. The idea is that in provinces with a high amount of real estate activity, local corrupt officials channel more than the efficient amount of funds to real estate activity, leading to increased risk for the bonds backed by local real estate collateral.

Table 3
Summary Statistics of Variables in Estimations.

Variable	Mean	SD	Skewness	Kurtosis
Excess Yield (against 5-year Treasury YTM, %)	1.81	4.37	144.61	37,970.74
Excess Yield (against 7-year Treasury YTM, %)	1.66	4.37	144.74	38,015.30
M2 Growth (% yoy)	12.29	1.98	2.71	20.64
Real M2 Growth (deflated by CPI, %yoy)	10.75	1.90	4.66	43.47
M2 Growth - Nominal GDP Growth (% yoy)	8.51	2.01	2.48	20.39
Actual M2 Growth - Target of M2 Growth (%yoy)	-0.47	1.58	1.96	14.18
Credit Growth (%yoy)	14.01	1.69	6.32	66.98
Actual Credit Growth - Target of Credit Growth (%yoy)	0.77	0.63	0.46	2.47
Real M2 Growth, instrumented with Monetary Stance (%yoy)	6.94	7.95	-3.55	25.54
"Exogenous M2" Growth (%yoy)	-0.01	0.02	1.16	4.91
Exogenous M2 Growth (M2PR) (%yoy)	-0.31	1.44	-1.03	4.58
Monetary Policy Shocks (bps)	-1.14	5.34	-1.37	15.05
Provincial Misallocation (unit)	1.37	0.42	-2.22	7.43
FractionSOE (%)	90.02	2.62	0.38	2.53
Alternative Misallocation Measure (unit)	0.12	0.04	0.54	2.54
Convicted Officials (no.)	29.61	18.15	1.03	3.49
lagged SOE share (%)	7.76	6.62	1.31	3.85
Lagged corruption index (index)	4.49	1.24	-1.61	6.22
Bond Age (months)	19.53	19.79	1.49	6.04
Issue Amount (RMB million)	2,515.47	3,777.60	3.74	20.47
Provincial GDP (RMB billion)	3,092.15	1,986.34	0.78	2.42
Natural Disaster Deaths (no.)	48.60	356.35	225.65	55,322.50
Provincial Budget Surplus (% of provincial GDP)	-0.09	0.08	-1.89	8.87
Provincial Real Estate Investment (RMB million)	188,621.40	106,366.40	0.68	2.71

8. Stylized facts

Before we delve into the estimation, here we show some simple correlations among the variables. We show that in China during this period, monetary expansions lowered the returns on Chinese central government bonds as is typically the case in other economies, but widened the spread between local government bonds and central government bonds.

Table 4 depicts the correlations between the monetary variables and the bond yields of both the local and central governments. We average the monthly local bond yields across the approximately 2500 issuers to arrive at the monthly average local bond yields. Here we depict the correlation among the yields and two monetary variables, the change in M2 and the change in the one-year interest rate swap (IRS) for short-term repo rates around the policy announcement dates (alternative measure 1, defined in the Online Appendix and measure 3), both aggregated to the monthly frequency.

We find that expansionary monetary policies are usually negatively correlated with 5-year central government bond yields. Increases in M2 growth are negatively correlated with central government bond yields. Short-term interest rate shocks representing tightening are positively correlated with central government bond yields (with higher statistical significance). Because individual local bond yields are highly heterogeneous, average local bond yields are noisy, and their correlation with monetary variables are generally insignificant. Still the spread between local government and central government bonds is negatively correlated with tightening short-term interest rate shocks. Given that central government bonds have a "convenience yield" advantage over local bonds, we would expect that the gap in returns between local and central government bonds will narrow with greater liquidity as M2 increases. That they widen suggests that there is some force that raises the risk premium of local bonds, such as a rise in default probabilities, perhaps owing to higher misallocation.

This result is corroborated in our difference-in-difference specifications below showing that expansionary monetary policies raise the excess yields (local bond returns minus central government bond returns). Again we would expect that local bonds being less liquid, monetary loosening will lower local bond returns by more than the returns on central government bonds. That this does not happen suggests that the riskiness of local government bonds rises when money supply or liquidity expands.

Although not depicted in Table 4, we also find that cross provincial loan growth is positively correlated with our measures of provincial misallocation. This is consistent with our story that loan growth to provinces with existing misallocation are higher. Given that loan growth can be endogenous, without controlling for provincial fixed and time-varying effects, we cannot rule out that this correlation between loan growth and provincial misallocation is spurious. We show in our estimates below that even after controlling for fixed provincial effects and other factors, the increase in overall liquidity raises the excess returns on local entity bonds in provinces with a higher degree of existing misallocation.

In our preliminary estimates, we could not find a statistically significant correlation between the levels of provincial spreads and our measures of misallocation such as the number of corrupt officials. This is because of the presence of provincial fixed effects. Many provincial fixed factors such as the distance from Beijing and the level of economic development affect the level of provincial spreads. A province may have a relatively high level of misallocation, but may have lower

Table 4
Monthly Correlations Between Monetary Policy Variables and Bond Yields.

	Correlations
<i>Correlations of M2 Growth with</i>	
Central Government Bond Yields	−0.27 (−3.03)
Average Local Government Bond Yields	−0.082 (−0.90)
Average Excess Yields	0.12 (1.30)
<i>Correlations of Monetary Policy Shocks with</i>	
Central Government Bond Yields	0.22 (2.44)
Average Local Government Bond Yields	0.013 (0.14)
Average Excess Yields	−0.16 (−1.80)

This Table presents simple correlations between the Monetary Policy Variables and Bond Market Yield Variables. The data are at the monthly frequency. The local bond yields are averages across all of the local bonds in China in that month. The Excess Yields are the differences between the Average Local Government Bond and Central Government Bond Yields. T-statistics are in parentheses. The sample period is from August 2007 to June 2017 (119 monthly observations).

spreads, owing to the fact that the province is close to Beijing or Shanghai where the central government and the financial sectors are located. In our estimates, we control for these provincial fixed factors by including provincial fixed effects dummy variables.

9. Results

This section presents the estimation results based on the framework discussed earlier.¹⁵

Tables 5 – 6 depict Specification (1), the relation between monetary variables and the spread without any control variables. Tables 7 and 8 depict Gertler-Karadi type of monetary announcement shocks, and Table 8 includes control variables such as provincial GDP, natural disasters, deaths, provincial budget surpluses and real estate investment. We show that the results are robust to including these control variables.

Starting from the relationship between local bond excess yields and real M2 growth (measure 1), the empirical results confirm that higher growth in M2 raises the excess yields on local bonds on average for all provinces (column 1, Table 5). Arithmetically, excess yields can rise when the yields to maturity of the local bonds increase or the yields on 5-year central government bonds decline. But we showed it in Table 4, that an increase in money supply *lowers* the yield on 5-year central government bonds and *raises* the yield on local bonds, thereby raising their spreads. Thus, the increase in excess yields is due to an increase in local bond returns.

9.1. Real M2 growth

The estimated relationship between local bond excess yields and real M2 growth (measure 2) is shown in Table 5. Real M2 growth is defined as nominal M2 growth deflated by nominal CPI growth to take account of the increase in money demand caused by the increase in the cost of living. When real money supply rises, an increase in a province's level of misallocation raises the excess yields of that province, although the results are not significant (Table 5, column (1)). In column (2), we show that in provinces with a higher level of misallocation (from 1998 to 2007), a rise in M2 raises local excess yields (at the 10 percent level). A higher share of a province's GDP accounted for by SOEs or a rise in the lagged time-varying fraction of SOE firms in the province raises the excess yields of bonds in that province (columns 3 and 5). We would expect the degree of corruption, as proxied by the number of convicted officials and the corruption index, will raise the excess yields in that province, but the coefficient is insignificant (columns 4 & 6).

M2 Growth Exogenous to past quarterly GDP growth and inflation

In Table 6 as our monetary growth variable, we use the component of M2 growth exogenous to past quarterly GDP growth and inflation (measure 2, based on Chen, Ren, and Zha, 2017). We find again that in provinces with a higher level of initial "misallocation", a rise in M2 growth results in widening excess return spreads. A rise in the share of a province's GDP accounted for by SOE, and the lagged time-varying corruption index increase the excess yields.

¹⁵ In all specifications, we also include variables that are correlated with bond market liquidity. Economists specializing in bond pricing have found that the liquidity of the bond affects its price, and its excess yield. They often use the daily bid-asks spreads of the bonds as a control for bond liquidity. While we are mostly concerned with only the long-run cross provincial properties of local bond excess yields and not their daily price fluctuations, we control for the liquidity of each bond by including its Age (since their issue date) and the Issue Amount as proxies. Konstantinovskiy, Ng, and Phelps (2016) have shown that the age and the issue amounts of the bonds—commonly used proxies for bond liquidity—influence their pricing.

Table 5
Local Bond Excess Yields and Real M2 Growth.

	(1)	(2)	(3)	(4)	(5)	(6)
RealM2Growth	0.06*** (0.007)	0.06*** (0.017)	0.14*** (0.031)	0.08*** (0.013)	0.04*** (0.015)	0.05* (0.026)
RealM2Growth*Provincial Misallocation		0.0015 (0.012)				
RealM2Growth*FractionSOE			0.0075** (0.003)			
RealM2Growth*Convicted Officials				-0.0005 (0.000)		
RealM2Growth*Lagged SOE Share					0.0023 (0.002)	
RealM2Growth*Lagged Corruption Index						-0.0044 (0.006)
Observations:	236,098	228,644	229,673	236,098	236,098	236,032
R-squared:	0.0232	0.0234	0.018	0.0226	0.0059	0.0115
Month Dummy:	yes	yes	yes	yes	yes	yes

This table presents the panel regression results with provincial fixed effects of Local Bond Excess Returns on Real M2 (deflated by CPI) (measure 1) and Real M2 interacted with various provincial level misallocation measures (including Misallocation within the province [Provincial Misallocation], the share of a province's GDP accounted for by State-owned enterprises in 2007 [FractionSOE], the Number of Convicted officials [Convicted Officials], the lagged time-varying proportion of firms that are state-owned within the province [Lagged SOE Share], and the lagged time-varying [Chen, Schneider, and Sun \(2018\)](#) corruption index [Lagged Corruption Index]). Control variables include the age of the bond (number of months since issue), the amount of bonds issued, and monthly dummy variables (as well as the standalone variable of Lagged SOE Share and Lagged Corruption Index in corresponding models). Panel fixed effects estimation at the provincial level. Standard errors are clustered at the province level reported in parentheses. The sample period is from July 2007 to December 2016.

Table 6
Local Bond Excess Yields and "Exogenous M2" Growth.

	(1)	(2)	(3)	(4)	(5)	(6)
"Exogenous M2" Growth	10.23*** (0.698)	8.67*** (1.309)	12.72*** (2.261)	12.81*** (1.628)	10.22*** (1.504)	0.68 (1.983)
"Exogenous M2"*Provincial Misallocation		1.03 (1.0644)				
"Exogenous M2"*FractionSOE			0.25 (0.207)			
"Exogenous M2*ConvictedOfficials				-0.09** (0.0432)		
"Exogenous M2"*Lagged SOE Share					-0.04 (0.168)	
"Exogenous M2*Lagged Corruption Index						1.38*** (0.428)
Observations:	257,413	249,041	234,079	251,361	257,413	236,032
R-squared:	0.0226	0.0228	0.0221	0.0226	0.0124	0.0167
Month Dummy:	yes	yes	yes	yes	yes	yes

This table presents the panel regression results with provincial fixed effects of Local Bond Excess Returns on "Exogenous M2" (measure 2) and "Exogenous M2" interacted with provincial level misallocation (including Misallocation within the province [Provincial Misallocation], the share of a province's GDP accounted for by State-owned enterprises in 2007 [FractionSOE], the Number of Convicted officials [Convicted Officials], the lagged time-varying proportion of firms that are state-owned within the province [Lagged SOE Share], and the lagged time-varying [Chen, Schneider, and Sun \(2018\)](#) corruption index [Lagged Corruption Index]). "Exogenous M2" is a generated from the residual of M2 growth on M2 growth, GDP growth and CPI inflation lagged one period. Control variables include the age of the bond (number of months since issue), the amount of bonds issued, and monthly dummy variables (as well as the standalone variable of Lagged SOE Share and Lagged Corruption Index in corresponding models). Panel fixed effects estimation at the provincial level. Standard errors are clustered at the province level reported in parentheses. The sample period is from July 2007 to December 2016.

10. Gertler and Karadi-type monetary announcement surprises

In [Table 7](#), we depict the relation between monetary announcement surprises (measure 3, the Gertler-Karadi-like measure) and excess yields. Monetary surprises that result in an increase in short term rates narrow the spreads between local and central government bonds. In provinces where distortions are relatively greater, monetary tightening surprises narrow the spreads. This pattern holds when distortions are measured as the share of a province's GDP accounted for by SOEs, the number of convicted officials, the lagged time-varying provincial fraction of SOEs, or the lagged time-varying provincial corruption index.

Monetary announcement surprises with provincial controls

Table 7

Local Bond Excess Yields and Monetary Policy Shocks (Without Provincial Level Control Variables).

	(1)	(2)	(3)	(4)	(5)	(6)
Monetary Policy Shocks	-0.016*** (0.001)	-0.016*** (0.002)	-0.02*** (0.003)	-0.016*** (0.002)	-0.015*** (0.001)	-0.01** (0.005)
Monetary Policy Shocks*Provincial Misallocation		-0.000005 (0.002)				
Monetary Policy Shocks*FractionSOE			-0.0004 (0.00032)			
Monetary Policy Shocks*Convicted Officials				-0.0000002 (0.00004)		
Monetary Policy Shocks*Lagged SOE Share					-0.0002 (0.0001)	
Monetary Policy Shocks*Lagged Corruption Index						-0.002** (0.001)
Observations:	300,163	289,951	300,163	91,806	300,163	236,032
R-squared:	0.0176	0.0181	0.0171	0.0176	0.0054	0.0107
Month Dummy:	yes	yes	yes	yes	yes	yes

The Table presents panel regression results with provincial fixed effects of Local Bond Excess Returns on monetary policy shocks (measure 3) and monetary policy shocks interacted with various provincial level misallocation measures (including Misallocation within the province [Provincial Misallocation], the share of a province's GDP accounted for by State-owned enterprises in 2007 [FractionSOE], the Number of Convicted officials [Convicted Officials], the lagged time-varying proportion of firms that are state-owned within the province [Lagged SOE Share], and the lagged time-varying [Chen, Schneider, and Sun \(2018\)](#) corruption index [Lagged Corruption Index]). The monetary policy shock measures were constructed using the method of Kambur and Mohanty (2018). Kambur and Mohanty construct the shocks series using information from high frequency data, specifically from the one-year interest rate swap contracts centered on the interbank 7-day repo rate to monetary policy announcements. Control variables at the bond level include the age of the bond, the amount of bonds issued, and monthly dummy variables (as well as the standalone variable of Lagged SOE Share and Lagged Corruption Index in corresponding models). Panel fixed effects are at the provincial level. Standard errors are clustered at the province level reported in parentheses. The sample period is from July 2007 to December 2016.

Table 8

Local Bond Excess Yields and Monetary Policy Shocks (With Provincial Level Control Variables).

	(1)	(2)	(3)	(4)	(5)	(6)
Monetary Policy Shocks	-0.0192*** (0.003)	-0.0385*** (0.004)	0.0023 (0.008)	-0.0169*** (0.006)	-0.0257*** (0.005)	0.0103 (0.013)
Monetary Policy Shocks*Provincial Misallocation		0.013*** (0.003)				
Monetary Policy Shocks*FractionSOE			0.0023** (0.001)			
Monetary Policy Shocks*Convicted Officials				-0.0001 (0.0001)		
Monetary Policy Shocks*Lagged SOE Share					0.0006* (0.0004)	
Monetary Policy Shocks*Lagged Corruption Index						-0.0056** (0.002)
Provincial GDP	-0.00005** (0.000019)	-0.00005** (0.00002)	-0.00005** (0.00002)	-0.00006* (0.00003)	-0.00005** (0.00002)	-0.00605*** (0.00213)
Natural Disaster Deaths	-0.00006* (0.00003)	-0.00006** (0.00003)	-0.00006* (0.00003)	23.91*** (4.80748)	-0.00006** (0.00003)	-0.00016*** (0.00002)
Provincial Budget Surplus	23.92*** (4.796)	24.28*** (5.011)	23.71*** (4.919)	-0.00000003 (2.3E-7)	26.25*** (4.484)	-0.00006*** (1.7E-5)
Real Estate Investment	-0.00000003 (2.3E-7)	-0.00000002 (2.3E-7)	0.00000001 (2.4E-7)	6.62*** (0.4390)	0.00000005 (2.4E-7)	-0.00006** (3.0E-5)
Observations:	65,071	63,698	63,469	65,071	65,071	65,071
R-squared:	0.0416	0.0427	0.0409	0.0417	0.0277	0.0334
Month Dummy:	yes	yes	yes	yes	yes	yes

This table presents the panel regression results with provincial fixed effects of Local Bond Excess returns on monetary policy shocks with controlling provincial level variables (measure 4) and monetary policy shocks interacted with various provincial level misallocation measures (including Misallocation within the province [Provincial Misallocation], the share of a province's GDP accounted for by State-owned enterprises in 2007 [FractionSOE], the Number of Convicted officials [Convicted Officials], the lagged time-varying proportion of firms that are state-owned within the province [Lagged SOE Share], and the lagged time-varying [Chen, Schneider, and Sun \(2018\)](#) corruption index [Lagged Corruption Index]). The monetary shock measures were constructed using the method of Kambur and Mohanty (2018). Kambur and Mohanty construct the shocks series using information from high frequency data, specifically from the one-year interest rate swap contracts centered on the interbank 7-day repo rate to monetary policy announcements. Control variables at the bond level include the age of the bond (number of months since issue), the amount of bonds issued, and monthly dummy variables (as well as the standalone variable of Lagged SOE Share and Lagged Corruption Index in corresponding models). Provincial level variables that vary over time include provincial GDP, the number of provincial natural disaster deaths, provincial budget surplus over provincial GDP, and the amount of provincial real estate investment. Panel fixed effects estimation at the provincial level. Standard errors are clustered at the province level reported in parentheses. The sample period is from July 2007 to December 2016.

In [Table 8](#), we include provincial control variables (measure 4) that may directly influence both positive monetary policy announcement shocks (measure 3, equivalent to the tightening of money) and the excess yields. While time-invariant differences among the provinces are controlled by the provincial fixed effects, time-varying variables, if correlated with the degree of provincial misallocations, may affect the estimates. As controls, we include provincial GDP, natural disaster deaths, the provincial budget surplus, and real estate investment. A positive interest rate shock, a tightening of money, narrows spreads. This effect is more pronounced, the higher the lagged time-varying provincial corruption index. The higher the provincial GDP, the lower the spreads. The debt of richer provinces has a lower probability of failing. Surprisingly, a rise in natural disaster deaths lowers the spreads, and a rise in provincial budget surpluses widens the spread. In this specification, a rise in real estate investment generally raises spreads, as much of this investment could be misallocated.

A higher level of provincial GDP lowers excess bond yields, which is not surprising. Provinces that have a positive shock to growth would have an easier time to pay back their debt, lowering their excess bond yields. The size of real estate investment is insignificant. Surprisingly, a rise in natural disaster deaths in the province lowers excess bond yields. This is perhaps because in the aftermath of a large scale natural disaster, the central government often makes announcements reaffirming their commitment to help financially the disaster-affected areas, making market participants believe that the local bonds are guaranteed.

We may expect that provinces with higher provincial surpluses will enjoy a lower cost of financing. The positive coefficient on the provincial surplus variable in [Table 8](#) may thus seem counterintuitive. However, as it is well-known, the Chinese central government engages in massive fiscal transfers among the provinces, and with such transfers, the provincial surplus position of poorer provinces may be overstated by the transfers. In fact, in the data, provincial per capita GDP and provincial budget surpluses are highly negatively correlated; that is, poorer provinces have larger budget surplus/GDP ratios. That higher budget surpluses result in higher excess returns may reflect the fact that poorer provinces have higher excess bond yields (as it is the case).

In summary, we find that in most specifications, positive monetary shocks raise the spread between local and central government bonds. In provinces with high levels of existing misallocation, positive monetary shocks lead to widening excess yields. In most specifications ([Tables 5 – 8](#), and [Table A1 – A8](#) in the Online [Appendix](#)), in provinces with a high share of SOEs and a high number of convicted officials, an expansion in M2 leads to widening excess yields. In addition, the results in [Tables 5 – 8](#) are robust if the excess yield against 5-year Treasury YTM is replaced by the excess yield against 7-year Treasury YTM ([Table A9 – A12](#) in the Online [Appendix](#)) or the sample excludes the local bonds in Tibet ([Table A13 – A16](#) in the Online [Appendix](#)).

10.1. Event study evidence

So far, we have shown that an increase in the money supply in the center tends to increase the spread between local and central government bonds, using the panel difference-in-difference methodology.

Below we address the same question using the event study methodology. For Chinese monetary policy, event dates identified by [Kamber and Mohanty \(2018\)](#), we calculated the abnormal returns of the yield of local bonds over government bonds during that day.¹⁶ On days of monetary tightening announcements, the abnormal returns on excess yields were -0.021 at the 1 percent level of significance. On days of monetary loosening announcements, the abnormal returns were 0.032 at the 1 percent level of significance. Thus, on looser monetary policy announcement days, the excess returns of local bonds tend to increase abnormally. This result is consistent with our earlier panel methodology.

10.2. Towards a quantification of economic importance

The implied probability of bond defaults using credit spreads can be derived from the following well-known formula:

$$\text{Credit Spread} = \text{Default Probability} \times (1 - \text{Recovery Rate}).$$

From [Table 5](#), column (1), we showed that a 10 percent increase in real money supply would result in a 0.6 percent increase in the spread between local bonds and central government bonds. Information on recovery rates on the debt of local government SOEs are sparse. From the aforementioned case of Dongbei Steel, only 23 percent of the debt was recoverable for larger debtholders. Let's assume that 30 percent of the total debt is recoverable.

Using the above formula, the Default Probability will be 0.6 percent times 0.70 (or 0.42 percent). That is, a 10 percent increase in Chinese real money supply will result on average in a 0.42 percent increase in default probabilities. Meanwhile, assuming the misallocation within the province is one standard deviation higher (0.4 units), the rise in default probability will increase marginally by 0.004 percentage points. However, a standard deviation higher share of a province's GDP accounted for by SOE (2.6 percentage points) or higher fraction of SOE firms in the province in the previous year (6.6 percentage points) will increase the default probability further by another 0.14 and 0.11 percentage points, respectively. Our empirical results show that default rates will be higher in provinces with higher levels of misallocation.

¹⁶ Abnormal returns were calculated using the methodology of Ellul et. al. (2011).

11. Conclusions

We show in a panel “difference-in-difference” framework using Chinese bond yields across provinces that expansionary monetary policies increase the excess yields of local government bonds. Specifically, for provinces with historically high accounting measures of misallocation, with high proportions of state-owned enterprises, or with a high number of convicted officials, a rise in aggregate money supply leads to widening excess yields on bonds of the local public sector. We interpret the widening excess yields as the market requiring a higher risk premium on the bonds of the local government entities invested in projects that are misallocated. Our results are robust to many specification checks.

Table 9 provides by province, local government expenditures allocated to infrastructure spending and local state-owned enterprises. Local government expenditures on SOEs include only paid-in capital. It does not include local government guarantees—both implicit and explicit—on local enterprise borrowing. Thus, while local government exposures to insolvent local SOEs may appear small in terms of paid-in capital, the actual exposure through loan guarantees could be quite large.

Our estimation results show that local bond yields play an important role in indicating the riskiness of overall Chinese local government borrowing. Traded local bonds are priced by the market, in contrast to other local government debt such as borrowing from banks.

Table 9
Local Government Investment on Infrastructure and SOEs (By Province, 2016 Figures).

Province	Infrastructure ¹	SOEs ²
Anhui ³	18.8%	2.4%
Beijing	26.3%	0.6%
Chongqing	30.4%	1.3%
Fujian ⁴	32.2%	0.8%
Gansu	29.9%	0.9%
Guangdong	26.5%	1.2%
Guangxi	26.6%	0.4%
Guizhou ⁵	23.3%	0.9%
Hainan	31.4%	0.3%
Hebei	29.5%	0.7%
Heilongjiang	30.7%	1.2%
Henan	25.8%	0.7%
Hubei	29.1%	0.2%
Hunan	25.9%	0.7%
Inner Mongolia	30.1%	0.1%
Jiangsu	32.7%	0.6%
Jiangxi ³	41.3%	1.0%
Jilin	30.4%	0.1%
Liaoning	22.7%	1.2%
Ningxia	34.0%	0.3%
Qinghai	35.8%	0.03%
Shaanxi	27.2%	0.9%
Shandong	28.3%	0.6%
Shanghai	28.5%	1.0%
Shanxi ³	38.6%	1.7%
Sichuan	29.5%	0.7%
Tianjin	20.6%	0.3%
Tibet	34.1%	0.01%
Xinjiang	58.6%	0.1%
Yunnan	30.3%	0.2%
Zhejiang	30.0%	0.4%

Sources: Provincial Statistical Yearbook, Reports from various Provincial Finance Bureau and Wind.

Notes:

- 1) The local government investment in infrastructure is proxied by the share of expenditures in infrastructure to the total government expenditures in all levels of governments at or below the provincial level. The total government expenditures include general fiscal expenditure, expenditure of local government funds and the operating expenditures of state-owned capital (i.e., the expenditure for SOEs). The expenditures in infrastructure included the fiscal expenditures on “Energy Saving and Environmental Protection”, “Affairs of Agriculture, Forest and Irrigation”, “Transportation” and “Resource Exploration, Power Information and Other Affairs”, and a half of expenditure of local government funds (since the detailed breakdown of expenditure of local government funds are not available for most of the provinces, we assume a half of these expenditures are for infrastructure). The figures are latest available figures (2016 figures), unless specified.
- 2) The local government investment in SOEs is proxied by the share of the operating expenditures of state-owned capital to the total government expenditures in all levels of governments at or below the provincial level.
- 3) Figures for Anhui, Jiangxi and Shanxi are proxied by the figures of provincial level government only.
- 4) Figure for Fujian's local government investment in infrastructure is 2015 share.
- 5) Figure for Guizhou's local government investment in SOEs is proxied by the figure of provincial level government only.

More broadly, our intra-national, regional results have implications for international finance. Our results suggest that among countries, especially those in a common currency area such as the European Union, an increase in liquidity, say by a sharp monetary loosening by the ECB, can lead to resource misallocations within some of the member countries with weak institutions. This misallocation can be inferred from the widening spreads of say, the return on Spanish bonds over German bonds.

In the aftermath of Covid-19, many industrialized countries engaged in a massive increase in money supply. According to the results of this paper, we may see an increase in yields in emerging markets, especially those with existing misallocations or weak institutions. Rather than interpreting these increases in yields as an improvement in their economies, this paper suggests that the increases may portend a future bust.

Data availability

Data will be made available on request.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary material

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jimonfin.2023.102891>.

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