The Great Wall of Debt: Corruption, Real Estate, and Chinese Local Government Credit Spreads*

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December 25, 2015

JEL Classification: D73, G12, G14, G28, H74.

Key Words: Chengtou bond, corruption, real estate, local government financing vehicle (LGFV), government guarantee, systemic risk.

*We thank Jennifer Carpenter, Darrell Duffie, Arvind Krishnamurthy, Stijn Van Nieuwerburgh, Wei Xiong (NBER discussant), Song Han, and seminar participants at NBER Chinese Economy conference (2015), the "G2 at GW conference on U.S.-China Economic Relations and Chinas Economic Development, the Summer Institute of Finance conference (2015), New York University, Stanford GSB, Georgetown, George Washington University, the IMF, the World Bank, Tsinghua University, Federal Reserve Bank of New York, Federal Reserve Board, for helpful comments and suggestions. We also thank Angsheng Gu, Biqing He, and Yichen Li for excellent research assistance. An animated graph of Chengtou bond issuance can be found at http://www.columbia.edu/~aa610/chinamuni.html

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Abstract

Issued by local government financing vehicles and backed mostly by land sales, Chengtou bonds are an important source of financing for Chinese local governments. We identify large heterogeneity in Chengtou bond yields, which is not supposed to exist since they are implicitly guaranteed by the central government. We find that corruption in China has a significant effect on local government credit spreads, with one standard deviation increase in "Tigers" or "Flies" corresponding to 9 or 5 basis points in elevated Chengtou bond yields. We measure corruption using the graft cases investigated by the Central Commission of Discipline and Investigation (CCDI), using the rank-weighted average and total number of cases as proxies for the depth and width of corruptions, "Tigers" and "Flies", respectively. Real estate GDP is the most prominent determinant of local government credit spreads, and the effect of corruption works mainly through the channel of real estate — more corruption clearly depresses the real estate value. Since the anti-corruption campaign started in late 2012, the effect of corruption has become highly significant and irreplaceable through the real estate channel.

1 Introduction

Chengtou bonds are financial obligations of Chinese local governments. Capital raised through the Chengtou bond market finances, to a large extent, the tremendous growth in the infrastructure projects in China—ranging from megaprojects like the $2.4 billion Shanghai Tower (the second tallest building in the world) to the housing estates sprouting in many cities. From 2008 to 2014, the Chengtou bond market increased by 85% per year, and as of December 2014, there were RMB 4.95 trillion ($0.82 trillion) Chengtou bonds outstanding. The brisk increase in Chengtou liabilities goes hand-in-hand with the growth of total debt in China, which increased from 130% of GDP in 2008 to over 200% at the end of 2014.

While its large size, fast growth, and central role in developing infrastructure of China make the Chengtou bond market interesting to study in and of itself, there is one feature that makes it uniquely suited to investigating the effect of government guarantees, political risk, and distortions in market pricing induced by such effects. Although Chengtou bonds are set up by local governments, they are implicitly guaranteed by the central government. This is a crucial feature that distinguishes them from municipal bonds in the United States of America. Under China's fiscal and tax system, the central government takes final responsibility for revenues and deficits of local governments. Chengtou bonds are local government obligations and thus are ultimately backed by the central government. Given this unique feature, one may hypothesize that all Chengtou bonds have similar yields. However, we show that despite the tacit endorsement by the central government, Chengtou bonds yields exhibit significant *economic* heterogeneity across provinces.

In this paper we study the dispersion of Chengtou bond yields and show that the Chengtou bond market can serve as a nexus for China's real estate, political risk, and market distortions. We first highlight the special features of Chengtou bonds in contrast to municipal bonds in the United States. These features discussed below set the foundation upon which the Chinese local government bonds differ remarkably from the U.S. municipal bonds, and such differences in turn provide unique explanations why Chengtou bond yields have provincial variations that are statistically significant and economically large.

In addition to the implicit central government guarantee, another main feature of Chengtou bonds is that Chengtou bond issuance mostly requires collateral, which often involves the land-use rights. In contrast, the municipal debt does not have to be backed by physical collateral. Chengtou bonds are officially issued by local government financing vehicles (LGFVs), through which municipalities receive funds to supplement the direct transfers they receive from the central government. In a typical structure, an LGFV provides funds to a local government which is recorded as revenue, and the municipality in turn transfers land-use rights, or existing assets such as highways or bridges, to the LGFV. LGFVs issue Chengtou bonds, literally translated as "urban construction and investment bonds", using the land-use right and the alike as collateral.

The central role of land-use right as bond collateral naturally links the Chengtou bond market to China's real estate market. In China, real estate plays a vital role in economic development, and the key components driving the real estate market are the supply of land and the rental price of land-use right, which is controlled and implemented by the local government. Our second hypothesis is that the cross-section of Chengtou bond yield spreads should reflect the issue province characteristics, especially the conditions in the local real estate market. Indeed we find the most important drivers of Chengtou bond yields are variables related to real estate. In particular, the coefficient of the value-added real estate GDP ratio, given as a percentage of total local GDP, is negative and significant: an increase of one standard deviation in the cross-section of real estate GDP corresponds to a decrease in Chengtou bond yields of approximately 0.17%. Given that the average Chengtou bond yield spread (in excess of corresponding central government bond yield) is 1.98%, this turns out to be a very large economic effect.

A third feature of the Chengtou bond market is its close relationship to political risk, especially corruption. While corruption and political connections influence market prices even in developed countries—Butler, Fauver, and Mortal (2009), for example, uncover a significantly positive relationship between high levels of corruption and the high yields of U.S. municipal bonds at issue—there is a significantly higher level of corruption, combined with the greater opacity of the political system, in China. Unlike municipal governments in

the United States, Chinese local governments are not authorized to levy sales, property, or income taxes (with this arrangement dating from the budget law enacted in 1994). Chinese municipalities also cannot directly borrow from banks or issue bonds, except with approval from the State Council.[1] In addition, China's promotion scheme for local government officials, where officials are rewarded for increasing revenue and meeting official targets set by the central government (cf. Li and Zhou, 2005), imparts additional pressure to seek financial resources including land leasehold sales and the issuance of Chengtou bonds. The process of seeking financial resources creates space for the possibilities of corruption—Cai, Henderson, and Zhang (2013) offers micro evidence of corruption in leasehold sales. Our third hypothesis is thus that the cross-section of Chengtou bond yield spread should capture investor's concerns about local political risk.

To study the influence of political risk, we create a novel measure of corruption by utilizing a manually collected dataset based on the officials investigated by the Central Commission for Discipline Inspection (CCDI). Among the 753 officials across 31 provinces who were named in CCDI's graft probes, more than half of the officials had "undesirable working practices" related to the real estate sector. Confirming our hypothesis, we find a statistically significant and economically meaningful positive relationship between risk-adjusted Chengtou bond yields and two corruption measures: the rank-weighted average index and the total number of graft cases which we call "Tigers" and "Flies", respectively, to reflect the depth and the width of corruption. A one standard deviation move by a province in the cross-section from less to more corrupt increases excess Chengtou bond yields by 0.09% under the Tigers measure, and 0.05% under the Flies measure.

We show that province-level corruption is significantly and negatively related to the local real estate value-added GDP ratio, suggesting that the influence of corruption on local government credit spreads is probably through the (impaired) real estate channel. The intuition is that corruption by local government officials conducted via land allocation and rental price of land-use right during the development of real estate projects, will reduce the

[1]When approved, municipal bond issuance is via the Ministry of Finance on behalf of the municipality. With an explicit guarantee from the central government, these "local government bonds" are quasi-treasuries and indeed behave like treasuries (Wang and Yu, 2014).

local real estate value-added GDP, and further dampen the collateral value of Chengtou bonds, finally increasing the financing cost of local government, that is, the higher excess yields of Chengtou bonds. We conduct event studies on the Chengtou bond market upon the announcement of graft reports for high-ranking officials. The results indicate that provinces with the most severe corruption conditions are inclined to respond positively on the announcement days with decreasing bond yields.

Finally, we find that Chengtou bond yields are also sensitive to variables reflecting aggregate credit risk and monetary policy. In particular, provinces with larger factor loadings on China's credit risk, as proxied by Chinese sovereign CDS spreads, and larger loadings on effective real exchange rate changes have significant positive and negative prices of risk, respectively. The former result is consistent with the close link between local and central government finances: as China becomes riskier, yields of Chengtou bonds in the provinces most exposed to central government risk increase. The latter result is possibly driven by provinces with a strong export sector whose local economies, and thus municipal budgets, improve when the effective real exchange rate depreciates. These findings indicate that Chengtou bond market could potentially pose a systemic risk and thus plays an important role in China's financial system.

Literature

There are few academic papers studying Chengtou bonds. Lu and Sun (2013) describe the function of LGFVs and discuss their role in China's credit expansion. Our paper is related to Wang and Yu (2014), who use a small sample of Chengtou bonds to study how the risk characteristics of LGFVs as bond issuers can determine Chengtou bond yields. We go beyond bond-level pricing, instead focus on how provincial characteristics, especially real estate variables, political risk such as corruption, and provincial risk exposures, are priced in the cross-section of Chengtou bonds. Our goal is to identify risk factors that drive the sharp and large economic variations across provinces, even under the implicit guarantee of the central government.

Our paper also relates to the literature about market distortion under government

guarantee. Other markets where policymakers have set, or have an undue influence on, prices often involve a limited number of securities: foreign exchange pegs at one extreme, for example, involve only one price—the exchange rate (cf. Husain, Mody, and Rogoff, 2005). Other markets with a large cross-section of securities with government guarantees have such guarantees suddenly imposed, and the guarantee does not extend to all securities within that asset class. For example, only certain bonds issued by financial institutions were suddenly guaranteed by governments during the financial crisis (see Levy and Schich, 2010). In this paper the Chengtou bond market provides an atypical environment to study the impact of guarantee since thousands of bonds have been under the same implicit guarantee from the beginning of their issuance in the past two decades. Such continuity allows us to examine alternative channels of market distortion such as political risk, reaching-for-yield, and systematic relevance.

In the political risk literature, many academic studies use Chinese markets and socioeconomic circumstances to study the economics of corruption and political interference (see, among many others, Fisman and Wang, 2011, 2013). An advantage of studying the Chengtou bond market is that its collateral is closely linked to the real estate market, allowing us to measure the fundamental economic health of the provinces issuing Chengtou bonds. Our finding further suggests that the influence of corruption on local government credit spreads is probably through the (impaired) real estate channel.

The rest of this paper is organized as follows. Section 2 provides background on local government finances, the Chengtou bond market, China's real estate industry and corruption. In Section 3, we describe how we construct Chengtou bond yields in excess of matched central government bond yields, and detail the national and provincial macroeconomic barometers, and the corruption measures. Section 4 contains the empirical results. Section 5 further examines the relationship between real estate and corruption in China. We conclude in Section 6 with a discussion on the relevance of our findings for China's current policies. Finally, in Appendix A, we supplement our analysis by adding the market microstructure analysis of the impact of bond liquidity on Chengtou bond yields.

2 Background

2.1 Local Government Finances

The history of local government debt in China can be traced back to 1978 when the economic reform began. The decision-making power of the central government has been gradually delegated to regional governments, and economic growth motives have been driving local governments to look for additional funding sources. The situation has been exacerbated since the early 1990s, when national budget reforms channeled more tax revenue to the central government, and the local spending responsibility remained roughly the same. The mismatch is normally balanced by central government transfer or extra revenue through channels such as land sales. However, a major proliferation of local government debt was triggered by the 2008-2009 global financial crisis and China's fiscal stimulus package of RMB 4 trillion, among which only RMB 1.18 trillion is provided by the central government and the rest needs to be shouldered by the local governments (Lu and Sun 2013).

In the presence of increasing fiscal pressure, Chinese local governments cannot directly borrow from banks or issue municipal bonds, except with approval from the State Council.[2] Unlike municipal governments in the United States, Chinese local governments are also not authorized to levy sales, property, or income taxes (with this arrangement dating from the budget law enacted in 1994). In addition, China's promotion scheme for local government officials, where officials are rewarded for increasing revenue and meeting official targets set by the central government (cf. Li and Zhou, 2005), imparts additional pressure to seek financial resources.

To answer the increased financing challenge while circumventing regulations, Chinese local governments have created a special purpose vehicle. Local government financing vehicles (LGFVs) thus act as the principal financing agents for local governments. LGFVs are corporations that can obtain bank loans and issue corporate bonds. This type of bond, different from standard corporate bonds, has a special name, the Chengtou bond,

[2]When approved, the municipal bond issuance is done through the Ministry of Finance on behalf of the municipality. With an explicit guarantee from the central government, these "local government bonds" are quasi-treasuries and indeed behave like treasuries (Wang and Yu, 2014).

literally "urban construction and investment bond." LGFVs play a crucial role in promoting China's infrastructure development and economic growth, as they provide off-balance sheet quasi-fiscal support for local governments. For example, they are primarily engaged in the construction of public welfare projects such as affordable housing construction, infrastructure, social services, and ecological and environmental protection. The first Chengtou bond, Pudong development bond, was issued in Shanghai in 1997 with a value of RMB 500 million. As shown in Table 1 and Figure 1, both the number of bonds issued and the issue amounts were negligible before 2005 but since the fiscal stimulus in late 2008, the Chengtou bond market has expanded dramatically. The number of bonds issued in 2009 jumped to 258 compared with just 79 in 2008. The post-2008 average growth rate of new issues has been 85% per year. In 2014, the number of new Chengtou bond issues reached 1,704, with a total amount outstanding of RMB 4.95 trillion ($0.82 trillion).

Chengtou bonds are, according to China Central Depository & Clearing Co., held mainly by commercial banks (31.0%), funds (24.8%), and insurance companies (21.4%)— the latter two types of investors belong to China's shadow banking sector. As the issuers of Chengtou bonds, LGFVs do not consider the liabilities as official debt, nevertheless, LGFV liabilities are backed by local governments, and thus Chengtou bonds represent a very large off-balance sheet obligation. The central government is ultimately responsible for all local government finances.

Figure 2 shows the relationships of the important institutions involved in local government finances in China. Local governments incorporate LGFVs by injecting capital through budget revenue—usually by transferring land-use rights and existing assets such as highways and bridges. LGFVs then finance the rest through bank loans or through raising funding from equity and bond markets. The borrowing of LGFVs is often collateralized by land and is based on implicit or explicit local government guarantees. Evidently, LGFVs have close business connections with both commercial banks and the shadow banking system, as well as the real estate sector.[3] Many financial institutions and financing sources are thus connected

[3] Commercial banks cannot directly lend to local governments. According to China's National Audit Office, commercial banks are the primary financing source for local governments mainly through their loans to LGFVs.

through issuing, holding, or collateralizing Chengtou bonds.

2.2 Real Estate and Corruption

Given the relationships involved in local government finances, the real estate sector plays an important role. Rapidly decreasing land prices may be a trigger for a systemic event as LGFV collateral consists of property, land-use, development rights, and other real estate related assets. In normal times, land value increases and LGFVs are able to rollover debts without increasing their cost of financing. In stressed times of low land prices, debt holders may demand more collateral, which increases financing costs and generates a significant rollover risk for LGFVs. One way to meet the shortfall is to sell land, but the fire-sale in an illiquid market would create a vicious circle. Indeed, revenue from the sales of land-use rights constitutes a principal source of local government revenue. In the United States, decreasing real estate prices played a major role in many bankruptcies of over-leveraged savings and loan banks in the 1980s and 1990s (see Case, 2000) and the subprime mortgage crisis of 2007 (see Brunnermeier, 2009). In our empirical work, we will investigate how real estate values and financial market conditions influence Chengtou bond prices.

The real estate sector has also become a hotbed of corruption. The development of a real estate project can be roughly divided into four steps: (i) acquiring land for construction, ii) applying and obtaining all necessary certificates and permits from various government agencies, iii) construction, and iv) sales. In this process, the local government officials play assorted roles as land suppliers, project supervisors, and quality evaluators. The completion of a real estate project on average needs approvals from 166 government departments, involving about 180 officials.[4] Such complicated administration procedures can nourish corruption. Indeed, land transfer and construction were ranked by the State Council as the top two sectors where bribery is most prevalent in business transactions.[5] Cai, Henderson, and Zhang (2013) offers micro evidence of corruption in land leasehold sales.

Since the new Politburo assumed power in the late 2012, President Xi Jinpings

[4] See the article "Corruption nourished by complicated land deals," as of January 23, 2013, China Daily.
[5] http://news.xinhuanet.com/politics/2006-12/25/content_5528527.htm

administration announced a set of major policy reforms, called the Eight-point Regulations, explicitly designed to tackle corruption. In the next two years, the Central Commission for Discipline Inspection (CCDI), the organization in charge of the anti-corruption drive, has investigated a significant number of officials. Most corrupt officials under investigation have close connections with real estate developers. Land has become a hotbed for the misuse of power and malpractice. Table A.III lists examples of local authorities that have been investigated for real estate corruption. These judiciary actions on local government officials may as well reflect investor concerns about Chengtou bond yields because the issuance of Chengtou bonds, as explained in the previous subsection, is often collateralized by land and is implicitly guaranteed by local government. Pricing in Chengtou bond market therefore provides a particularly fitting laboratory in which to test the impact of corruption and real estate risk in local government finances.

There are other sources of local government finances in addition to those associated with Chengtou bonds, including direct transfer from the central government, loans, and municipal bond issues. Except for Chengtou bonds, none of these have market prices.[6] In so far as Chengtou bonds reflect risk that is shared by other types of local government financing—credit risk, exposure to local economic growth and real estate conditions, fiscal health of the issuer and issuing province—the relatively transparent Chengtou bond market provides a window through which we can appraise the risk exposure of Chinese municipalities in general, and examine how that risk is related to broad financial market and macro factors. In particular, the relationships we uncover between Chengtou bond yields and corruption, real estate variables, aggregate monetary policy and economic growth factors, are of interest to the broad policy debate on Chinese local government finances.

2.3 Other Characteristics of Chengtou Bonds

The rapid expansion of the Chengtou bond market goes hand-in-hand with higher yields, which is consistent with investors perceiving greater risks with increasing LGFV liabilities.

[6]Directly issued municipal bonds are sold over-the-counter, and there are no public figures on their original issuance or secondary-market transactions, except for nationwide total issuance information that is published by the central government.

Table A.I shows that yields of newly issued bonds increased from an average value of 3.5% in 2007 to 6.9% in 2014. There are increases in yields even for short-term bonds with a maturity less than one year; such bonds exhibit yield increased from 2.7% in 2009 to 5.4% in 2014. The average maturity dropped from 6.0 years in 2009 to 5.3 years in 2014, implying that investors prefer shorter-term maturities as the risks of Chengtou bonds increase.

Panel B of Table 1 summarizes Chengtou bond issuance by province. By the end of 2014, there were 30 provinces which had issued and had outstanding Chengtou bonds. The top five provinces with the largest amounts outstanding are Jiangsu, Zhejiang, Beijing, Shanghai, and Guangdong. These provinces represent 40% of the total RMB 2.34 trillion Chengtou bonds outstanding. These are all coastal provinces, except for Beijing which is the capital. The five provinces with the smallest issuance are Ningxia, Hainan, Jilin, Qinghai, and Shanxi. With the exception of Hainan, these are all interior provinces.

Decomposing the issue amounts of bonds by maturity in Figure A.I, it is clear that the bonds issued before 2008 are mainly long-term and very short-term bonds. Since the global financial crisis of 2007-2008, the bonds issued mainly have a maturity of three to seven years, and these tenors account for 66% of the total issued bonds in 2014.

Chengtou bonds are rated from A to AAA, with short-term notes rating from A1 to A1+. Each bond is rated at issue by one of the five major credit rating agencies: (i) China Chengxin International Credit Rating Co., Ltd.(a joint venture with Moody's); (ii) China Lianhe Credit Rating Co. Ltd. (a joint venture with Fitch Ratings); (iii) Dagong Global Credit Rating Co., Ltd.; (iv) Pengyuan Credit Rating Co., Ltd.; and (v) Shanghai Brilliance Credit Rating & Investors Service Co., Ltd. (in partnership with S&P). We quantify bond ratings by assigning numerical values, where higher numbers indicate higher credit quality. We assign a value of six to the highest rated bonds (AAA), a value of one for the lowest rated bonds (A), and fill in the numbers in between. Except for non-rated bonds (16% of the total issuance), 18% of bonds have a rating of AAA at issue, 27% are rated AA+, and 37% are rated AA. The lower-quality bonds with AA-, A+ and A ratings only account for 1.5% of the total issuance.

3 Data

3.1 "Tigers" and "Flies" – Corruption Measures

Corruption in China seems to be endemic. The Carnegie Endowment estimates that the cost of corruption in China in 2003 was $86 billion, or 3% of GDP, and in 2013 this increased to 13% of GDP.[7] When China's new Politburo took power in November 2012, the Communist Party of China launched an anti-corruption campaign. President Xi Jinping has vowed to crack down on both "tigers" and "flies" — a reference to powerful leaders and low-level local officials — in his campaign against corruption.[8] Up to the end of our sample, December 2014, China's Central Commission for Discipline Inspection (CCDI), the organization in charge of the anti-corruption drive, had investigated a significant number of officials from township-level "flies" to high-ranking "tigers".

We measure province-level corruption by considering both its depth and width through CCDI' graft investigations during November 2012 to December 2014. We manually compile a list of individual officials in graft investigations published on the CCDI website. There are a total of 753 officials named in the graft investigations, covering 31 provinces. We further collect information on the titles and rankings of corrupt officials, and categorize individuals into seven rankings. The final index number, denoted as *Corruption_Tigers*, is a weighted ranking of corrupt officials in each province, which gauges the depth of corruption. A higher index number suggests more severe corruption for corresponding provinces, and thus greater political risk. We also use the number of officials listed in the graft cases in each province as an alternative proxy, denoted as *Corruption_Flies*, which gauges the width of corruption. The average corruption index number, Corruption_Tigers, is 2.1 with a standard deviation of 0.4 across 30 provinces whose LGFVs issue Chengtou bonds.On average, there were 21.2 officials investigated for each province, with a standard deviation of 13.7. The number of officials named in the graft report varies across provinces: Tianjin and Guangxi, for example,

[7] See www.carnegieendowment.org/files/pb55_pei_china_corruption_final.pdf.

[8] Cited from the speech of Xi: "We must uphold the fighting of tigers and flies at the same time, resolutely investigating law-breaking cases of leading officials and also earnestly resolving the unhealthy tendencies and corruption problems which happen all around people," according to the state news agency Xinhua on January 22, 2013.

each have four cases in our sample, whereas Shanxi has 49 cases, and Sichuan and Hubei have 50 and 51 cases, respectively.

3.2 Chengtou Bond Excess Yields

We study the corruption and real estate risk in China through local government credit spreads, Chengtou bond excess yields, which is the cornerstone of our analysis. In this subsection, we define Chengtou bond excess yields.Our data on Chengtou bond issuance and transactions comes from Wind Information Co. (WIND), which provides information on Chinese financial markets.

A well-known fact about fixed income is that all yields are highly correlated with the level of sovereign bond yields, or the "level" factor (see Knez, Litterman, and Scheinkman, 1994). We construct yields in excess of matching central government bond yields to isolate the yield spreads in the Chengtou bond market. We need to control at least for duration because of the very different maturities at issue (see Figure A.I), but our matching procedure also takes into account convexity and other effects, because we control for the entire cash flow of the Chengtou bond.

We define the excess yield as the difference between the Chengtou bond yield and the matching central government bond yield:

$$Y_{ij}(t) = y_{ij}^{CTB}(t) - y_i^{CGB}(t), \tag{1}$$

where $y_{ij}^{CTB}(t)$ is the yield for Chengtou bond i in province j at time t, which we calculate based on bond characteristics and the transaction price at time t; $y_i^{CGB}(t)$ is the matching central government bond yield at time t, which has the same cash flow characteristics as Chengtou bond i.

We first compute the zero-coupon rates of Chinese government bonds as follows. We take daily transaction records from WIND on Chinese central government bonds at time t satisfying the following criteria: (1) there are at least 20 bond transactions, (2) the time-to-maturity of these bonds spans at least 10 years, and (3) we exclude bonds with a remaining

maturity of less than one month. We fit the zero-bond yield curve following Svensson (1994), who assumes the following functional form for the instantaneous forward rate, f:[9]

$$f(s,\theta) = \beta_0 + \beta_1 \exp\left(-\frac{s}{\tau_1}\right) + \beta_2 \frac{s}{\tau_1} \exp\left(-\frac{s}{\tau_1}\right) + \beta_3 \frac{s}{\tau_2} \exp\left(-\frac{s}{\tau_2}\right), \tag{2}$$

where s denotes the time to maturity and $\theta = (\beta_0, \beta_1, \beta_2, \beta_3, \tau_1, \tau_2)$ are the model parameters to be estimated. The forward curve in equation (2) is understood to apply at time t. Using the parameterized forward curve, we derive the corresponding zero-coupon central government bond yield curve at time t over different maturities s, $\{r_s(t)\}$.

To find the matching central government bond yield for Chengtou bond i, $y_i^{CGB}(t)$, we hold fixed bond i's characteristics—coupon type, coupon rate, coupon frequency, and maturity date—at the time of trade and discount each cash flow using the central government bond zero-coupon rates $\{r_s(t)\}$:

$$P_i^{CGB} = \sum_{s=1}^{T} \frac{C_i^{CTB}}{(1+r_s(t))^s} + \frac{100}{(1+r_T(t))^T}, \tag{3}$$

for maturity T, and coupon C_i^{CTB}. With the implied government bond price P_i^{CGB}, we calculate the corresponding yield, y_i^{CGB}, which we define as the matching central government bond yield for Chengtou bond i. Equation (3) effectively prices bond i as a Chinese central government bond because it uses that series of discount rates (see Duffie and Singleton, 1999), and is thus more accurate than just matching on duration or maturity because it controls for all the cash flow effects unique to each Chengtou bond.

We calculate the Chengtou bond excess yields at the daily frequency, and then aggregate to the monthly frequency and/or province level depending on the research design, which we detail below. In our final sample, there are 20,357 bond-month observations issued in 28 provinces from August 2007 to December 2014.

[9]The Svensson (1994) model produces smaller fitting errors than the Nelson and Siegel (1987) procedure.

3.3 Nationwide Economic Barometers

To isolate the impact of corruption and real estate risk on local government credit spreads, we need to control for province-level risk exposure to the central government or national economic conditions. We select the following national variables to calculate province risk exposures, on the basis that they capture China's solvency risk, monetary policy, and financial market conditions.

CDS	Chinese credit default swap rate
FDI	Foreign direct investment in China
CA	Log of the current account
FX	Effective real exchange rate
RF	One-year time deposit interest rate
RET	Chinese stock market return (including all A-shares and B-shares)

Credit default swap rates (CDS), foreign direct investment (FDI), and current account (CA) all capture different aspects of solvency risk. We use the effective real exchange rate (FX) and the one-year time deposit interest rate (RF) for monetary policy proxies. The latter is the benchmark interest rate adopted in China. For China's financial market conditions, we take the Chinese stock market index (including all A-shares and B-shares) and calculate the value-weighted return (RET). The nationwide variables come from WIND, China's National Bureau of Statistics, and Global Financial Data, and are available at the monthly frequency from January 2005 to December 2014.

3.4 Province-Level Economic Barometers

We expect that Chengtou bond yields should reflect the underlying quality and price dynamics of their collateral, real estate, and local economic growth. We obtain province-level economic indicators from the National Bureau of Statistics and WIND. These variables reflect local economic and fiscal conditions and are available for each province at the annual frequency from 2005 to 2014:

Real Estate GDP	Ratio of real estate value-added GDP to total GDP
Service GDP	Ratio of service value-added GDP to total GDP
Retail GDP	Ratio of wholesale and retail value-added GDP to total GDP
Hotel GDP	Ratio of hotel industry value-added GDP to total GDP
GDP Growth	Log difference of real GDP
Fiscal Surplus	Difference of revenue and expenditure, scaled by local GDP

3.5 Summary Statistics of Chengtou Bond Excess Yields

Under China's current fiscal and tax system, the central government is ultimately responsible for all local governments revenues and deficits. If investors perceive that Chengtou bonds have an inviolable central government guarantee, there should be no predictable cross-sectional variation in excess Chengtou bond yields and we should expect to observe the same average Chengtou bond yields across provinces. Is this true?

Figure 3 plots the dispersion of issue yields in the primary market in Panel A and excess Chengtou bond yields in the secondary market in Panel B. We mark the median value along with the 10th and 90th deciles from 2005 to 2014. The graph in Panel B reveals that Chengtou bond excess yields are persistent, with a first-order autocorrelation of 0.79. Evidently, there is also large heterogeneity in both issue yields and excess yields. In the primary market, the average range between the 10th and 90th deciles is 2.95% with a standard deviation of 0.95%. In the secondary market, the corresponding range is 1.84% with a standard deviation of 0.87%. Figure 3 shows that the dispersion of excess bond yields changes over time, and tends to increase when the median excess yield is high. This suggests that the market more finely distinguishes underlying risks of Chengtou bonds across provinces when overall market conditions deteriorate.

Table 2 reports the summary statistics of Chengtou bond excess yield. Overall, Chengtou bonds earn a premium of 1.98%, on average, over matching central government bond yields. We further show the subsample excess yields when dividing all bonds into three portfolios according to province characteristics such as: 1) geography, 2) the local fiscal surplus(or deficit if the value is negative) to GDP ratio, 3) local GDP growth rate, 4) real estate rank

(measured by the average price per squared meters during 2008 to 2014), 5) corruption measure by depth, Corruption_Tigers, and 6) corruption by width, Corruption_Flies.

There is predictable variation in excess yields across provinces: more expensive bonds (lower yields) tend to be those issued in provinces located along the coast, those bonds issued in provinces with higher housing prices, bonds issued in provinces with lower GDP growth rates and smaller fiscal gaps, and in provinces with more political risk such as corruption. It's also worth noting that contrary to conventional wisdom, provinces with higher fiscal surplus or with higher local GDP growth tend to have higher Chengtou bond excess yields. That is, the financing cost is higher for provinces with relatively better economic foundation. Meanwhile we note that those provinces with better economic performance also have a high volatility of corresponding economic barometers.

In summary, we find evidence supporting a large cross-sectional heterogeneity in Chengtou bond excess yields even though Chengtou bonds, regardless of issuing provinces, are guaranteed by the Chinese central government. The financial market seems to perceive that all Chengtou bonds are not equal. We now describe potential risk factors which may be priced in the cross-section of Chengtou bonds.

4 Empirical Results

We examine the pricing power of risk factors in the cross section of Chengtou bond excess yields through the following panel regression:

$$Y_{ijt} = \alpha_0 + \eta_t + \alpha Y_{ij,t-1} + \sum_{s=1}^{S} \xi_s \cdot X_{j(s),t} + \sum_{k=1}^{K} \gamma_k \cdot \beta_{j,F(k)} + \sum_{v=1}^{V} \zeta_v Z_{i(v)t} + \varepsilon_{ijt}, \qquad (4)$$

where Y_{ijt} is the excess yield of Chengtou bond i in province j in month t, $\beta_{j,F(k)}$ is the risk exposure of province j to national economic barometers $F(k)$, and γ_k is the price of macro risk of factor $F(k)$. The primary parameters of interest are $\{\xi_s\}$ $(s = 1, \cdots, S)$ which measure the pricing power of risk factors $X_{j(s),t}$. In particular, we investigate the corruption

risk in Section 4.1, the macro risk in Section 4.2, and the real estate risk in Section 4.3.

In the panel regression, we include the lagged yields, $Y_{ij,t-1}$, on the right-hand side because Chengtou bond spreads are persistent (see Figure 3, the one-month autocorrelation of the median excess yield across all bonds is 0.79.). The monthly fixed effect, η_t, captures any unobservable (bond-invariant) factors that can influence Chengtou yields not spanned by risk factors or province risk exposures. In some of the specifications, we also include bond characteristics, $Z_{i(v)t}$, as additional control variables such as bond size, time-to-maturity, bond liquidity proxied by the bid-ask spread. In all regressions, we cluster standard errors at the bond level.

When running regression (4), we standardize the explanatory variables in the cross section each month. We do not standardize the lag of the excess yield or the betas. In this way, the estimated coefficients in the regression can be interpreted as the effect of a one standard deviation move in the cross section, so the economic scale is also comparable across variables.

4.1 Corruption

Corruption is our prime variable for testing in the cross-section of Chengtou bond excess yields. As explained in Section 2, local governments have a vested interest in selling land-use rights to promote economic growth and the issuance of Chengtou bonds are often collateralized by such land-use rights. However, real estate projects especially those related to land sales "need approval from 166 government departments, involving about 180 officials."[10] Such complicated administration procedures can nourish corruption. China's anti-corruption campaign since 2012 reflects to some extent the severity of corruption in damaging the economy, such as in the local government financing cost reflected in Chengtou bond yields.

In Table 8, we run panel regressions as in formula (4) with our two corruption measures: Corruption_Tigers (the rank-weighted corruption index) and Corruption_Flies (the number of corruption cases), which we define in Section 3.1. We consider the corruption series individually in specifications (1) and (2). Both variables are significant, with higher levels of corruption corresponding to higher yields. A one standard deviation move of a province

[10]See an article in China Daily on January 23, 2013, "Corruption nourished by complicated land deals."

in the cross section from less to more corruption increases excess Chengtou bond yields by 0.09% for the corruption index and 0.05% for the number of corruption cases. The adjusted R^2s for these univariate regressions are around 20%, which is relatively high because we use time fixed effects. In the bivariate regression, column (3), both corruption measures maintain their own statistical significance and economic magnitude, indicating that these two proxies although correlated, target different dimensions of the corruption risk.

In specifications (4) to (5), we add the control variables: the lagged yield in column (4), and the bond characteristics in column (5). Here the bond characteristics include outstanding bond amount, time to maturity, and bond liquidity proxied by the bid-ask spread. In the presence of these control variables, there still exists a positive and highly statistically significant relationship between the level of corruption and Chengtou bond yields.

4.2 Macro Risk

Beyond corruption, other province-level characteristics and risks may also affect Chengtou bond yields. As explained in Section 2, local governments have limited legal financing power and all Chengtou bonds, regardless of issuing provinces, are implicitly guaranteed by the central government. The risk exposure of each province to the central government may therefore play an important role in determining Chengtou bond yields. In this subsection, we construct the province risk exposures and explore their risk premia.

4.2.1 Province Risk Exposures

We estimate province risk exposures by calculating the betas of province-level Chengtou bond yields with respect to national economic barometers in the following model:

$$\Delta Y_{jt} = \alpha_j + \beta_{j,F(k)} \Delta F(k)_t + \varepsilon_{jt} \tag{5}$$

where ΔY_{jt} is the monthly change of province-level excess yields, which are computed by averaging across all bond-level excess yields issued in province j during month t. $F(k)$ is national economic barometers introduced in Section 3.3 which captures China's solvency

risk, monetary policy, and financial market conditions. $\Delta F(k)_t$, is the change of the macro risk factor from month $t-1$ to month t.

We run the regression (5) for each province j using the full sample data from August 2007 to December 2014, a total of 89 monthly observations. The factor loadings, $\beta_{j,F(k)}$, in equation (5) are analogous to betas computed in the first phase of the Fama-MacBeth (1973) regression in the equity market; the factor loadings measure the contemporaneous response of bond yields to changes in macro conditions.

Table A.II in the appendix reports summary statistics of the distribution of betas. The betas exhibit significant variation across provinces, with the largest dispersion between the 10th and 90th percentiles being 1.17 for betas on the change in the one-year time deposit rate (ΔRF) and 1.79 for betas on the Chinese stock market return (RET). In Panel B, we sort provinces into three portfolios: Low, Medium, and High based on the betas for each factor. We report the excess Chengtou bond yields in the Low and High portfolios, along with a t-test for the average difference. There are significant differences in the excess yields for all the macro factors. Provinces with higher betas to China's solvency risk, CDS, tend to have higher Chengtou bond yields, with the difference between the Low and High portfolios being -0.24%. Provinces with higher betas to direct foreign investment also tend to have higher yields. These univariate portfolio sorting results suggest that Chengtou bonds reflect macroeconomic, credit, monetary policy, and financial conditions.

4.2.2 The Price of Macro Risk

We now formally test which risk exposures have pricing power for the cross-section of Chengtou bond excess yields. We estimate the simplified version of regression (4):

$$Y_{jt} = \alpha_0 + \eta_t + \alpha Y_{j,t-1} + \sum_{k=1}^{K} \gamma_k \cdot \beta_{j,F(k)} + \varepsilon_{jt}.$$

where $\beta_{j,F(k)}$ is the risk exposure of province j to risk factor $F(k)$, calculated in equation (5), and γ_k is the price of risk of factor $F(k)$ with $k = 1, \ldots, K$.

Table 4 reports the results. Columns (1) to (6) are univariate regressions. The regressions

show that the province risk exposures to China's solvency risk (CDS), the monetary policy (FX and RF), and the Chinese stock market return (RET), are priced in the cross-section of Chengtou bond yields, with a statistical significance. The magnitude of the coefficients is economically large. For example, the difference between the 10th and 90th percentiles for the beta with respect to CDS changes is 0.50 (see Table A.II). Multiplying this by the coefficient of 0.15 on the CDS factor equals 0.08%—thus, the coefficient represents a risk premium change of 0.08% moving from the 10th to 90th beta percentiles. This is an effect representing about 4% of the average 1.98% Chengtou bond risk premium.

Several of the variables are correlated, so some of the significance changes in the multivariate regressions which we report in columns (7) and (8), with and without the lagged yield, respectively. Nevertheless, CDS, FX, and RET remain significant in the multivariate regressions. After further controlling for bond characteristics in column (9), CDS and FX robustly maintain their strong pricing power both statistically and economically. The positive coefficient on China's sovereign risk suggests that Chengtou bonds are economically leveraged versions of sovereign credit risk—the greater the exposure to China's solvency risk, the higher the Chengtou bond yields. The negative coefficient on the real effective exchange rate is possibly due to government finances in provinces with high exchange rate betas benefiting from increased exports when the RMB depreciates.

4.3 Real Estate

After province risk exposures, we now turn to examining the province-level characteristics. In the terminology of asset pricing, we include characteristics in the cross-sectional regression as opposed to just factor loadings (cf. Daniel and Titman, 1997). In the extended regression (4), we still include the betas with respect to CDS and FX controlling for province risk exposures.

In Table 5, we investigate how provincial economic barometers, in particular, the various components of local GDP, influence the cross section of Chengtou bond yields. Columns (1) - (4) report the univariate regression coefficients taking just one GDP component at a time. All local GDP components are statistically significant. The coefficient on real estate

GDP is -0.17, implying that if a given province moved by one standard deviation in the cross section, that province's Chengtou bond yields would decrease by 0.17%. Given that the average excess Chengtou bond yield is 1.98%, this is a large economic effect. In the multivariate regression, column (5), which also controls for the lagged excess yield, however, only the real estate GDP and service GDP remain significant, both with negative coefficients, with the service GDP only marginally significant at the 10% level.

Column (6) shows that both local real GDP growth and the fiscal surplus are positively related to Chengtou bond excess yields. These results echo the summary statistics of Chengtou bond yields in portfolios sorted by these two local economic barometers in Table 2. A priori we might expect that, like the negative coefficient on real estate GDP, higher real estate-related economic growth should indicate a lower risk of default due to higher collateral values, and thus lower yields. The positive coefficients thus seem counter-intuitive. One possible reason for this unexpected sign is that provinces with higher GDP growth and higher fiscal surpluses also exhibit higher volatilities of growth. This conjecture is confirmed by the right panel in Table 2. When dividing the provinces into high, middle, and low terciles, provinces in the high tercile of fiscal surpluses have a mean of 20.73% and a standard deviation of 9.94%. The provinces in the low fiscal surplus tercile have, by construction, the lowest mean of fiscal surplus of 3.18% but also a low standard deviation of 3.04%. The same findings apply to GDP growth: the provinces with the highest average GDP growth also have the most volatile growth. The mechanical relationship between high economic growth and high volatility drives the positive coefficients in the regression specification, column (6), as these provinces are actually risky!

In column (7), we consider the full set of provincial economic variables. When jointly taking local GDP components and GDP growth as well as fiscal surplus in the multivariate regression, the real estate value-added GDP ratio becomes the only variable which keeps its significant pricing power. The result remains the same when controlling for province risk exposures, the betas with respect to CDS and FX, in column (8) and controlling for additional bond characteristics in column (9).

In sum, all regression specifications favor real estate GDP. This strong result indicates

that real estate risk plays an essential role in explaining the cross-section of Chengtou bond excess yields.

4.4 Kitchen Sink Regressions

We now reexamine the pricing power of corruption risk using a kitchen-sink regression. Before the regression, we first check the correlation among explanatory variables. Table 6 shows that two corruption proxies, Tigers and Flies which represent corruption depth and corruption respectively, are negatively correlated. Real estate value-added GDP is also negatively related to both Tigers and Flies, indicating that provinces with higher corruption depth and width are also those with lower real estate value-added GDP. Moreover, real estate GDP is negatively related to GDP growth and fiscal surplus.

Putting explanatory variables together in the kitchen-sink regression, we want to identify the main risk factors that squeeze out other variables. Column (1) in Table 7 shows that corruption risks, both Corruption_Tigers and Corruption_Flies remain significant even after controlling for province risk exposures with respect to CDS and FX, lagged excess yields, and bond characteristics. However, when real estate GDP is considered in the regression, column (2), both measures of corruption risk lose their explanatory power. In the kitchen-sink regression with all risk factors considered in our tests, real estate GDP stands out again. The province risk exposures also matter, however, in province economic barometers, the real estate value-added GDP ratio is clearly the most important economic factor in determining the cross-section of Chengtou bond excess yields.

5 Economic Mechanism

So far we have shown that corruption, local marco risk, and real estate variables all have explanatory power in the cross-section of Chengtou bond excess yields. When controlling for bond characteristics and provincial risk exposures, corruption risk and real estate risk stand out. In the kitchen-sink regression, however, real estate value-added GDP is the only important factor which drives out corruption risk. As discussed in Section 2.2, corruption

is often embedded in real estate industry. In this section, we thus examine the relationship between corruption and real estate variables and show that the pricing power of corruption on Chengtou bond yields is indeed partially via the channel of real estate. Since the anti-corruption campaign, corruption also has its own independent explanatory power, even after controlling for real estate variables.

5.1 Corruption and Real Estate

As discussed in Section 2.2, the real estate sector is closely related to local governments, through channels including land allocation, changes of the purpose of land (e.g. from public-use to commercial use), revision of plot ratio, and especially sales of land. In theory, local governments should supervise all the functioning departments in managing the real estate industry, however, many of government officials have directly participated in or even organized real estate corruption. Table A.III lists some examples of high-rank local officials involved in real estate corruption. For example, Ni Fake, once the deputy governor of Anhui Province, was in charge of land resources when in office. From 2008, he helped nine real estate companies illegally acquire land in return for gifts, according to the China Business News.

The correlation results in Table 6 has already suggested a negative relationship between real estate GDP and Corruption_Tigers as well as Corruption_Flies, although the two corruption proxies are negatively correlated. We now examine their relationship formally in regressions. The dependent variable is real estate value-added GDP for each province per year, and the explanatory variables are corruption proxies: Corruption_Tigers and Corruption_Flies. Columns (1) and (2) in Table 8 report the univariate regression results. Both corruption depth and corruption width are negatively and significantly related to real estate GDP. The magnitude is particularly great for corruption depth, indicating that provinces with higher corruption index value, Corruption_Tigers, tend to have far lower real estate GDP. The results remain the same, as shown in Column (3) and (4), after controlling for provincial risk exposures measured by the factor loadings on China's CDS spread and the real effective exchange rate. The multivariate regression in Column (5) further suggests that

corruption index value and the number of corruption cases both contain marginal information that is negatively related to real estate GDP. The overall explanatory power is 11.2% in adjusted R-squared value.

5.1.1 Instrument Variable Methodology

The degree of corruption in a province is likely to be endogenously explained by the same variables that also reduce local real estate GDP. Properly claiming the impact of corruption on Chengtou bond yields through the real estate channel, therefore, calls for controlling the unobserved common variations that underlie both corruption and real estate. We instrument the degree of corruption with two candidate variables: (i) the total assets of state-owned-enterprises in a province scaled by local GDP; and (ii) the housing turnover measured by the ratio of trading volume to housing volume completed. The rationale for using these variables as instrument variables is that SOE assets and housing turnover are correlated with the corruption proxies while they are not related to the common variation underlying both corruption and real estate.

We start by testing whether instrument variables are correlated with corruption. The first stage regressions suggest that (i) SOE assets are negatively related to Corruption_Flies—larger SOE sizes typically associated with less small scale corruption cases, and (ii) housing turnover is positively related to Corruption_Flies—anecdotal news reports suggest that since the anti-corruption campaign began in 2012 there have been more anonymous apartments sales with large discounts.

The second stage regressions provide evidence that when exogenizing the corruption proxies—Tigers and Flies—the significant effects of corruption on (lowering) real estate value remain statistically significant. In other words, there seems to be exogenous variations in the corruption proxies that cause impairment in local real estate value. One possible channel is that more local government corruption would typically cause money to be siphoned away from land lease auctions, which in turn results in lower quality in the infrastructure constructions supporting the real estate development. The worse real estate value would further be translated into lower collateral value, and eventually a higher excess yield in

Chengtou bonds.

5.2 Effect of Anti-Corruption Campaign

It is very important to point out that although our data sample spans from 2007 to 2014, the anti-corruption campaign only began in the late 2012. Whether corruption proxies should be expected to impact the Chengtou bond excess yields significantly should therefore differ between the pre- and post-anti-corruption campaign. More precisely, if the market participants do not note that local government corruption will be punished severely and properly, they may not price in such a political risk correctly in the secondary market. Only when corruption is revealed and investigated effectively, can investors infer properly that more corruption probably leads to low quality infrastructure and thus causes shady real estate value.

We use the timing of President Xi Jinping's administration assuming power as the start of the anti-corruption campaign, which was November 2012 when the 18th National Congress of the Communist Party of China was held. Indeed, 19 days after the election of the new administration, the central government announced a set of policy reforms targeting corruption. We thus define the before-campaign period in our sample as August 2007 to October 2012, and the campaign period as November 2012 to December 2014.

Not surprisingly, Table 10 shows that before the anti-corruption campaign, only real estate GDP seems to be a dominant determinant of the Chengtou bond yields, while both Corruption_Tigers and Corruption_Flies are driven to be statistically insignificant. During the anti-corruption campaign, real estate GDP can no longer crowd out the Corruption_Flies, which suggests that the secondary market takes notice of which local province has more corruption and thus prices the Chengtou bond yields more aggressively, above and beyond what traders can infer from the real estate channel alone.

This finding has an important policy implication that the anti-corruption campaign has an important economic value: the revealing of more corruption should indicate worse real estate value and lead to more risky Chengtou bonds. Therefore capital allocation should lean toward less corrupt and thus less risky real estate development projects, which improves the

resource allocation efficiency in a society.

5.3 Event Study of Corruption Announcement

Given the fact that corruption involved irreplaceable information after the anti-corruption campaign, we further examine the impact of the corruption announcement on the Chengtou bond market. There are a total of 753 officials named in the graft investigations. Many announcements took place on the same day or in adjacent periods. We examine two types of events: (1) the first corruption event in each province; and (2) Tiger events in each province. For an event to be identified as a Tiger event, the official in the graft report should have a ranking higher than 3, and the event be at least three months away from a previous event of the same province to avoid the overlapping of information.

To estimate the abnormal yield spread (conventionally called AR), we first regress the province-level Chengtou bond excess yield to the national average excess yield, in the spirit of CAPM in asset pricing studies. The estimation window is the period before the anti-corruption campaign, from August 2007 to October 2012. After identifying each event, we calculate the abnormal yield spread as the difference in realized province excess yield and that predicted, where the prediction is based on the realized national excess yield and the regression coefficients in the estimation window. Table 11 reports the abnormal yield spread for the event day, AR(0), and the day before and after the event, AR(-1) and AR(1). For both types of events, the abnormal yield spreads tend to be negative but insignificant around event days; only the announcements of Tiger events have significant impact on the Chengtou bond market for the top 5 provinces with the highest corruption indexes. The results indicate that provinces with the most severe corruption conditions are inclined to respond positively on the announcement days, and their average excess yields are lower than those predicted, suggesting lower financing costs for these provinces. The cumulative effect over event days [0,1], or [-1,1], is even stronger for TIGER events in provinces with the most severe corruption indexes, but remains muted for other events or for the same events in other provinces.

By isolating the changes in other market conditions, the event study of CCDI corruption announcements provides further evidence that corruption plays an important role in the

Chengtou bond market,

6 Conclusion

Chengtou bonds play an important role in funding Chinese local governments. The market experienced tremendous growth after the 2008 global financial crisis and as of December 2014, there were RMB 4.95 trillion ($0.82 trillion) of Chengtou bonds outstanding. The Chinese central government is ultimately responsible for the finances of all local governments, but despite the guarantee, we find large heterogeneity in Chengtou bond yields.

Reflecting the systemic risk of Chengtou bonds, we find that variables reflecting aggregate credit risk, monetary policy, and the real effective exchange rate are priced in the cross section. We find that real estate values are important drivers of Chengtou bonds, which is not surprising given that their collateral value is directly linked to the real estate market. We also find that Chengtou bond yields reflect corruption risk: we construct an index of corruption based on the officials investigated by the Central Commission for Discipline Inspection (CCDI). We find a significantly positive correlation between risk-adjusted Chengtou bond yields and the corruption index.

The rules governing local government finances in China are changing. In October 2014, the State Council issued Rule No. 43 which states that from January 1, 2016, LGFVs are no longer allowed to issue Chengtou bonds. This effectively shuts down Chengtou bonds as a source of funds for local governments. Instead, local governments will rely on alternative financing channels: (1) issuing regular municipal bonds for public-interest projects fully backed by tax revenue, (2) forming public-private partnerships for infrastructure developments which do not carry a government guarantee, and (3) issuing private corporate debt for non-public (commercial) real estate projects.

These developments mean that although the amounts outstanding are large, Chengtou bonds are likely to become a legacy asset. At present, Chengtou bonds are the only local government asset where market prices are observable. Thus, the pricing of credit risk, political risk, real estate risk, and other province and bond-level characteristics in Chengtou

bonds provides a unique opportunity to study how these types of risk impact Chinese local government finances in general.

References

[1] Allen, F., J. Qian, and M. Qian, 2005. Law, finance and economic growth in China. *Journal of Financial Economics* 77, 57-116.

[2] Amihud, Y., 2002. Illiquidity and stock returns: Cross-section and time-series effects. *Journal of Financial Markets* 5, 31-56.

[3] Ang, A., V. Bhansali, and Y. Xing, 2015. The muni bond spread: Credit, liquidity, and tax. Working paper, Columbia Business School.

[4] Bao, J., J. Pan, and J. Wang, 2011. The illiquidity of corporate bonds. *Journal of Finance* 66, 911-946.

[5] Brunnermeier, M. K., 2009. Deciphering the liquidity and credit crunch 2007-2008. *Journal of Economic Perspectives* 23, 77-100.

[6] Butler, Alexander W., Larry Fauver, and Sandra Mortal, 2009. Corruption, Political Connections, and Municipal Finance. *Review of Financial Studies* 22, 2873-2905.

[7] Cai, Hongbin, J. Vernon Henderson, and Qinghua Zhang, 2013. China's land market auctions: evidence of corruption? *The RAND Journal of Economics* Volume 44, Issue 3, 488521.

[8] Case, K. E., 2000, Real estate and the macroeconomy, in Glaeser, E. L., and J. A. Parker, *Brookings Papers on Economic Activity* vol. 2000, no. 2, 119-162, Brookings Institution Press.

[9] Daniel, K., and S. Titman, 1997. Evidence on the characteristics of cross sectional variation in stock returns. *Journal of Finance* 52, 1-33.

[10] Duffie, D., and K. J. Singleton, 1999. Modeling term structures of defaultable bonds. *Review of Financial Studies* 12, 687-720

[11] Fang, H., Q. Gu, W. Xiong, and L.A. Zhou, 2015. Demystifying the Chinese housing boom. Working paper, Princeton University.

[12] Fisman, R., and Y. Wang, 2011. Evidence on the existence and impact of corruption in state asset sales in China. Working paper, Columbia University.

[13] Fisman, R., and Y. Wang, 2013. The mortality cost of political connections. Working paper, Columbia University.

[14] Gervais, S., R. Kaniel, and D. H. Mingelgrin, 2001. The high volume-return premium. *Journal of Finance* 56, 877-919.

[15] Gospodinov, Nikolay, Brian Robertson, and Paula Tkac, 2014. Do Municipal Bonds Pose a Systemic Risk? Evidence from the Detroit Bankruptcy. Working paper at Federal Reserve Bank of Atlanta.

[16] Harrison, M., and D. Kreps, 1978. Speculative investor behavior in a stock market with heterogeneous expectations. *Quarterly Journal of Economics* 92, 323-336.

[17] Husain, A. M., A. Mody, and K. S. Rogoff, 2005. Exchange rate regime durability and performance in developing versus advanced economies. *Journal of Monetary Economics* 52, 35-64.

[18] Knez, P. J., R. Litterman, and J. Scheinkman, 1994. Explorations into factors explaining money market returns. *Journal of Finance* 49, 1861-1882.

[19] Levy, A., and S. Schich, 2010. The design of government guarantees for bank bonds: Lessons from the recent financial crisis. *OECD Journal: Financial Market Trends 2010/1.*

[20] Li, H., and L. A. Zhou, 2005. Political turnover and economic performance: the incentive role of personnel control in China. *Journal of Public Economics* 89, 1743-1762.

[21] Ang, Andrew and Francis Longstaff, 2014. Systemic Sovereign Credit Risk: Lessons from the U.S. and Europe. *Journal of Monetary Economics*, forthcoming.

[22] Lu, Y., and T. Sun, 2013. Local government financing platforms in China: A fortune or misfortune? IMF working paper 13/243.

[23] Mei, J., and W. Xiong, 2009. Speculative trading and stock prices: Evidence from Chinese A-B share premia. *Annals of Economics and Finance* 10, 225-255.

[24] Miller, E. M., 1977. Risk, uncertainty, and divergence of opinion. *Journal of Finance* 32, 1151-68.

[25] Nelson, C. R. and A. F. Siegel, 1987. Parsimonious modeling of yield curves. *Journal of Business* 60, 473-89.

[26] Pástor, L., and R. F. Stambaugh, 2003. Liquidity risk and expected stock returns. *Journal of Political Economy* 111, 642-685.

[27] Svensson, L. E., 1994. Estimating and interpreting forward interest rates: Sweden 1992-1994. NBER Working Paper 4871.

[28] Wang, S., and F. Yu, 2014. What drives Chinese local government bond yields? Working paper.

[29] Wu, X., and He, H., 2014. China financial policy report: 201. China Finance Publishing House.

Appendix A Liquidity and Chengtou Bond Yields

In this appendix we investigate if liquidity is priced in Chengtou bond excess yields. We first construct liquidity measures through real transaction data.

After issuance, Chengtou bonds trade mainly in the interbank market, which has a market share of 68%. They also trade in the Shanghai and Shenzhen stock exchanges, with these venues capturing a market share of 30%. For each bond transaction on day t, we observe its open and closing prices, the highest and lowest price, the mid price, trading volume, and the yield to maturity. To obtain accurate bond pricing information, we only keep bonds which trade on the interbank or exchange markets, and screen out bonds with special terms such as callable or putable bonds.

To get a sense of the overall market liquidity, we calculate the trading frequency as the number of traded bonds divided by the total number of outstanding bonds in each month. The monthly trading frequency is below 30% before 2006, jumps to 65% in 2007, remains stable between 60% to 70% after August 2007. Given our object of interest is the cross section of Chengtou bonds, we choose our final sample to cover the relatively liquid period from August 2007 to December 2014.

We compute three bond-level liquidity statistics:

1. **Turnover** is the ratio of trading volume to the outstanding amount, which we compute at the monthly frequency. We sum across trading days within each month to obtain the monthly trading volume. We take the amount outstanding at the end of the month.

2. **Amihud**: Following Amihud (2002), *Amihud* is defined for bond i as

$$Amihud_i = \frac{1}{N_t} \sum_t \frac{|R_{it}|}{Vol_{it}}, \tag{A.1}$$

   where R_{it} is bond i's return on day t, Vol_{it} is bond i's trading volume on day t, and N_t is the number of days where bond i trades that month.

3. **High-Low Spread** is the difference between daily high and low prices.

As shown in the table below, the average spread is 0.21 with a standard deviation of 0.74. The average monthly turnover ratio is 42.6% and the average Amihud liquidity measure is 32.9. In sum, Chengtou bond market is relatively illiquid.[11] Thus, we might expect the cross section of Chengtou bonds to exhibit an illiquidity premium, as is the case for equity and bond markets (see, for example, Pástor and Stambaugh, 2003, and Bao, Pan, and Wang, 2011, respectively).

Liquidity Characteristics

	Mean	Median	Stdev	P10	P90
Spread	0.21	0.00	0.74	0.00	0.51
Amihud	32.87	1.37	115.75	0.03	51.87
Turnover	42.58	14.00	98.95	0.25	101.00

Table A.IV presents the regression results. In the first three columns, we examine the univariate regression for turnover, the Amihud (2002) measure, and the High-Low spread. Only turnover and the Amihud measure are statistically significant. For the Amihud measure, a one standard deviation increase leads to a decrease of 0.04% in Chengtou bond yields. The Amihud measure becomes insignificant in regression (4), controlling for all three liquidity variables jointly, and in regressions (5) to (7) with the CDS, FX, and RF risk factor exposures, and lagged yields, respectively. Only the turnover ratio remains robust in the presence of province-level risk exposures, credit ratings, and the lagged yield in regressions(4) to (6).

The turnover coefficient is statistically significant across all regression specifications. The coefficient, however, is surprisingly positive: bonds with higher turnover should be more liquid bonds, and this should lead to lower yields as the greater liquidity should be attractive to investors. The positive sign between turnover and yields is reminiscent of the positive relation between volume and returns which Gervais, Kaniel, and Mingelgrin (2001) find in equity markets. Gervais, Kaniel, and Mingelgrin postulate that their finding of higher liquidity-higher returns is when a stock becomes more visible, it draws in a large number of potential buyers while the number of potential sellers remains the same. In the presence of short-sale constraints, the increase in visibility tends to increase expected returns (cf. Miller, 1977; Harrison and Kreps, 1978). Chinese markets fit these

[11] But Chengtou bonds are significantly more liquid than U.S. municipal bonds, see Ang, Bhansali, and Xing (2015).

particular circumstances. Short-selling of securities is not permitted. Mei and Xiong (2009) note that speculative investors play a pronounced role in Chinese markets.

There is another possible channel contributing to the positive correlation between current turnover and chentou bond yields in the cross section. Speculators are most drawn to those bonds with the highest yields—the riskiest bonds. Consistent with this "reaching for yield," turnover is highest at 52.4% for AA-rated bonds, and lowest at 32.4% for AAA-rated bonds.

In regression (7), we introduce an interaction term between turnover and high-quality bonds. The latter variable is a dummy which is equal to one if the bond credit rating is AAA, and zero otherwise. Although the Amihud measure is insignificant in the multivariate regressions (regressions (4) to (6)), it is significant in the univariate specification (regression(2)), so for completeness we also include an interaction term between the Amihud measure and high-quality bonds. Table A.IV, regression (7) shows that while the coefficient on turnover remains significantly positive, the coefficient on the interaction term between turnover and high quality is negative. Thus, within the high credit quality category, bonds with high turnover ratios have lower yields.

Table 1: **Chengtou Bond Issuance**

The table reports chengtou bond issuance in terms of the number of bonds issued each year and the issue amounts in billions of RMB broken down by maturity buckets (Panel A) and by province (Panel B). Maturity buckets include less than or equal to one year, (0,1]; between one and three years, (1,3]; between three and seven years, (3,7]; and between seven and 30 years, (7,30]. *Amount* in Panel B is in RMB billion. Integer values are assigned to ratings: one for A increasing to six for AAA. We report the average maturity and rating at issue.

Panel A: Issuance over Time

	Number of Bonds Issued (Years)					Issue Amount (Bil RMB)					Outstanding
Year	(0,1]	(1,3]	(3,7]	(7,30]	Total	(0,1]	(1,3]	(3,7]	(7,30]	Total	(Bil RMB)
1997	0	0	1	0	1	0	0	0.5	0	0.5	0.5
1998	0	3	2	0	5	0	0.9	0.8	0	1.7	2.2
1999	0	1	2	1	4	0	0.2	1.1	0.8	2.1	4.3
2000	0	2	3	0	5	0	0.3	2.1	0	2.4	6.7
2001	0	0	0	0	0	0	0	0	0	0	5.8
2002	0	0	0	5	5	0	0	0	7.5	7.5	12.6
2003	0	0	0	8	8	0	0	0	16.6	16.6	28.1
2004	0	0	1	4	5	0	0	1.4	7	8.4	35.4
2005	12	0	6	25	43	18.2	0	7	33.3	58.5	91.8
2006	19	0	3	37	59	23.1	0	1.8	44.3	69.2	142.3
2007	34	0	1	38	73	42.1	0	1.5	43.8	87.3	205.2
2008	36	4	32	7	79	49.3	8.5	50.7	11.7	120.2	280.9
2009	40	11	162	45	258	45.6	22.6	248.7	92.4	409.3	648.3
2010	68	17	156	47	288	79.4	19.9	203.2	72.8	375.3	964.2
2011	74	26	243	41	384	70.7	33.4	314.3	63.3	481.6	1362.2
2012	139	49	763	76	1027	133.1	35.6	930.1	109.1	1207.8	2469.4
2013	184	78	678	44	984	210.5	51.6	816.3	95.5	1173.8	3435.3
2014	352	139	1129	84	1704	381.9	56.01	1303.1	159.0	1900.0	4954.5
Total	958	330	3182	462	4932	1053.9	229.0	3882.5	756.9	5922.3	

Panel B: Issuance by Province

	At Issue			Outstanding		Maturity	Rating
Province	Amount	Bonds	Issuers	Amount	Bonds	(year)	
Jiangsu	949.89	844	223	745.78	689	5.20	3.80
Zhejiang	418.58	426	120	360.09	362	6.11	3.63
Beijing	390.37	199	25	246.10	125	5.14	4.68
Shanghai	296.83	221	43	162.93	119	5.09	4.45
Guangdong	280.10	198	56	227.65	145	5.92	4.12
Shandong	272.57	246	73	256.07	232	6.56	3.67
Hunan	270.90	207	56	249.58	193	6.39	3.56
Chongqing	268.55	219	61	254.55	205	6.49	3.74
Tianjin	259.62	155	38	209.07	124	5.44	4.03
Anhui	258.24	229	53	222.64	196	6.02	3.64
Sichuan	233.97	216	64	202.92	183	5.27	3.53
Hubei	194.92	169	43	176.30	151	6.72	3.76
Liaoning	192.45	152	47	190.55	145	6.96	3.25
Jiangxi	185.05	165	35	154.20	135	5.80	3.81
Fujian	175.54	189	46	148.54	154	5.51	3.62
Henan	143.35	124	38	133.85	109	6.82	3.57
Shaanxi	128.70	103	30	101.10	85	5.06	3.69
Hebei	118.05	98	26	112.15	89	7.40	3.73
Yunnan	117.60	105	26	105.95	94	5.95	3.57
Guangxi	116.61	119	29	98.81	98	5.91	3.63
Guizhou	102.50	80	30	100.80	78	7.15	3.20
Xinjiang	96.22	103	34	85.52	84	5.86	3.26
Gansu	95.00	63	13	71.90	52	5.43	3.82
Inner Mongolia	92.25	80	29	85.30	72	6.72	3.38
Heilongjiang	80.98	74	19	77.58	70	6.75	3.40
Shanxi	59.55	44	15	57.85	41	7.06	3.36
Qinghai	49.10	41	8	44.00	34	7.15	3.63
Jilin	44.47	39	10	42.47	37	6.90	3.68
Hainan	16.40	12	3	16.40	12	6.51	3.67
Ningxia	13.90	12	5	13.90	12	8.22	3.75
Total	5922.25	4932	1298	4954.54	4125	6.25	3.69

Table 2: **Summary Statistics**

The table reports the distribution statistics of the excess yield (%) on chengtou bonds based on transaction data. We also report the bond excess yield distribution subdivided by six criteria based on province-level characteristics: (1) geography, (2) the local fiscal surplus to GDP ratio, (3) local GDP growth rate, (4) real estate price (the average price per squared meters during 2008 to 2014), (5) Corruption_Tigers (the weighted-average index), and (6) Corruption_Flies (the number of graft cases). P10 and P90 denote the 10th and 90th percentiles, respectively. Right panel reports the mean and standard deviation (*SD*) for corresponding criterion. The sample period is from 2007 to 2014.

		Excess Yields (%)					Characteristics	
		Mean	Median	SD	P10	P90	Mean	SD
All Bonds		1.98	1.90	0.81	1.11	2.98		
Geography								
	Coastal	1.87	1.77	0.81	1.04	2.83		
	Middle	2.15	2.11	0.83	1.19	3.19		
	West	2.21	2.16	0.75	1.34	3.10		
Fiscal Surplus							Fiscal Surplus (%)	
	High	2.37	2.35	0.76	1.43	3.29	20.73	9.94
	Mid	2.13	2.07	0.79	1.24	3.09	10.44	3.13
	Low	1.85	1.76	0.80	1.03	2.81	3.18	3.04
GDP Growth							GDP Growth (%)	
	High	2.09	2.00	0.80	1.25	3.05	19.08	7.34
	Mid	2.10	2.06	0.81	1.20	3.07	16.51	5.02
	Low	1.79	1.69	0.79	0.97	2.79	13.93	5.73
Real Estate Price							RE Price (¥/m^2)	
	High	1.92	1.81	0.81	1.08	2.90	7659	3629
	Mid	2.08	2.03	0.81	1.14	3.11	3687	267
	Low	2.17	2.18	0.76	1.26	3.07	3145	144
Corruption_Tigers							Corruption Index	
	High	2.20	2.13	0.82	1.26	3.18	2.47	0.23
	Mid	1.89	1.80	0.79	1.07	2.87	2.13	0.13
	Low	1.91	1.84	0.80	1.04	2.87	1.75	0.09
Corruption_Flies							Number of Cases	
	High	2.01	1.95	0.78	1.17	2.97	39	9
	Mid	2.04	1.98	0.83	1.12	3.05	23	3
	Low	1.92	1.82	0.82	1.08	2.94	9	4

Table 3: **Corruption Risk and Chengtou Bond Excess Yields**

This table presents the panel regression results of chengtou bond excess yields on the corruption risk of local governments, as in (4). We use two proxies for corruption: *Corruption_Tigers* which is weighted-average index by the ranking of officials investigated by the CCDI in each province, and *Corruption_Flies* which is the number of officials listed in graft cases in each province. The former measures the depth of corruption whereas the latter measures the width. We average bond yields over each month to obtain monthly frequency values. We include the lagged bond excess yields as a control variable. In Column (5) we also include additional control variables of bond characteristics such as bond size, time-to-maturity, and bond liquidity proxied by the bid-ask spread. Standard errors are clustered at the bond level and corresponding t-statistics are reported. *, **, and *** represent statistical significance at the 10%, 5%, and 1% confidence levels, respectively. The sample period is from August 2007 to December 2014.

	(1)	(2)	(3)	(4)	(5)
Corruption_Tigers	0.09***		0.09***	0.02***	0.02***
	[4.33]		[4.65]	[4.39]	[4.56]
Corruption_Flies		0.05***	0.06***	0.01***	0.01**
		[3.09]	[3.58]	[2.92]	[1.93]
Lagged yield				0.77	0.76
				[49.10]	[44.31]
Month FE	Y	Y	Y	Y	Y
Cluster (Bond)	Y	Y	Y	Y	Y
Bond Controls	N	N	N	N	Y
Observations	20342	20342	20342	18772	18772
Adjusted R2	0.198	0.191	0.203	0.620	0.621

Table 4: **Macro Risk and Chengtou Bond Excess Yields**

This table presents the panel regression results of chengtou bond excess yields on the macroeconomic risks of local governments, as in (4). The macro risks are constructed in a first-pass time-series regression (5), that is, the betas of regressing the change of province-level chengtou bond yields on the change of each of six macro factors: (i) the credit default swap on the Chinese central government (CDS), (ii) the log of foreign direct investment (FDI), (iii) the log of current account (CA), (iv) the effective real exchange rate (FX), (v) the one-year time deposit interest rate (RF), and (vi) the Chinese stock market return (RET). The β's measure corresponding macro risks. We average bond yields over each month to obtain monthly frequency values. We include the lagged bond excess yields as a control variable. In Column (9) we also include additional control variables of bond characteristics such as bond size, time-to-maturity, and bond liquidity proxied by the bid-ask spread. Standard errors are clustered at the bond level and corresponding t-statistics are reported. *, **, and *** represent statistical significance at the 10%, 5%, and 1% confidence levels, respectively. The sample period is from August 2007 to December 2014.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
β_{CDS}	0.15*						0.24***	0.06***	0.08***
	[1.86]						[2.75]	[2.70]	[3.17]
β_{FDI}		0.12					-0.01	0.03	0.04
		[1.25]					[-0.08]	[0.75]	[1.02]
β_{CA}			0.50				1.07	0.15	0.07
			[1.35]				[1.53]	[0.79]	[0.37]
β_{FX}				-1.22*			-2.87***	-0.59**	-0.58**
				[-1.90]			[-2.89]	[-2.23]	[-1.97]
β_{RF}					-0.04*		0.02	0.01	0.00
					[-1.72]		[0.43]	[0.42]	[-0.03]
β_{RET}						-0.06**	-0.12***	-0.03**	-0.02
						[-2.15]	[-3.05]	[-2.32]	[-1.64]
Lagged Yield								0.77	0.76
								[48.21]	[43.71]
Month FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Cluster (Bond)	Y	Y	Y	Y	Y	Y	Y	Y	Y
Bond Controls	N	N	N	N	N	N	N	N	Y
Observations	20357	20357	20357	20357	20357	20357	20357	18785	18785
Adjusted R^2	0.185	0.184	0.184	0.186	0.185	0.186	0.199	0.620	0.621

Table 5: **Real Estate and Chengtou Bond Excess Yields**

This table presents the panel regression results of chengtou bond excess yields on the provincial economic barometers, as in (4). The provincial economic barometers include the real estate value-added GDP, the service value-added GDP, the wholesale and retail value-added GDP, the hotel value-added GDP, as well as the local real GDP growth, and fiscal surplus, all scaled by the local GDP. We average bond yields over each month to obtain monthly frequency values. We include the lagged bond excess yields and the CDS and FX risk factor exposures as control variables. In Column (9) we also include additional control variables of bond characteristics such as bond size, time-to-maturity, and bond liquidity proxied by the bid-ask spread. Standard errors are clustered at the bond level and corresponding t-statistics are reported. *, **, and *** represent statistical significance at the 10%, 5%, and 1% confidence levels, respectively. The sample period is from August 2007 to December 2014.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Real Estate GDP	-0.17***				-0.03***		-0.03***	-0.04***	-0.04***
	[-9.69]				[-5.03]		[-3.80]	[-4.50]	[-4.36]
Service GDP		-0.06***			-0.01*		-0.01	-0.02	-0.02
		[-10.23]			[-1.85]		[-1.91]	[-1.26]	[-1.13]
Retail GDP			-0.05***		0.01		0.01	0.01	0.02
			[-10.38]		[1.23]		[1.30]	[0.80]	[1.16]
Hotel GDP				0.12***	0.01		0.01	0.00	0.01
				[2.95]	[0.55]		[0.57]	[0.79]	[0.99]
GDP Growth						0.02***	0.00	-0.01	0.00
						[2.94]	[0.50]	[-0.75]	[-0.23]
Fiscal Surplus						0.01**	0.00	0.00	0.00
						[2.31]	[-0.66]	[0.23]	[0.22]
β_{CDS}								0.06**	0.08***
								[2.47]	[2.98]
β_{FX}								-0.69***	-0.71***
								[-2.80]	[-2.86]
Lagged yield					0.78	0.77	0.78	0.77	0.77
					[43.15]	[46.23]	[42.97]	[43.65]	[40.28]
Month FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Cluster (Bond)	Y	Y	Y	Y	Y	Y	Y	Y	Y
Bond Controls	N	N	N	N	N	N	N	N	Y
Observations	17524	17524	17524	17524	16238	18741	16194	16194	16194
Adjusted R2	0.214	0.222	0.219	0.191	0.628	0.620	0.628	0.628	0.629

Table 6: **Correlation Matrix of Major Explanatory Variables**

	Tigers	Flies	RE GDP	β_{CDS}	β_{FX}	GDP Growth	Fiscal Surplus
Tigers	1	.	.	.	.	.	.
Flies	-0.24	1	.	.	.	.	.
RE GDP	-0.25	-0.15	1	.	.	.	.
β_{CDS}	0.03	0.10	-0.16	1	.	.	.
β_{FX}	-0.15	0.17	-0.05	0.50	1	.	.
GDP Growth	0.08	-0.01	-0.28	-0.01	-0.12	1	.
Fiscal Surplus	0.12	-0.18	-0.60	0.05	0.05	0.15	1

Table 7: **Kitchen-Sink Regressions**

This table presents the kitchen-sink regression results of chengtou bond excess yields on all risk factors. We average bond yields over each month to obtain monthly frequency values. We include three types of control variables: the lagged bond excess yields, the province-level CDS and FX risk factor exposures, and the bond characteristics such as bond size, time-to-maturity, and bond liquidity proxied by the bid-ask spread. Standard errors are clustered at the bond level and corresponding t-statistics are reported. *, **, and *** represent statistical significance at the 10%, 5%, and 1% confidence levels, respectively. The sample period is from August 2007 to December 2014.

	(1)	(2)	(3)
Corruption_Flies	0.01**	0.00	0.00
	[2.54]	[0.12]	[-0.01]
Corruption_Tigers	0.02***	0.01	0.01
	[3.72]	[0.92]	[0.92]
Real Estate GDP		-0.03***	-0.03***
		[-5.19]	[-3.98]
Service GDP			-0.02
			[-1.09]
Retail GDP			0.02
			[1.18]
Hotel GDP			0.01
			[0.86]
GDP Growth			0.00
			[-0.34]
Fiscal Surplus			0.00
			[0.18]
β_{CDS}	0.08***	0.08***	0.08***
	[3.33]	[2.85]	[2.95]
β_{FX}	-0.43**	-0.62***	-0.64**
	[-2.26]	[-2.90]	[-2.09]
Lagged yield	0.76	0.77	0.77
	[43.97]	[40.34]	[40.19]
Month FE	Y	Y	Y
Cluster (Bond)	Y	Y	Y
Bond Controls	Y	Y	Y
Observations	18772	16238	16194
Adjusted R2	0.622	0.629	0.629

Table 8: **Corruption and Real Estate**

This table examines the relationship of corruptions of local governments and provincial real estate factor. The dependent variable is the real estate value-added GDP scaled by local GDP. The explanatory variables are two proxies of corruption: *Corruption_Tigers* which is weighted-average index by the ranking of officials investigated by the CCDI in each province, and *Corruption_Flies* which is the number of officials listed in graft cases in each province. Regression is run using the province-year panel during 2007-2014 for provinces studied in our sample. We also include provincial risk exposures to national credit risk (β_{CDS}), and to national effective real exchange rate (β_{FX}), as control variables. *t*-statistics are reported in brackets. *, **, and *** represent statistical significance at the 10%, 5%, and 1% confidence levels, respectively.

LHS = Real Estate GDP

	(1)	(2)	(3)	(4)	(5)
Corruption_Flies		-0.02**		-0.02**	-0.02**
		[-2.16]		[-2.03]	[-2.92]
Corruption_Tigers	-1.05***		-1.08***		-1.24***
	[-3.98]		[-3.90]		[-4.46]
β_{CDS}			-0.82***	-0.80***	-0.76**
			[-2.75]	[-2.65]	[-2.53]
β_{FX}			0.86	2.63	1.47
			[0.27]	[0.92]	[0.49]
Observations	187	187	180	180	180
Adjusted R2	0.056	0.017	0.078	0.034	0.112

Table 9: **Real Estate Effect of Corruption: IV Analysis**

This table reports the estimates for an instrumental variable analysis, using three instruments for corruption of local governments: Panel A: the local fiscal surplus scaled by the GDP for Corruption_Tigers; Panel B: the relative size of state-owned-enterprises scaled by the local GDP for Corruption_Flies; and Panel C: the housing turnover defined as the ratio of the house traded to the house completed in terms of squared meters, for Corruption_Flies. *Corruption_Tigers* which is weighted-average index by the ranking of officials investigated by the CCDI in each province, and *Corruption_Flies* which is the number of officials listed in graft cases in each province. Column (1) presents estimates for the first stage, where the dependent variable is one of the two proxies of corruption. Column (2) and (3) display the estimates of the second stage, where the dependent variable is Real Estate GDP, and the indicator variable for corresponding corruption proxy is instrumented as per the first stage. All regressions are run using the province-year panel during 2007-2014 for provinces studied in our sample. *, **, and *** represent statistical significance at the 10%, 5%, and 1% confidence levels, respectively.

Panel A: IV = Relative Size of SOE

	Corruption_Flies		Real Estate GDP	
	First Stage		IV	
	(1)	(2)	(3)	(4)
Relative Size of SOE	-6.53***	-6.33***		
	[-5.27]	[-5.07]		
Corruption Indicator			-0.07***	-0.07***
			[-3.21]	[-3.23]
β_{CDS}		5.59		-0.90***
		[1.22]		[-3.08]
β_{FX}		11.20		2.56
		[0.42]		[0.85]
Observations	174	168	174	168
Adjusted R2	0.096	0.111	0.039	0.063

Panel B: IV = Housing Turnover

	Corruption_Flies		Real Estate GDP	
	First Stage		IV	
	(1)	(2)	(3)	(4)
Housing Turnover	0.10***	0.09***		
	[4.05]	[4.28]		
Corruption Indicator			-0.08***	-0.10***
			[-2.40]	[-2.98]
β_{CDS}		3.17		-1.06***
		[0.85]		[-3.53]
β_{FX}		46.91**		2.76
		[2.23]		[0.97]
Observations	240	232	187	180
Adjusted R2	0.057	0.076	0.026	0.064

Table 10: **Subsample Results Before and During the Anti-Corruption Campaign**

This table presents the panel regression results of chengtou bond excess yields on all risk factors for subsamples before and during anti-corruption campaign. The explanatory variables include *Corruption_Tigers* (the weighted-average index by the ranking of officials investigated by the CCDI in each province), *Corruption_Flies* (the number of officials listed in graft cases in each province), *Real Estate GDP* (the real estate value-added GDP scaled by local GDP). Control variables include the provincial CDS and FX risk factor exposures, bond characteristics such as bond size, time-to-maturity, and bond liquidity proxied by the bid-ask spread, and the lagged bond excess yields. We average bond yields over each month to obtain monthly frequency values. Standard errors are clustered at the bond level and corresponding t-statistics are reported in square brackets. *, **, and *** represent statistical significance at the 10%, 5%, and 1% confidence levels, respectively. The before-campaign sample period is from August 2007 to October 2012, and the campaign subsample is from November 2012 to December 2014.

	Anti-Corruption Campaign					
	Before			During		
	(1)	(2)	(3)	(4)	(5)	(6)
Corruption_Flies	0.01	0.00	0.00	0.02***	0.02***	0.01**
	[1.61]	[-0.05]	[-0.12]	[4.17]	[2.57]	[1.99]
Corruption_Tigers	0.03***	0.01	0.01	0.01**	0.00	0.01
	[2.84]	[0.91]	[0.93]	[2.13]	[-0.38]	[0.69]
Real Estate GDP		-0.04***	-0.04***		-0.04***	-0.03***
		[-5.06]	[-5.15]		[-4.23]	[-3.80]
β_{CDS}	0.07*	0.03	0.04	0.04	0.04	0.07**
	[1.92]	[0.98]	[1.04]	[1.53]	[1.30]	[2.08]
β_{FX}	-0.68***	-0.84***	-0.85***	-0.08	-0.49	-0.43
	[-2.65]	[-3.17]	[-3.31]	[-0.34]	[-1.67]	[-1.48]
Lagyield	0.84***	0.83***	0.83***	0.67***	0.67***	0.63***
	[40.49]	[40.70]	[36.78]	[37.43]	[29.18]	[25.53]
Month FE	Y	Y	Y	Y	Y	Y
Cluster (Bond)	Y	Y	Y	Y	Y	Y
Bond Attributes	N	N	Y	N	N	Y
Observations	8271	8271	8271	10501	7967	7967
Adj R2	0.708	0.709	0.709	0.505	0.484	0.495

Table 11: **Event Study on Corruption Announcement**

This table presents the event study result on two types of corruption announcements: A. the first corruption in each province, and B. Tiger events in each province. An event is identified as a Tiger event if the official in graft report has a ranking higher than 3 and the event is at least three months from the previous event of the same province to avoid the overlapping of information. The estimation window is the sample period before anti-corruption campaign, from August 2007 to October 2012. The abnormal yield spread (AR) is calculated as the difference of realized province excess yield and the predicted one, where the prediction is based on the realized national excess yield and the regression coefficients in the estimation window.

Event	AR(-1)	AR(0)	AR(1)	CAR[0,1]	CAR[-1,1]
A: First corruption in each province	0.168	-0.204	-0.066	-0.245	-0.085
B: Tiger graft in each province	-0.187	0.027	-0.100	-0.061	-0.221
in Top 5 provinces with highest corruption index	-0.392***	-0.265***	-0.312**	-0.558***	-0.861***
in Bottom 5 provinces with lowest corruption index	-0.230	0.09	-0.170	-0.04	-0.253
in Top 5 provinces with largest corruption cases	0.143	-0.139	0.174	0.019	0.141
in Bottom 5 provinces with smallest corruption cases	-0.241	-0.206	-0.119	-0.305	-0.497

Table A.I: **Yield at Issue (%) by Maturity (Years)**

The table breaks down chengtou issuance by maturity buckets: less than or equal to one year, (0,1]; between one and three years, (1,3]; between three and seven years, (3,7]; and between seven and 30 years, (7,30].

	(0,1]	(1,3]	(3,7]	(7,30)	Average
1997			12.50		12.50
1998		7.64	9.00		8.32
1999		3.78	5.10	4.32	4.40
2000		3.72	4.00		3.86
2002				4.40	4.40
2003				4.43	4.43
2004			5.30	5.72	5.51
2005	2.95		4.58	4.98	4.17
2006	3.55		4.00	4.20	3.92
2007	4.38		1.00	5.19	3.52
2008	5.03	5.83	6.14	6.46	5.87
2009	2.72	3.75	6.10	6.13	4.68
2010	3.40	4.43	5.90	6.04	4.94
2011	5.64	5.76	6.88	7.06	6.33
2012	5.09	6.12	6.95	7.02	6.29
2013	5.40	6.88	6.58	6.07	6.23
2014	5.41	8.16	7.16	6.80	6.88

Table A.II: **Provinces Sorted on Macro Factor Betas**

We estimate province-level betas by regression changes in yields on changes in nation-wide macro factors (equation (5)). We aggregate bond-level yields to the province level for the dependent variable. The macro factors are the change in the credit default swap rate (CDS), the change of foreign direct investment to China (FDI), the change of the log of the current account (CA), the change of the effective real exchange rate (FX), the change in the one-year time deposit rate, (RF), and the stock market return, (RET). In Panel A, we report summary statistics of the betas. In Panel B, we sort provinces on the betas into three portfolios: High, Medium, and Low. We report chengtou bond excess yields (in percentages) of the High and Low portfolios, and report a the t-test for the difference of average returns across the High and Low portfolios. The sample period is from August 2007 to December 2014.

	β_{CDS}	β_{FDI}	β_{CA}	β_{FX}	β_{RF}	β_{RET}
Panel A: Summary Statistics of Betas						
Mean	0.14	0.11	-0.01	0.00	-0.33	0.12
Median	0.30	0.21	0.07	0.03	0.96	0.69
SD	0.13	0.09	-0.02	0.00	-0.12	0.16
P10	-0.15	-0.14	-0.04	-0.03	-0.92	-0.77
P90	0.35	0.34	0.03	0.03	0.25	1.02
Panel B: Excess Yields (%) Sorted by Macro Betas						
Low	1.91	1.89	1.98	2.05	2.15	2.11
High	2.15	2.10	2.13	1.97	1.94	2.01
High-Low	0.24	0.21	0.16	-0.07	-0.21	-0.09
t-statistics	5.52	5.51	3.82	-1.81	-5.15	-2.49

Table A.III: High-Rank Local Officials involved in Real Estate Corruption (selected)

Name	Province	Rank	Date Investigated	Real Estate Corruption
NiFake	Anhui	Vice Provincial	Jun2013	Illegal land transaction
BoXilai	Chongqing	Provincial	Apr2012	Related to RE company–Shide's bribe
ZhouZhenhong	Guangdong	Vice Provincial	Fed2013	Related to his relatives' speculation in RE market
WanQingliang	Guangdong	Vice Provincial	Jun2014	Illegally changing the volume ratio and taking bribes
LiDaqiu	Guangxi	Vice Provincial	Jul2013	Illegal land transaction
LiaoShaohua	Guizhou	Vice Provincial	Jan2013	Bank loans, taking bribes and seeking interests for RE developers
GuoYouming	Hubei	Vice Provincial	Nov2013	Related to some RE projects in Yichang City and Sanxia project
ChenBohuai	Hubei	Vice Provincial	Nov2013	Illegal land transaction
JiJianye	Jiangsu	Vice Provincial	Jan2013	Related to Wuzhong RE Company's bribe
ChenAnzhong	Jiangxi	Vice Provincial	Dec2013	Taking bribes and seeking interests for RE developers
YaoMugen	Jiangxi	Vice Provincial	Mar2014	Taking bribes and seeking interests for RE developers
ZhaoShaolin	Jiangxi	Vice Provincial	Aug2015	Helping his son to make illegal profit in RE market
ChenTiexin	Liaoning	Vice Provincial	Jul2014	Taking bribes and seeking interests for RE developers
HuangSheng	Shandong	Vice Provincial	May2013	Related to several RE developers' bribe
JinDaoming	Shanxi	Vice Provincial	Fed2014	Related to speculations in RE market
ShenWeichen	Shanxi	Vice Provincial	Apr2014	Taking bribes and seeking interests for RE developers
LiChuncheng	Sichuan	Vice Provincial	Dec2012	Illegal land transaction
LiChongxi	Sichuan	Provincial	Dec2013	Taking bribes and seeking interests for RE developers
Yanggang	Xinjiang	Vice Provincial	Dec2013	Taking bribes and seeking interests for RE developers
ZhangTianxin	Yunnan	Vice Provincial	Jul2014	Illegal land transaction
BaiEnpei	Yunnan	Provincial	Aug2014	Taking bribes and seeking interests for RE developers

Table A.IV: **Trading Liquidity Risk**

The table reports the cross-sectional regression estimates of equation (4) with liquidity characteristics. We use three liquidity measures: the monthly trading volume divided by the total amount outstanding (*Turnover*); the Amihud (2002) illiquidity measure, which is the absolute bond return divided by daily trading volume at the monthly frequency (*Illiq*); and the High-Low spread (*Spread*), which is the difference between high and low prices. *High Quality* denotes a dummy variable equal to one if the bond rating is AAA. We include three factor loadings: credit default swap rates on the Chinese central government (CDS), the exchange rate (FX), and the policy interest rate (RF), which is the one-year time deposit rate. We also include bond rating as a control variable. We quantify bond ratings by assigning numerical values, where higher numbers indicate higher credit quality, for example, the highest-rated bonds (AAA) have a value of 6 and the lowest-rated bonds (A) have a value of 1. The regression is run at the bond level at the monthly frequency. We average bond yields over each month to obtain monthly values. Standard errors are clustered at the bond level, and corresponding t-statistics are reported. Estimates with statistical significance levels at the 90% or above are highlighted in bold. The sample period is from August 2007 to December 2014.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Turnover	**0.07**			**0.02**	**0.02**	**0.01**	**0.02**
	[4.42]			[3.77]	[3.77]	[3.26]	[3.41]
Turnover × High Quality							**-0.01**
							[-1.65]
Amihud		**-0.04**		0.01	0.01	0.01	0.01
		[-3.23]		[1.07]	[1.11]	[1.64]	[1.08]
Amiud × High Quality							0.00
							[-0.28]
High-Low Spread			0.00	0.00	0.00	0.00	
			[-0.17]	[-0.74]	[-0.65]	[0.29]	
β_{CDS}					**0.07**	**0.09**	**0.09**
					[3.01]	[3.67]	[3.69]
β_{FX}					**-0.54**	**-0.72**	**-0.71**
					[-2.96]	[-4.39]	[-4.31]
Rating						**-0.08**	**-0.08**
						[-11.77]	[-11.76]
Lagged Yield				**0.80**	**0.80**	**0.74**	**0.74**
				[52.3]	[52.4]	[40.3]	[40.4]
Month Fixed Effects	Y	Y	Y	Y	Y	Y	Y
Observations	20357	15646	20357	14472	14472	14472	14472
Adjusted R^2	0.195	0.201	0.187	0.675	0.676	0.684	0.684

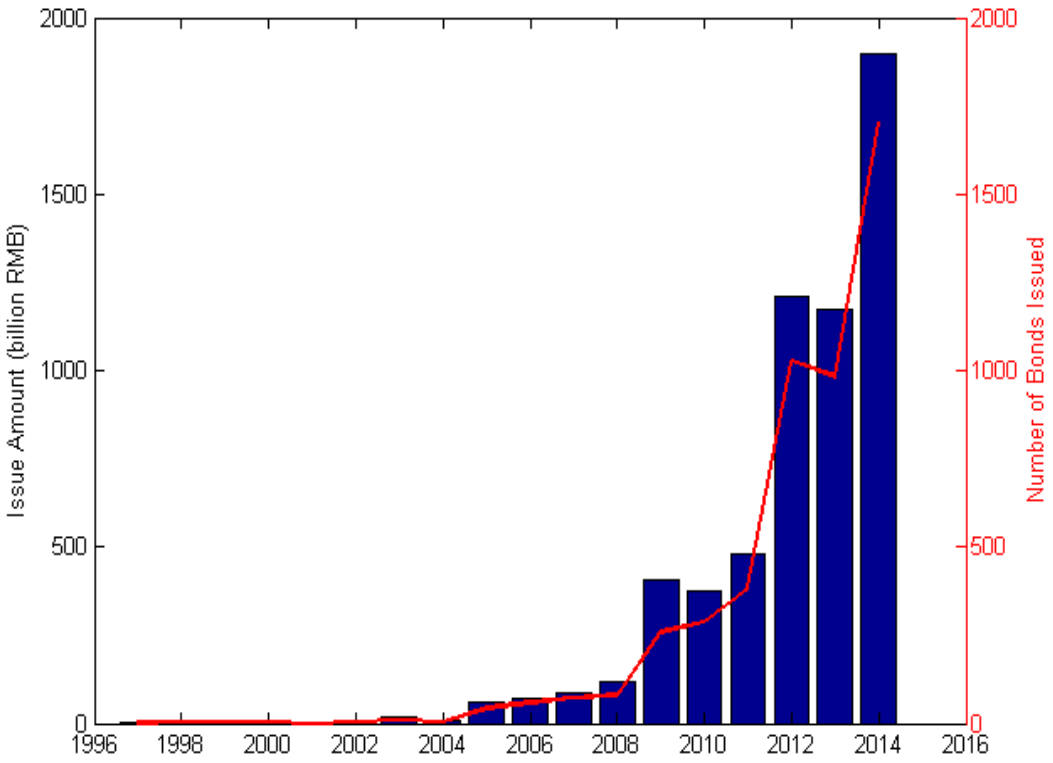


Figure 1: Annual Issues of Chengtou Bonds

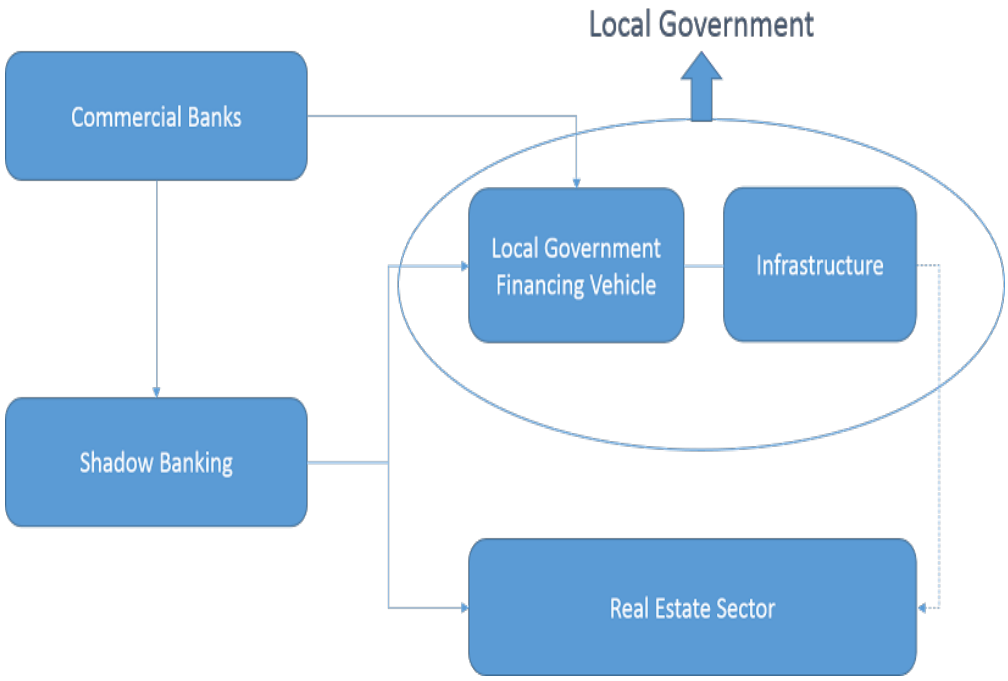
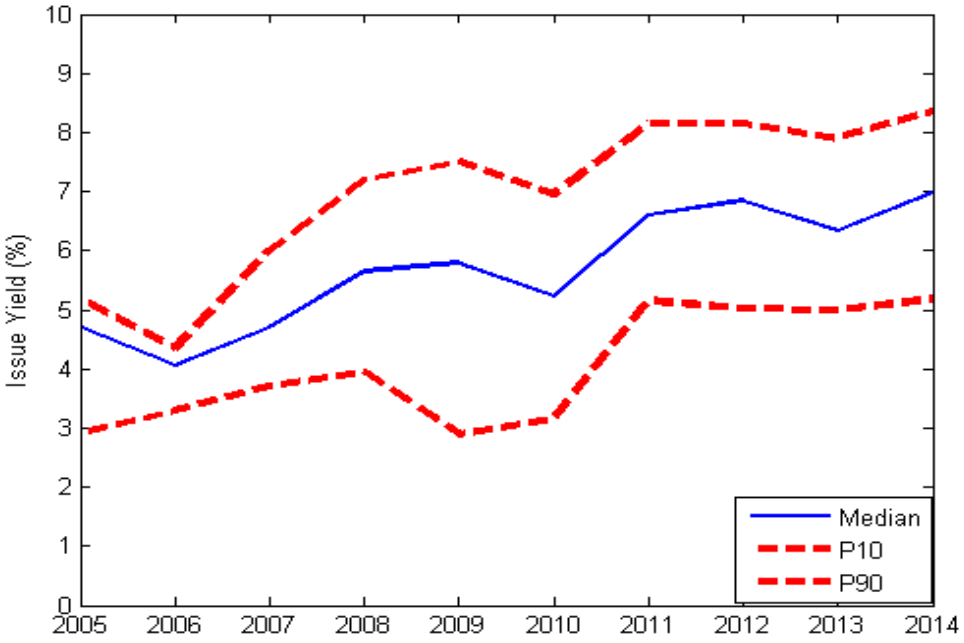


Figure 2: The Nexus of Chinese Local Government Debt

Panel A: Issue Yields in the Primary Market



Panel B: Excess Yields in the Secondary Market

Figure 3: **Dispersion of Chengtou Bond Yields**

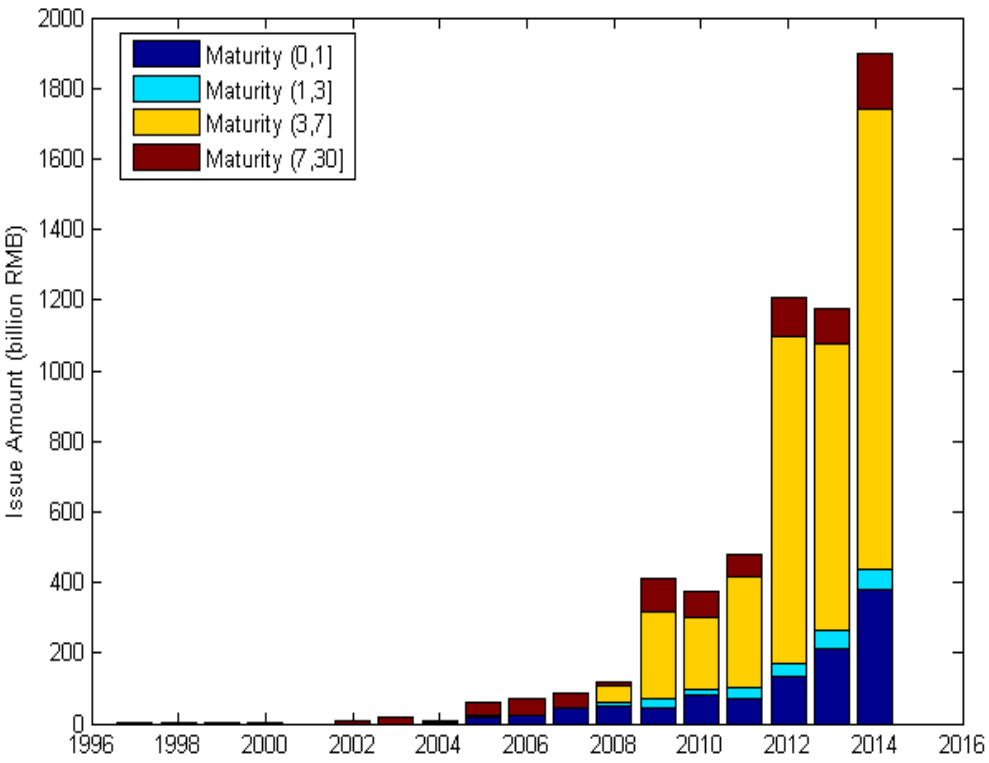


Figure A.I: Tenor Decomposition of the Annual Chengtou Bond Issuance