How Does Local Government Financing Affect Bond Market in China: Evidence from Municipal Corporate Bond*

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Abstract

This paper studies the impact of municipal corporate bond on China's bond market which has developed rapidly as the second largest market globally but has limited efficient benchmark securities. We find that municipal corporate bonds provide benefits in four aspects: improve the investment opportunities set relative to existing bond instruments; enhance the process of price discovery, explaining at least 25% for enterprise bond yield spreads variations, and information from municipal corporate bonds transfers along industry and location channel; reduce the spreads of existing bond instruments when the supply of municipal corporate bonds is under moderate level; and promote long-term corporate debt security issues. The government (implicit) guarantee behind municipal corporate bond makes it better span systematic risk and complement the market incompleteness. Overall, our findings contribute to a comprehensive understanding of the role of government financing.

Keywords: Municipal corporate bond; Spanning enhancement; Price discovery; Maturity impact.

1 Introduction

Chinas corporate bond market has achieved remarkable growth over the past decade and ranked the second largest in the world. The Outstanding debt securities issued by non-financial sectors in China reached 3.8 trillion dollars by the end of 2018, making up 22.73% of GDP. A series of market opening programs make it more accessible and attractive to international investors. However, compared with developed bond market, Chinas bond market is still in an immature state, where market segmentation, extremely low default rate as well as unreliable domestic ratings have been criticized both in practice and academic research. Besides, the treasury bond market, which is supposed to provide a benchmark for fixed-income asset pricing, cannot keep pace with the development of corporate debt market. Amstad and He (2019) show that the liquidity in Chinas treasury market is much lower relative to the U.S. treasury market. A recent document released by the Central Committee of the Communist Party of China and State Council has set the requirement that improve the treasury bond yield curve to enhance its benchmark ability. [1]

Though treasuries play a relatively weak role in Chinas corporate bond market, another debt instrument, municipal corporate bonds, have experienced tremendous growth since 2008. By the end of year 2018, the outstanding amount of municipal corporate bonds is 7.7 trillion RMB, accounting for 36% of all debt securities issued by non-financial corporations in China. Municipal corporate bonds are generally perceived as quasi-municipal debts. They are issued by local government financial vehicles (LGFVs), which are corporate bonds in a legal sense, but enjoy implicit guarantee from local and even central governments. LGFVs are usually supported by local governments with land-use right transferring and other kinds of capital injection. And central government takes the final responsibility for the revenues and deficits of local government, therefore indirectly supporting the municipal corporate bonds. This is different from the municipal bonds in the U.S. that are independent from the Federal government and do not carry systemic risk, and also different from other credit instruments issued by non-financial firms in China, which are exposed to firm-specific risks.

These distinctive features might enable municipal corporate bonds to play a special role in the immature corporate bond market. According to Yuan (2005), Dittmar and Yuan (2008), the addition of benchmark securities will benefit the emerging market by allowing investors to hedge against systematic risk, thus completing the incomplete market; and hedge against adverse selection cost, thus encouraging investors to obtain more firm-specific information and promoting price discovery. As analyzed in Ang, Bai, and Zhou (2019), municipal corporate bonds capture the systematic risk and are sensitive to the national solvency risk due to their close relation with local and central government. We would like to investigate whether municipal corporate bond brings some positive impact on corporate bond pricing, like the function of benchmark security. Since there are lacking of benchmark assets for risk spanning and financial derivatives for portfolio hedging in China, the introduction of municipal corporate bonds could provide investors with more choices. [2]

We explore the interaction between municipal corporate bonds and other debt securities issued by non-financial firms by analyzing the spanning enhancement, price discovery, and the impact of municipal corporate bond issues on corporate debt costs as well as maturity choice. We focus on the main types of corporate bonds in China: enterprise bonds, and regular corporate bonds (consisting of exchange-traded corporate bonds and mid-term note). First, six spanning tests show that municipal corporate bond enriches the investment opportunities set relative to enterprise bond and regular corporate bond alone. Both the tangency portfolio and the minimum variance portfolio in the efficient frontier are improved. That means that investors can realize higher Sharpe ratio with the introduction of municipal corporate bond.

Second, municipal corporate bond contributes to the process of price discovery. The variability in enterprise bond yield spreads attributable to municipal corporate bond ranges from 27% to 36%, and ranges from 6% to 20% in regular corporate bond. Information appears to flow from municipal corporate bond to existing bond securities. A variety of heterogeneity tests based on issuers' or bonds' characteristics further confirm the price discovery impact. Especially, the explanatory power of municipal corporate bonds which are issued in high fiscal surplus areas or provincial level city are more performed, indicating that the higher degree of government guarantee strengthens the benchmark ability of municipal corporate bond. We also find that the information from municipal corporate bond flow to other bond along the industry and location channel.

We attribute the price discovery of municipal corporate bond to its ability of spanning systematic risk and then encouraging investors to better acquire firm-specific information, but the high correlations among bond spreads may also drive the results. To address this concern, we conduct the placebo tests by examining the price discovery impact of enterprise bond and regular corporate bond. The results show that the maximum information share in enterprise (regular corporate) bond attributable to regular corporate (enterprise) bond makes up less than 2% (3%) during the full sample, much lower than the information share attributable to municipal corporate bond. If it is the correlation among bond spreads that causes the price discovery, we should observe similar explanatory ability of different types of bonds. However, the placebo tests imply that only municipal corporate bond substantially enhances the price discovery, therefore, excluding the influence of bond spreads correlation.

Third, we explore the pricing impact of municipal corporate bond. Though excessive issues of municipal corporate bond could crowd out corporate debt, our empirical results indicate that an appropriate amount of issuance of municipal corporate bond will lower the yield spread of existing bonds. The negative impact still holds after controlling for the endogeneity coming from the market timing decision of municipal corporate bond. It suggests that when the new supply of municipal corporate bond is within certain amount, municipal corporate bond contributes to hedge systematic risk and then reduce adverse selection costs and yield spreads. In addition to pricing impact, we also provide evidences that municipal corporate bond promotes the issues of long-term corporate bonds, especially those with low rating or issued by non-state-owned (Non-SOE) firms.

Most studies have discussed the negative externality of government debt. Graham, Leary, and Roberts (2014) show that government debt will crowd out corporate debt and investment by affecting investors choice and assets relative price in the U.S.. Huang, Pagano, and Panizza (2019), Liang, Shi, Wang, and Xu (2017) provide similar evidences that local government debts crowd out private investment and leverage in China. Based on the cross-country data, Demirci, Huang, and Sialm (2019) document that corporate leverage is lower in countries with higher government debt. Greenwood, Hanson, and Stein (2010), Greenwood, Hanson, and Stein (2015), Badoer and James (2016), Krishnamurthy and Vissing-Jorgensen (2012), Krishnamurthy and Vissing-Jorgensen (2015) show the substitution effects between corporate debt and government debt in terms of maturity.

But for an incomplete market, where investors face severe adverse selection and inefficient benchmark rate, government debts can benefit the bond market (Dittmar and Yuan (2008)). Flannery, Hong, and Wang (2019) analyze the benchmark role of sovereign bonds in Chinas offshore market. USD-denominated Chinese corporate bonds experienced a decline in yield spreads, bid-ask spreads, and price volatility after the announcement of sovereign issues. van Bekkum, Grundy, and Verwijmeren (2019) show that government bonds will improve corporate issues by providing high-quality reference rate. Our research complements the literature by documenting that bonds issued by local government financial vehicles can also benefit the emerging market where treasuries cannot provide efficient pricing information. Municipal corporate bonds not only meet the demand of investors asset allocation, but also promote the price informativeness. Though over supply of local government debts crowd out private credit in terms of quantity, they could generate favorable pricing impact on corporate debt market. Our study comprehensively evaluates the role of municipal corporate bond.

Our paper also makes contribution to the burgeoning literature on Chinas bond market. Hu, Pan, and Wang (2018), Amstad and He (2019) offer an overview for the rapidly growing market. Ang et al. (2019) investigate two risk characteristics, real estate and political risk, in municipal corporate bond pricing. Chen, He, and Liu (2020) document the linkage between shadow baking activities and municipal corporate bond issuance. Liu, Lyu, and Yu (2017) investigate how local government fiscal conditions influence municipal corporate bond spreads. Several papers analyze the Chinas bond market characteristics, e.g., market segmentation, implicit guarantee. Liu, Wang, Wei, and Zhong (2019) show that the demand of yield-chasing investors causes the pricing wedge between interbank and exchange markets for dual listed bonds. Chen, Chen, He, Liu, and Xie (2019) utilize the market segmentation setup and a policy shock happened in one of the market to estimate the pledgeability premium. Geng and Pan (2019) document the low price discovery in Chinas corporate bond market, and show that there is significant segmentation between SOE and non-SOE issuers due to the government support for SOEs. Besides, Huang, Liu, and Shi (2020) analyze the determinants of commercial paper using the unique secondary transaction prices in China. Ding, Xiong, and Zhang (2020) uncover the issuance overpricing in Chinas corporate bond market, which is different from the underpricing phenomenon in the U.S. market. Wu, Liu, Meng, and Zeng (2018) find that foreign banks can incorporate new information more quickly, and therefore contribute more price discovery than most Chinese banks. Mo and Subrahmanyam (2020) investigates the corporate bond liquidity. Our paper complements the bunch of research by linking municipal corporate bond with other corporate debt instruments and shed some light on the pricing impact of municipal corporate bond.

The remainder of the article is organized as follows. Section 2 summarizes the data. Section 3 investigates the spanning enhancement of municipal corporate bond. Section 4 investigates the price discovery. Section 5 examines the pricing impact of municipal corporate issues. Section 6 analyzes influence on corporate debt maturity choice. Section 7 concludes the paper.

2 Data

2.1 Bond sample

Bond securities issued by non-financial firms in China have different categories: municipal corporate bond (MCB), enterprise bonds, exchange-traded corporate bonds, medium-term notes, commercial papers, and other bond products (e.g., asset-backed securities, private placement notes). Figure 1 summarizes the fraction of each type of bond instrument. The outstanding amount of municipal corporate bonds have tremendous growth from year 2010 to 2018, making up 36% of total credit market by the end of 2018.

[Place Figure 1 about here]

Consistent with Geng and Pan (2019), the group of corporate bonds in our paper include three main types: enterprise bond, exchange-traded corporate bond and medium-term note. Among them, enterprise bonds (EB) are mainly issued by large state-owned enterprises (SOEs), such as institutions affiliated to central government departments, enterprises solely funded by the state, or state-controlled enterprises. Their issuances are subject to administrative approval from National Development and Reform Commission (NDRC). The economic function of enterprise bonds has some similarity with municipal corporate bonds. The raised funds are generally used for infrastructure construction, fixed asset investment, and technological innovation. With the development of municipal corporate bond, the proportion of enterprise bond in credit market has decreased from 21% in 2010 to 3% in 2018.

Distinguished from enterprise bonds, exchange-traded corporate bond and mid-term note are called regular corporate bond (RCB) in our paper. They differ from enterprise bonds in many aspects. First, the issuance of regular corporate bonds is market oriented and mainly for corporate operation, different from the administratively oriented feature of enterprise bonds. Second, while enterprise bonds are issued by state-owned enterprises with strong government guarantee, regular corporate bonds are mainly backed up by corporate performances (and may also have certain implicit guarantee if issued by SOEs), and are mainly for financing corporate operations. Third, they are regulated by different institutions. Table 1 compares the features of MCB, EB and RCB.

[Place Table 1 about here]

In this paper, we examine how municipal corporate bonds (MCBs) influence enterprise bonds (EBs) and regular corporate bonds (RCBs). We focus on the fixed-rate bonds. Consistent with Ang et al. (2019), to obtain accurate bond pricing information, we only keep bonds which are matured or listed in the interbank or exchange markets and exclude bonds with special terms such as callable.

2.2 Bond-level data

Sample period starts from January 2010 to June 2019. Data are from Wind database, which provides bond characteristics and trading variables. For each bond, we can observe the basic information, such as maturity, issuance, rating at issue, issuers industry and province, and trading information, such as daily price and rating.

We compute weekly returns for each bond as the standard method:

$$r_t = -\frac{P_t + AI_t + C_t}{P_{t-1} + AI_{t-1}} - 1 \tag{1}$$

where r_t is weekly return, P_t is the clean price at the end of each week, AI_t is accrued interest, and C_t is the coupon payment, if any, in week t.

Bond spreads are calculated relative to the (synthetic) matching central government bond yields following the procedure in Ang et al. (2019), Liu et al. (2017), and Chen et al. (2019). First, fit the zero-bond yield curve using Svensson model. Second, compute the implied government bond price $P_{i,t}^{CGB}$ for each municipal corporate bond, enterprise bond and regular corporate bond using the same cash flow structure. Third, calculate the matching central government bond yield $y_{i,t}^{CGB}$ using the implied price $P_{i,t}^{CGB}$. Finally, bond spread is obtained: $ys_{i,t} = y_{i,t} - y_{i,t}^{CGB}$.

Table 2 presents the summary statistics of daily spreads, weekly returns and bond characteristics. Though the mean value of bond rating at issue for MCBs is lower than RCBs, but MCBs have lower yield spread than RCBs on average, implying the impact of government guarantee. As EBs are mainly for social economic development, it is also closely related with government, and enjoy the lowest yield spreads. EBs are generally issued with long maturity and large amount, whereas MCBs and RCBs have short maturity and relatively small amount. And the maturity for MCBs is longer than RCBs. Besides, 75% of RCB are issued by SOEs and the proportion of listed firms in our sample is less than 30%.

[**Place Table 2 about here**]

3 Spanning Enhancement

3.1 Spanning test

Spanning test answers the question whether an investor, conditional on having a portfolio of K benchmark assets, can benefit by investing in a new set of N assets. In other words, it tests the hypothesis of whether N test assets can be spanned or replicated in the mean-variance space by a set of K benchmark assets. In this paper, the test asset is MCB and the benchmark assets are EB and RCB. We examine whether the MCB contains important pricing information for EB and RCB.

We construct equal weighted bond portfolios for each type. Then, we regress the portfolio return of MCB on the portfolio return of EB and RCB:

$$r_{MCB} = \alpha + \beta_1 r_{EB} + \beta_2 r_{RCB} + \epsilon_t \tag{2}$$

where $r_{MCB,t}$, $r_{EB,t}$, $r_{RCB,t}$ are the portfolio returns of MCB, EB and RCB, respectively. The spanning hypothesis is:

$$H_0 : \alpha = 0, \delta = 0 \tag{3}$$

where $\delta = \beta_1 + \beta_2 - 1$. Rejecting the null hypothesis indicates that MCB cannot be fully replicated by EB and RCB, and hence, MCB can improve the investment opportunity set relative to existing bonds.

Santis (1993), Bekaert and Urias (1996), and Dittmar and Yuan (2008) provide another framework to investigate the same issue. Denote the gross returns on the EB portfolio and RCB portfolio at time t as R_t^B, and the gross return on MCB portfolio as R_t^T. Assuming two pricing kernels:

$$M_{1t} = \alpha_1 + \beta_1^B(R_t^B - \mu_B) + \beta_1^T(R_t^T - \mu_T) \tag{4}$$

$$M_{2t} = \alpha_1 + \beta_2^B(R_t^B - \mu_B) + \beta_2^T(R_t^T - \mu_T) \tag{5}$$

where μ_B and μ_T are the expected gross returns of benchmark assets and test asset, respectively, and the means of the pricing kernels, α_1 and α_2, are constrained to differ. We can estimate the set of parameters $\beta_1^B, beta_1^T, beta_2^B, beta_2^T$ via GMM based on the moment conditions:

$$\frac{1}{T}\sum_{t=1}^{T} M_{1t}\{R_t^B; R_t^T\} - \iota = 0 \tag{6}$$

$$\frac{1}{T}\sum_{t=1}^{T} M_{2t}\{R_t^B; R_t^T\} - \iota = 0 \tag{7}$$

where ι denotes a conforming vector of ones. The null hypothesis is that EB and RCB span MCB:

$$H_0 : \beta_1^T = \beta_2^T = 0 \tag{8}$$

Rejection of H_0 will proof the importance of MCB in pricing kernel and its ability to enhance the efficient frontier.

Similar with Kan and Zhou (2012), we carry out six spanning tests to test the null hypothesis: Wald test under conditional homoscedasticity (W); Wald test under independent and identically distributed (IID) elliptical distribution (We); Wald test under conditional heteroskedasticity (Wa); Bekerart-Urias spanning test with errors-in-variables (EIV) adjustment (J_1); Bekerart-Urias spanning test without the EIV adjustment (J_2); DeSantis spanning test (J_3). The first three are regression based and the last three are SDF based. All six tests have asymptotic chi-squared distribution with $2N$ ($N = 1$) degrees of freedom.

Following Dittmar and Yuan (2008), we also adopt the economic evaluation statistics, i.e., maximum Sharpe ratio achievable with the assets. We calculate the annualized Sharpe ratio of the pricing kernel with mean equal to the reciprocal risk-free rate and minimum variance.

Table 3 presents the spanning test results during the full sample period. In the first two rows where the benchmark assets are equal weighted portfolios of EB and RCB, all six tests are strongly rejected, indicating that MCB expands the opportunity set relative to the existing bonds, and the annual Sharpe ratio shows some slight improvement. In the last four rows, we put the portfolio of treasuries or financial bonds issued by China Development Bank (CDB) into benchmark assets. As discussed in Dittmar and Yuan (2008), it is possible that some of the spanning enhancement in MCB relative to EB and RCB occurs because MCB permits investors to better span risks in the default-free term structure. Both treasury and CDB can be regarded as the risk-free security and provide a natural way of hedging risks and spanning the existing bonds, so we control them in the benchmark assets. As shown in the last for rows, test statistics are a little bit smaller after the inclusion of treasury and CDB portfolio, but all of them are still significantly rejected, confirming the spanning power of MCB.

[**Place Table 3 about here**]

Hansen and Jagannathan (1991) bounds for the sets of securities in Figure 2 further support the spanning enhancement of MCB. The bound is shifted upward after introducing MCB into benchmark assets.

[**Place Figure 2 about here**]

3.2 Step-down test

Kan and Zhou (2012) also suggest a step-down procedure to test the spanning hypothesis, which investigates whether the spanning improvement from test asset comes from the minimum-variance portfolio or the tangency portfolio in the efficient frontier. An investor would care more about the improvement in tangency portfolio, so that they can achieve higher investment gains.

Step-down test first examines $\alpha = 0$ using F_1 test, and then examines $\delta = 0$ using F_2 test conditional on the constraint $\alpha = 0$. The rejection of F_1 will indicate that MCB statistically improves the tangency portfolios, and the rejection of F_2 indicates that MCB statistically improve the global minimum-variance portfolios. Details can be found in Kan and Zhou (2012). Table 4 reports the step-down results. The spanning enhancement of MCB comes from both the improvement in tangency portfolio and the global minimum-variance portfolio, and the improvement in the latter is more significant.

[Place Table 4 about here]

To be robust, we also change the way of portfolio construction to test the spanning impact. First, we employ face value weighted bond portfolios. Second, we construct benchmark portfolios by bond characteristics: (1) equal weighted portfolios of EB and RCB (plus treasury and CDB) traded on interbank or exchange market ($EB_{exchange}, EB_{interbank}, RCB_{exchange}, RCB_{interbank}$); (2) equal weighted portfolios of EB and RCB (plus treasury and CDB) with maturity less than five or over five years ($EB_{(0,5)}, EB_{[5,...)}, RCB_{(0,5)}, RCB_{[5,...)}$); (3) equal weighted portfolios of EB and R-CB (plus treasury and CDB) with ratings of AAA or below AAA ($EB_{AAA}, EB_{BelowAAA}, RCB_{AAA}$, $RCB_{BelowAAA}$), and test asset is still the equal weighted portfolio of all MCBs. The spanning results based on these different sets of benchmark assets are presented in Table 5, which are basically consistent with previous findings. Especially, maximum Sharpe ratio increases nearly 41% after putting MCB in to rating sorted portfolio of EB and RCB (plus treasury and CDB). This economically rise in Sharpe ratio is in line with the strong rejection of F_1 test that suggests the significant enhancement in tangency portfolio

[Place Table 5 about here]

3.3 Sub-sample results

We also perform the spanning tests and step-down tests over two sub periods: January 2010 to December 2014, and January 2015 to June 2019. Several important regulations have been enacted since the year 2014, such as Document 43 in 2014, Document 88 in 2016, and Document 50 in 2017, which attempted to slow down the growth of local government debts and banned local governments from providing guarantee to MCB. If these polices are effective in promoting the marketization of MCB, MCB might be closer to regular corporate bonds during the second sub period, and thus, their spanning power will be weakened. However, a wave of corporate bond default occurs since year 2014. With the perceived increasing credit risk in the corporate debt market, investors may flight to municipal corporate bonds, which are still relatively safe. Under this circumstances, municipal corporate bonds play a more crucial role in spanning enhancement during the second the sub period. Table 6 displays the sub sample results.

[Place Table 6 about here]

As shown in Panel A, though the magnitude of six spanning test statistics is a little smaller during January 2015 to June 2019, there is still significant spanning enhancement in the corporate debt market. The results suggest that MCBs remain close relation with government after the introduction of restrictive measures. The step-down results in Panel B further decomposes the sources of spanning. For the first sub period, the spanning enhancement mainly comes from the improvement in the global minimum-variance portfolio. For the second sub period, MCB only improves the global minimum-variance portfolio, but also improves the tangency portfolio, thus providing investors with more economic gains when the bond default risk becomes more concerned.

4 Price Discovery

4.1 Empirical methodology

Section 3 demonstrates that MCB contains important pricing information for EB and RCB. Next, we examine whether the market relevant information in MCB transfers to EB and RCB, and promotes price discovery by allowing investors to better hedge against adverse selection cost. As in Hasbrouck (1995), Hasbrouck (2003), Dittmar and Yuan (2008), we use variance decomposition from a vector autoregression representation of the yield spreads on EB, RCB and MCB to evaluate the contribution of MCB to price discovery. To explore the price discovery beyond the impact of treasury and CDB, we investigate the orthogonalized yield spreads for each bond portfolio as the residuals in the following regression:

$$ys_{\{MCB,EB,RCB\},t} = \delta_0 + \beta' X_t + ys^{\perp}_{\{MCB,EB,RCB\},t} \tag{9}$$

where X_t denotes the vector of three principal (level, slope, curvature) extracted from the on-the-run treasuries and CDBs closest to 90 days, 1 year, 2 years, 5 years, 7 years, and 10 years. The residuals, $ys^{\perp}_{\{MCB,EB,RCB\},t}$, represent the orghogonalized yield spreads of bond portfolios.

Based on the residual spreads, we can conduct variance decomposition via VAR system (VAR: MCB and EB, VAR: MCB and RCB). We place the bounds on the variance contribution by re-ordering the variables in the VAR. When MCB is the first variable in the VAR, an upper bound on the proportion of volatility in EB (RCB) attributable to MCB can be obtained. And the lower bound is estimated when EB (RCB) is the first variable.

4.2 Empirical results

We estimate VAR for MCB and EB, MCB and RCB separately. The lag length in the VAR is determined via BIC statistics. The bounds on the information share in EB and RCB are presented in Table 7.

[Place Table 7 about here]

According to the first row of each panel, MCB can explain the variations in the yield spreads of EB and RCB during the full sample period. The information share in EB attributable to MCB is substantial, accounting for at least 25%. The explanatory power of MCB for RCB is a little weaker than EB, but still nonnegligible, with information share ranging from 5.58% to 19.46%. The results suggest that there is common information in MCB which affects EB and RCB. Impulse response functions in Figure 3 present the cumulative impact of a standard-deviation change in the spread of MCB on the spread of EB and RCB. EB and RCB react slowly to the shock and fully respond after a period of about 100 days. As shown in the figure, the long-run impact of the MCB shock on EB is a bit larger than on RCB during the full sample period.

[Place Figure 3 about here]

The last two rows of each panel in Table 7 presents the variance decompositions for two sub periods. Panel A and Panel B reports the price discovery for EB and RCB, respectively. The results show that the price discovery impact of MCB is stronger during 2010-2014 than 2015-2019. The maximum information share from MCB in RCB reaches 36.93% for the first sub period, and decreases to 9.36% for the second sub period. Geng and Pan (2019) has discovered that corporate bond pricing becomes more informative about issuers fundamentals after year 2014 when a wave of bond default happens. With the improved price discovery during this period, the market relevant information in MCB makes up a smaller proportion in EB and RCB.

4.3 Placebo test

There is usually high correlation among bond prices movement, which may be the main drivers for the information contribution of MCB, thus weakening our argument that MCB improves price discovery by allowing investors to better understand systematic and firm-specific risk. To examine this alternative explanation, we conduct placebo test that replaces MCB with RCB to analyze the price discovery impact of RCB in EB, and replaces MCB with EB to analyze the price discovery impact of EB in RCB. If it is due to bond spreads correlation, we should observe that the magnitude of information share from RCB (EB) is similar to that from MCB in EB (RCB). Panel A (B) in Table 8 presents the price discovery of RCB (EB) in EB (RCB), which are in comparison with Panel A (B) in Table 7. We can easily find that when explaining the variations in EB spread, MCB performs much better than RCB. The comparisons between EB and MCB also support the superior explanatory ability of MCB in RCB relative to EB. Therefore, MCB plays a distinctive role in existing corporate debt instrument.

[Place Table 8 about here]

4.4 Heterogeneity tests

We perform a bunch of heterogeneity tests in this subsection. The results confirm the price discovery impact of MCB and help identify the source of the gains.

4.4.1 Price discovery and the degree of implicit guarantee in MCB. If it is the government backup that enables MCB to better span the risks, MCB should present higher price discovery in areas with stronger implicit guarantee. To examine this hypothesis, we use fiscal surplus (the difference of revenue and expenditure scaled by local GDP), and the administration level of MCBs issuers to measure the degree of implicit guarantee in MCB. Areas with high fiscal surplus and high administration level are expected to be able to provide more backup for MCB.

Specifically, we identify the bonds issuers provinces, and calculate the average annual fiscal surplus over 2010-2019. We sort all bonds into three groups based on the average fiscal surplus, construct equal-weighted portfolios for EB, RCB, and MCB within each group. Then, variance decompositions are conducted in each group as the procedures in Section 4.2. The analysis based on city administration level is similar, except that administration level is divided into: provincial level, prefecture-level city, and county level.

Figure 4 presents the maximum and minimum information share from MCB in each sub sample. The results are consistent with our expectation that MCB with stronger implicit government guarantee have more explanatory power for EB and RCB. For example, the maximum information share attributable to MCB in EB (RCB) reaches 39.10% (17.70%) in provincial-level cities, but only makes up 11.6% (0.95%) in county-level cities.

[Place Figure 4 about here]

4.4.2 Price discovery and issuers' characteristics. We examine the price discovery of MCB in subsamples divided by issuers' characteristics. Findings in this subsection are presented in Figure 5: (1) price discovery impact of MCB is larger in RCB issued by SOEs than Non-SOEs [3]; (2) price discovery impact of MCB is larger in EB and RCB whose issuers are in the industries directly affected by LGFVs [4].

[Place Figure 5 about here]

4.4.3 Price discovery and bonds' characteristics. We examine the price discovery of MCB in subsamples divided by bonds' characteristics, including trading market, bond rating, maturity, and issuance [5]. Findings in this subsection are presented in Figure 6: (4) price discovery of MCB in EB/RCB is robust across different subsamples divided by the bonds characteristics, and especially larger in EB and RCB with AAA rating, medium and long-term maturity, and large issuance.

[Place Figure 6 about here]

4.5 Compare the price discovery impact of MCB and EB

To further investigate how MCB explains the variations in the yield spreads of RCB, we compare the price discovery impact of MCB and EB on RCB in specific dimensions. Our conjectures are that, EBs, as a type of bonds closely related with national industrial policies, may contain much pricing information along the industry dimension, and therefore, are able to explain the variations in the spreads of RCBs in the same industries. By contrast, MCBs, issued by LGFVs and mainly for local investment, may contribute to more price discovery along the industry-location dimension.

Referring to Huang et al. (2019), we identify the industries that are directly affected by LFGVs, and construct equal weighted portfolios of RCB and MCB whose issuers belong to these industries. Column 2 to Column 4 in Panel A of Table 9 reports the information share in RCB attributable to MCB in the same industry. Similarly, the portfolios of RCB and EB are constructed using the bonds whose issuers are in the industries directly affected by EB. The last three columns in Panel A of Table 9 reports the information share in RCB attributable to EB in the same industry. The results indicate that EB contains more pricing information for RCB than MCB along the industry level.

[Place Table 9 about here]

Next, we double sort the bonds according to their industry and location. In China, there are generally seven geographical areas: North China, East China, South China, Center China, Northeast, Northwest, and Southwest. Panel C of Table 9 presents the number of bonds in the industries identified in Panel A in each area. Based on the bonds in the same industries and location, we construct equal weighted portfolios for MCB, EB and RCB. "Portfolio Obs." denotes the number of portfolio observations available for VAR estimation after merging MCB or EB with RCB. As the number of bonds and portfolio observations in Center China, Northeast, Northwest, and Southwest is too small, which may harm the statistical estimation efficiency, we only examine the variance decompositions for North China, East China, South China. Panel B of Table 9 compares the price discovery impact of MCB and EB on RCB in these three areas and the same industries. MCB beats EB in two of three subsamples, basically consistent with our intuition that MCB performs better in industry-location dimension.

5 Price Impact of MCBs Issuances

Following Dittmar and Yuan (2008), we examine how the yield spreads of EBs and RCBs respond to the issuance of MCBs through event study. If the over-supply of MCBs crowd out existing bonds, the spreads of EBs and RCBs are likely to increase after the issuance of MCBs. By contrast, if MCBs serve as a kind of benchmark in China's immature bond market which contribute to relieve the adverse selection, the yield spreads of EBs and RCBs are expected to decrease with the introduction of MCBs.

There are two major concerns in the analysis. One is the difficulty to identify a clean event due to the frequent issues of MCBs. The other is that the issue decision may be endogenous. Local governments may time the issuances of MCBs and choose to issue when the market liquidity is adequate and issuance costs are low, thus causing upward bias in the benchmark effect of MCBs. We try to address the concerns through the following procedures.

We divide the issuance of MCBs into two event categories: high supply and low supply. Each day we calculate the total amount of issuance of MCBs ($issue_t^i$) for two maturity bins, i.e., [1,5) and [5,) [6], and the average issuance of each maturity bin during previous month ($benchissue_t^i$), which is regarded as a normal issuance amount at daily level. If $issue_t^i$ ($i = [1,5), [5,)$) exceeds $benchissue_t^i$, day t is defined as a high-supply event date. And if $issue_t^i$ is below $benchissue_t^i$, it is a low-supply event. Identifying the events by maturity is to match the maturity structure of EBs and RCBs. As shown in Panel A of Table 2, both mean and median maturity of EBs are above five years, and those of RCBs are below five years.

The probability of LGFVs timing is expected to be higher on high-supply days than low-supply days, since most LGFVs would like to issue MCBs or issue more MCBs on days with good market conditions, causing these days more likely to be high-supply days. Then, if we observe more spread reductions in EBs and RCBs around the low-supply events than high-supply events, it is more attributable the benchmark impact of MCB rather than LGFV timing. And fewer or no reductions in EB and RCB spreads around high-supply events could be due to some crowd-out effect of MCB.

To be more clean, we employ the events where $issue_t^i - benchissue_t^i$ is in the lowest decile in all low-supply events and the highest decile in all high-supply events as the events for analysis, obtaining a bound for the price impact of MCBs issuance. In addition, we exclude the issuance events that coincide with important monetary policy events, such as the announcement of adjusting the deposit reserve ratio. Events that are too close with each other, such as the interval between two adjacent events is less than five days, are also dropped from our analysis. Finally, we obtain 66 high-supply events and 46 low-supply events.

EBs and RCBs are also separately divided into two groups according to their remaining periods to maturity, to match the maturity bin of newly issued MCBs, i.e., [1,5) and [5,). Then, we evaluate the influence of MCBs issuance on the spreads of individual EBs and RCBs for each event category and maturity bin based on the following equation:

$$ys_{\{EB,RCB\},t} = a + bPost_t + c_i + d_j + e_t + \epsilon_{\{EB,RCB\},t} \tag{10}$$

where $Post_t$ equals 1 after MCBs issue, and 0 otherwise. c_i, d_j, and e_t refers EBs (RCBs) issuers, events, and year-month fixed effect, respectively. The coefficient on $Post_t$ captures the impact of MCB issues. The estimation is conducted for four event windows, ranging from 4 weeks to 1 weeks before and after the issue date of MCBs. Standard errors are corrected based on Newey and West (1987).

Estimation results for EBs and RCBs are reported in Panel A and Panel B of Table 10, respectively. In Panel A, the coefficient on $Post_t$ is positive and insignificant during the first one or two weeks around high-supply events, but becomes significantly negative around low-supply events, which confirms our expectation that MCBs can reduce EBs spreads when the amount of MCBs issuance is within certain level. In Panel B, the response pattern of RCBs is more impressive. RCBs spreads significantly decrease around low-supply events, where the average reduction is 0.015% in two-week window, and 0.019% in four-week window. In contrast, there is increase in RCBs spreads around high-supply events.

[Place Table 10 about here]

Table 11 reports the results by maturity bins. Main findings are in line with Table 10. Especially, the new issuance of MCBs have larger impact in reducing the spreads of EBs with long maturity and RCBs with short maturity. These results are consistent with the maturity structure of EBs and RCBs.

[Place Table 11 about here]

To further address the endogeneity problems caused by LGFV timing, we adopt the approach in Dittmar and Yuan (2008). By regressing the raw spreads of EBs and RCBs on default-free term structure as well as the yield spread of municipal corporate bond portfolio (MCB_t) which captures the timing decision, we obtain the residual spreads for event analysis. The residual spreads are orthogonalized with LGFV timing. Specific estimation is as the following equation:

$$ys_{\{EB,RCB\},t} = \delta_0 + \beta' X_t + \gamma MCB_t + \nu_{\{EB,RCB\},t} \tag{11}$$

where $ys_{\{EB,RCB\},t}$ denotes the yield spreads of individual EBs and RCBs, X_t are the principal components in the term structure, and MCB_t is the yield spread of municipal corporate bond portfolio. $\nu_{\{EB,RCB\},t}$ are the estimated residual spreads.

Table 12 reports the event analysis based on the residual spreads, and Table 13 reports the results by maturity bins. Main conclusions still hold. Low-supply of MCB, rather than high-supply of MCB, significantly reduces the residual spreads of EBs with maturity more than five years, and RCBs with maturity less than five years, though the magnitude of spread reduction is smaller than the results based on raw spreads.

[Place Table 12 about here]

[Place Table 13 about here]

6 The Impact of MCBs on Corporate Bond Maturity Choice

Greenwood et al. (2010), Badoer and James (2016) document that corporate bond issuance will fill in the supply gaps created by the changes in government financing patterns, resulting in negative correlation between the maturities of government and corporate debt. van Bekkum et al. (2019) argue that the quality of reference rates influences the relationship between government and corporate debt maturity. When there are not enough reference rates, government issues will complement corporate debt issues of the same maturity by providing reference rates. Though we cannot directly define the spread of MCB as reference rate, previous evidences have suggested that MCB may act like a benchmark security in Chinas immature corporate debt market. We would like to explore how MCBs influence corporate bond maturity choice. Will MCBs issued by LGFV improve the willingness of other non-financial corporations to borrow long-term debts?

Different from previous analysis, to investigate the maturity structure of corporate debt, all the bond securities issued by the non-financial corporations are included in the sample, including enterprise bonds, exchange-traded corporate bonds, mid-term notes, commercial papers, private placement notes, asset-backed securities and other credit instruments. Figure 7 plots the proportion of each maturity bin of bonds issuance each year.

[Place Figure 7 about here]

As shown in Figure 7, the maturity structure of enterprise bonds tends to be long term and relatively stable. There is no short-term (less than one year) enterprise bonds, and most enterprise bonds are issued with maturities longer than 5 years. By contrast, regular corporate bonds have relatively diverse maturity. In this section, we mainly examine the impact of MCBs on the maturity choice of RCBs. And to ensure the sample clean, we focus on the corporate issuers who do not have any issuance of EBs.

Maturity equal or more than 5 years are defined as long term. Each month, we calculate the long-term RCBs issuance share as the issuance of RCBs with maturity no less than 5 years divided by total amount of RCBs issuance, denoted as d_L^{RCB}/d^{RCB}. Similarly, we calculate the long-term RCBs (MCBs) outstanding share as the outstanding amount of RCBs (MCBs) due in no less than 5 years divided by total outstanding RCBs (MCBs), denoted as D_L^{RCB}/D^{RCB} (D_L^{MCB}/D^{MCB}). Figure 8 compares the fraction of long-term RCBs and MCBs.

[Place Figure 8 about here]

6.1 Aggregate level

Corresponding to Figure 8, we conduct a set of OLS regressions. We separately regress monthly long-term RCBs issuance share and outstanding share on the long-term MCBs outstanding share. Adapted from Badoer and James (2016), we also employ weighted maturity of MCBs ($MCBmat$)

as another measure for MCB maturity structure. MCBmat is defined as the average maturity of outstanding MCBs valued-weighted by outstanding principal. Control variables are commonly used in the literature: the spread between the 10-year treasury yield and 1-year treasury yield ($term$); the credit spread, defined as the AA yield minus AAA yield of corporate bonds ($AA - AAA$); 5-year fixed effect. To control the bench rates, we also include 10-year CDB yield ($yield^{CDB}_{10yr}$), as CDBs are generally perceived as the benchmark assets in corporate bond market by the investors. Table 14 presents the estimation results.

The variables of key interest are D^{MCB}_L/D^{MCB} and $MCBmat$. They both positively related with the issue or the level of long-term RCBs. For example, according to Column (2) and Column (5), 1% increase in long-term MCBs fraction will lead to 0.209% increase in the fraction of long-term RCB issues and 0.088% increase in the fraction of long-term RCB outstanding.

[Place Table 14 about here]

6.2 Logit models of long-term RCBs issues

Section 6.1 examines the maturity impact of MCBs at aggregate level. In this section, we provide more empirical evidence at individual bond level and show some heterogeneities. We estimate a logit model for the likelihood of long-term corporate bond issuances. The dependent variable takes a value of one if the bond issue had a maturity of [5,) years, and zero otherwise. Employing D^{MCB}_L/D^{MCB} to model the maturity structure of MCB, Panel A of Table 15 presents the regression results. Bonds without rating information are dropped. Column 1 is about the full sample results. Column 2 to 4 show the sub samples. A bond, which is already easy to be issued, such as receiving high rating, issued by SOEs, might less benefit from the new supply of bench assets, i.e. MCBs. The positive impact from long-term MCBs is expected to be weaker in these bonds. To test this idea, we introduce the interaction between D^{MCB}_L/D^{MCB} and $HighRating$ or SOE. $HighRating$ equals to 1 if the bond rating belongs to AAA, and 0 otherwise. SOE denotes whether the bond issuer is SOE or not. If our hypothesis is true, both the coefficient of $D^{MCB}_L/D^{MCB} \times HighRating$ and $D^{MCB}_L/D^{MCB} \times SOE$ should be negative. The marginal effects for low rating group or Non-SOE group should also be larger. The results in Table 18 are in line with the predictions.

[Place Table 15 about here]

7 Conclusion

In this paper, we study the impact of municipal corporate bond in Chinas credit market, focusing on whether it generates benefits for this immature market. Municipal corporate bond is distinguished from other corporate debt instruments in terms of large scale and strong implicit government backup. Liu et al. (2017) document that local government fiscal conditions significantly influenced municipal corporate bond spreads. Therefore, municipal corporate bond is likely to capture more macro risks relative to other corporate debt instruments. According to Yuan (2005), and Dittmar and Yuan (2008), the introduction of benchmark assets that spanning systematic risks will improve the incomplete market.

Our empirical results show that municipal corporate bond benefits China's credit market in four ways. First, municipal corporate bond contains important pricing information for enterprise bond and regular corporate bond, which is beyond the systematic information in treasuries and CDBs. There is significant enhancement in both minimum variance portfolio and tangency portfolio in efficient frontier. Second, municipal corporate bond promotes price discovery, which cannot be explained by simple bond spread correlation. Especially, municipal corporate bond with stronger government guarantee presents larger explanatory power for existing bond securities. Third, excessive supply of municipal corporate bond could crowd out enterprise bond and regular corporate bond, but moderate supply of municipal corporate bond contributes to reduce the spread of other bond products. Finally, promotion effect, instead of substitution effect, are discovered between long-term municipal corporate bond and long-term corporate debt.

High-quality benchmark asset is crucial for the development of fixed-income security market. Municipal corporate bond complements the role of treasuries, acting like a benchmark security. With the improvement in treasury market in the future, we expect corporate debt market in China will be more efficient and liquid.

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Notes

[1]Source:http://www.gov.cn/zhengce/2020-04/09/content_5500622.htm

[2]The former director of finance department of the National Development and Reform Commission has evaluated the role of municipal corporate bond, "On the one hand, municipal corporate bonds serve as standardized and transparent financing channels for urban infrastructure construction, one the other hand, they enrich the fixed-income products for institutional investors." Source: https://www.ndrc.gov.cn/xxgk/jd/jd/201108/t20110829_1183127.html

[3]We sort the bonds into "SOEs" and "Non-SOEs" according to their issuers' attribute. Note that almost all the enterprise bonds and municipal corporate bonds are issued by SOEs. EBs and MCBs only have the category of "SOEs".

[4]Following Huang et al. (2019), we identify industries directly related with LGFV, upstream of LGFV industry, downstream of LGFV industry and other industries.

[5]Market: Enterprise bonds can be traded on both interbank market and exchange market. Exchange-traded corporate bonds are only allowed to be traded on the exchange market. Medium-term notes are only allowed to be traded on the interbank market. Bond rating: all bonds are divided into two rating groups by bond type: AAA, and below AAA. Maturity: all bonds are divided into two maturity groups by bond type: (0,5), [5,). Bond issuance: all bonds are divided into "Small" and "Large" groups according to the median issuance within each bond type each year.

[6]As explained in Section 2, commercial papers and other bond instruments with maturity less than one year have been screened out from our sample, the shortest bond maturity in our sample is 1 year.

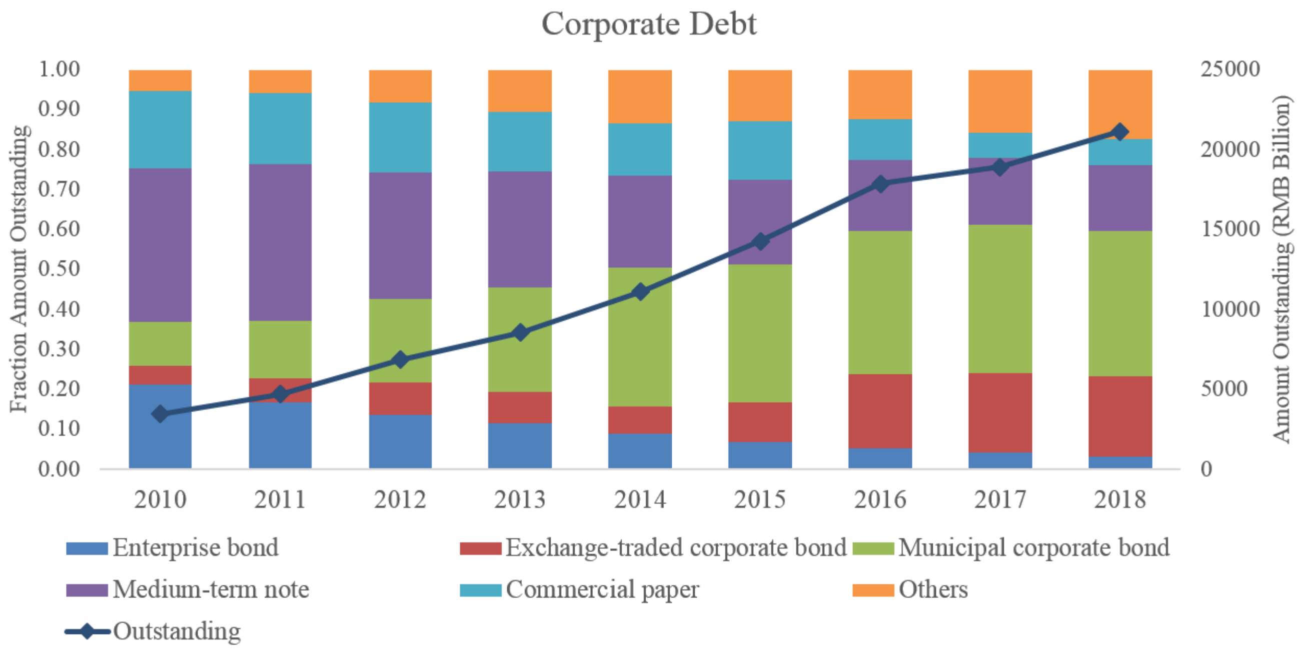


Figure 1.
Growth and component of Chinas corporate debt market.
This figure depicts the total amount outstanding of corporate debt in China (RMB billion, right axis) and the fraction by instrument category (left axis).

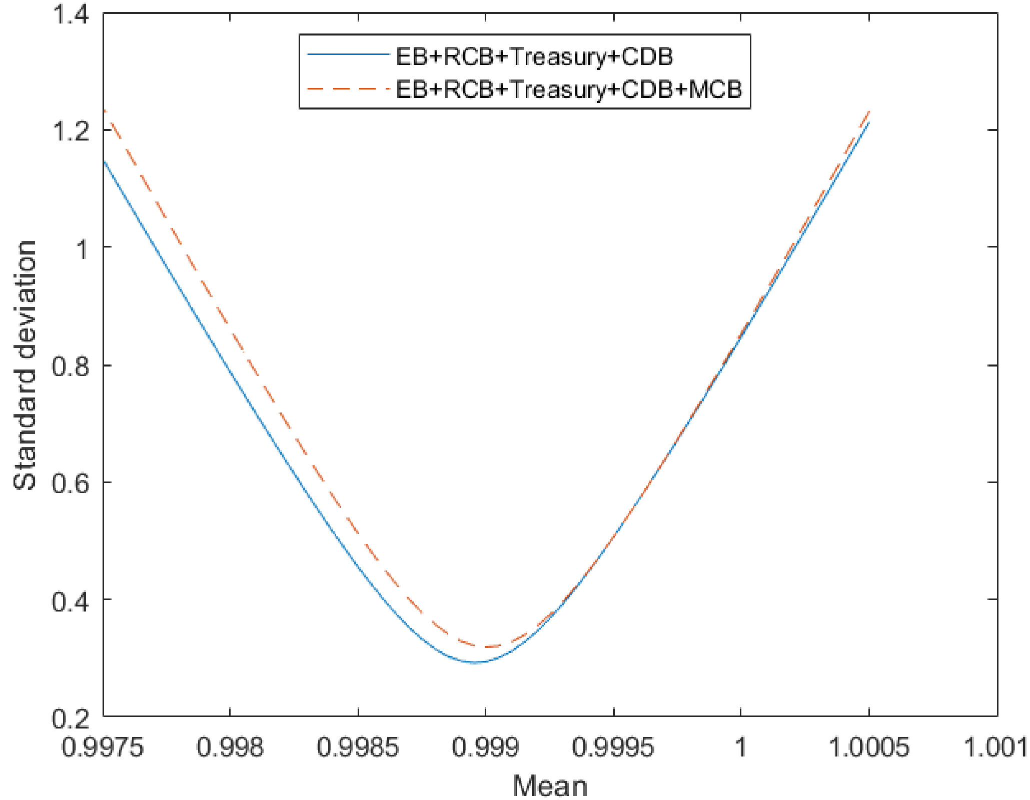


Figure 2.
Hansen-Jagannathan bounds.
This figure depicts Hansen-Jagannathan (1991) bounds on admissible pricing kernels for two asset sets: benchmark assets consisting of EB, RCB, CDB and treasury in solid blue lines, and benchmark plus test assets consisting of EB, RCB, CDB, treasury and MCB in dotted red lines. The bounds are constructed using weekly returns on equal weighted portfolios of bonds.

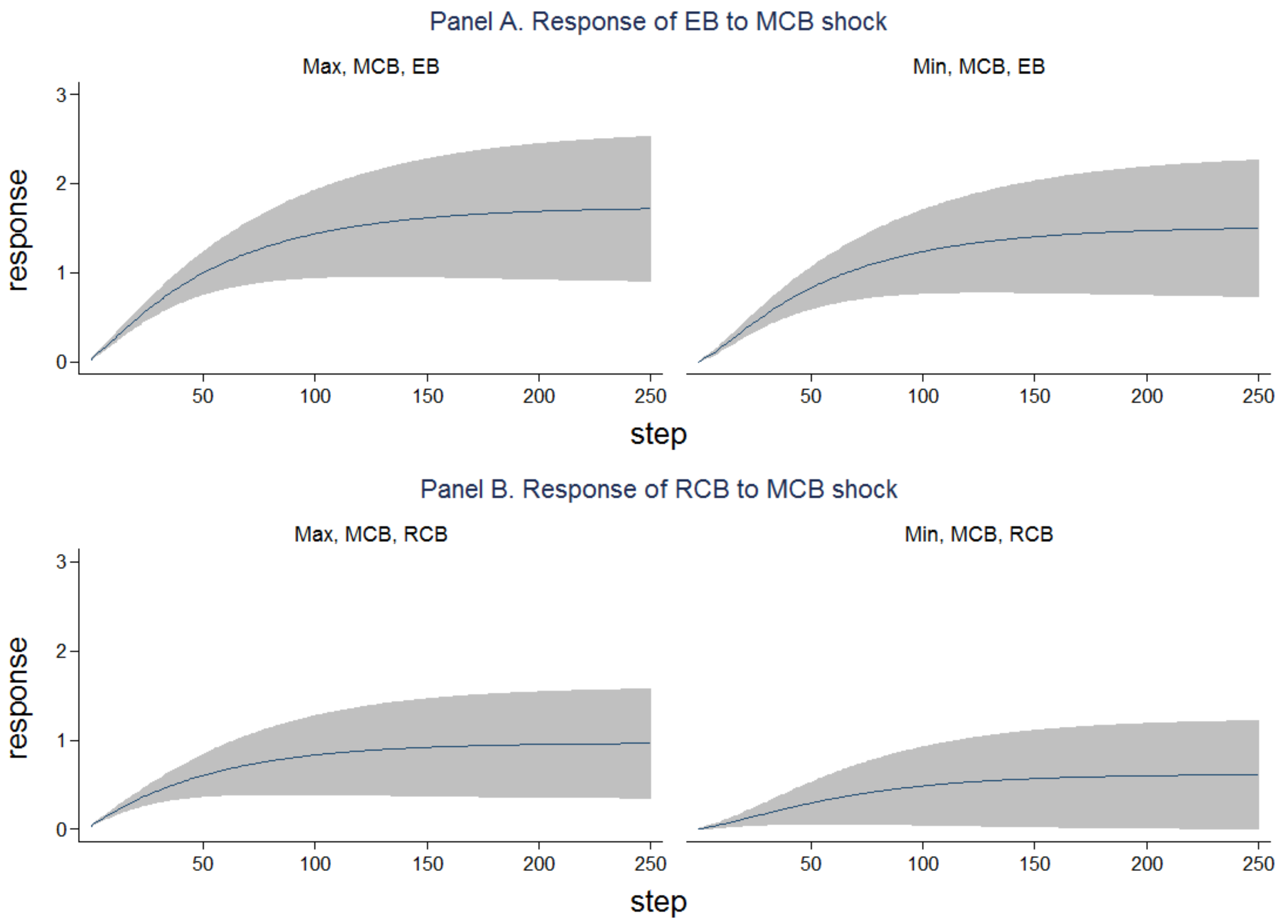


Figure 3.
Impulse response.
This figure presents impulse response functions for the effect of a one-standard-deviation shock in the residual spread of municipal corporate bond portfolio on the residual spread of enterprise bond or regular corporate bond portfolio. Shocks are orthogonalized using a Cholesky decomposition, and are based on the VAR results in Table 7. Sample period is from January 2010 to June 2019.

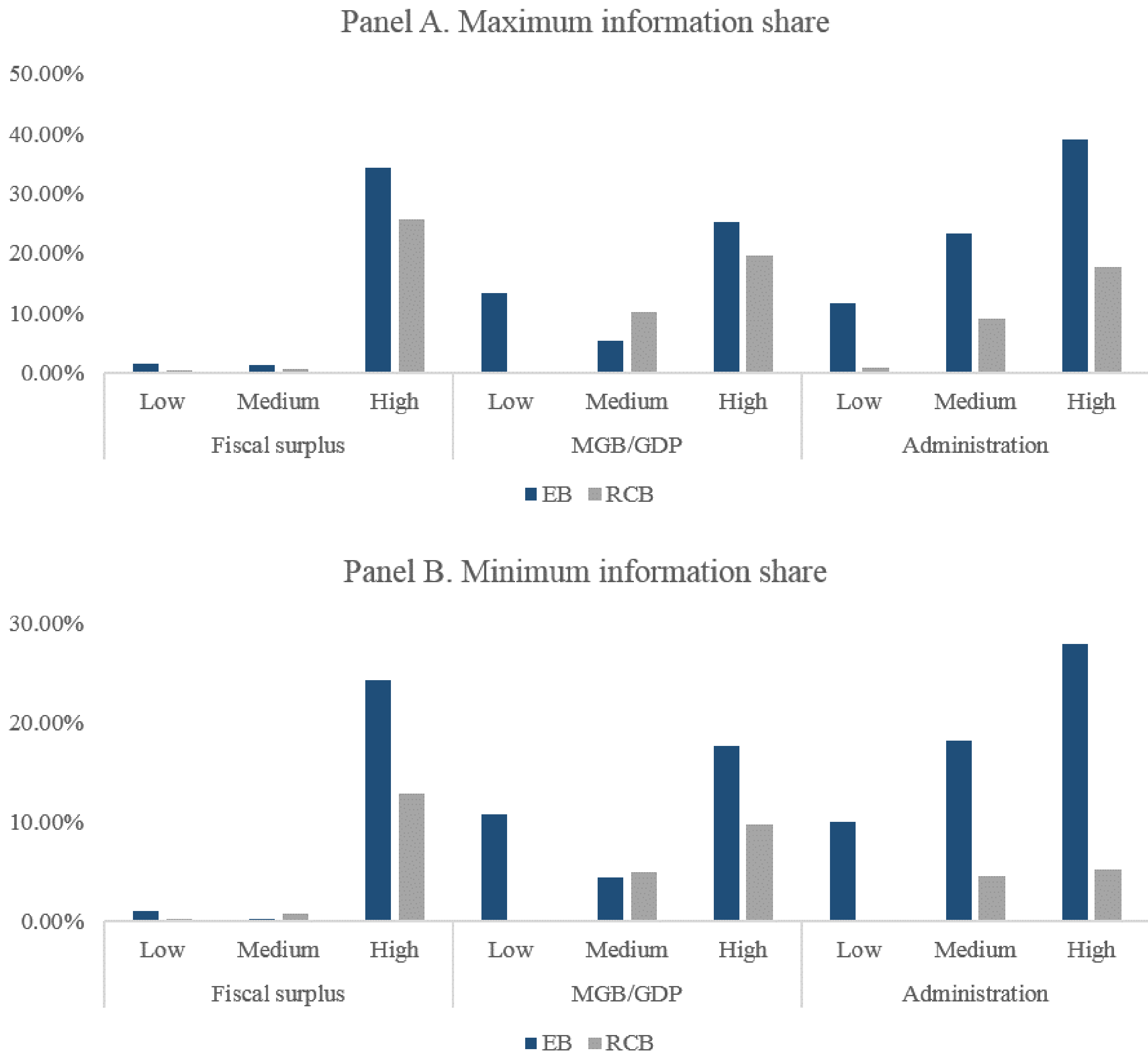


Figure 4.
Price discovery in subsamples by the degree of implicit guarantee in MCB.
This figure summarizes the results of variance decompositions in subsamples sorted by the degree of implicit guarantee in MCB. We employ two measures to proxy the degree of implicit guarantee in MCB: province-level fiscal surplus, administration level of MCBs issuers. Panel A presents the maximum information share attributable to MCB in EB or RCB. Panel B presents the minimum information share. Sample period is from January 2010 to June 2019.

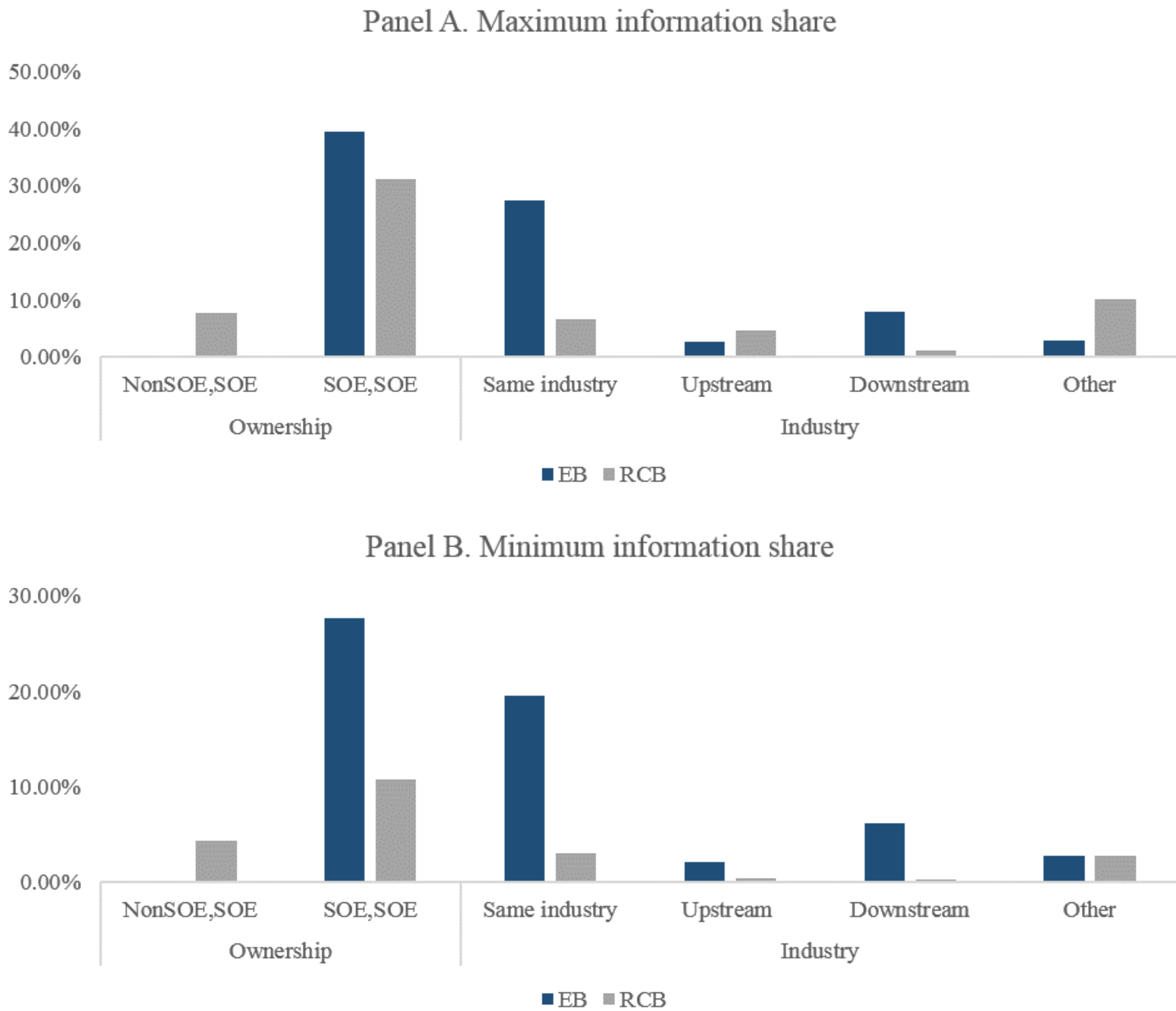
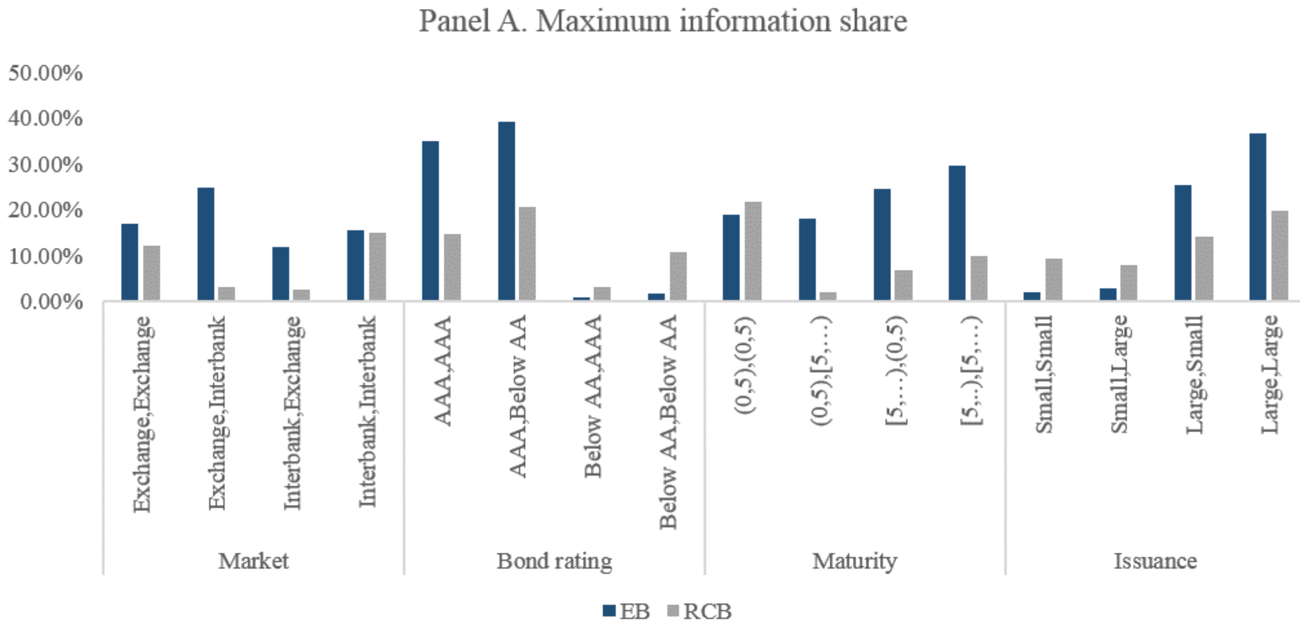


Figure 5.
Price discovery in subsamples by issuers' characteristics.
This figure summarizes the results of variance decompositions in subsamples sorted by the characteristics of bond issuers: SOE and Industry exposure. Panel A presents the maximum information share attributable to MCB in EB or RCB. Panel B presents the minimum information share. Sample period is from January 2010 to June 2019.



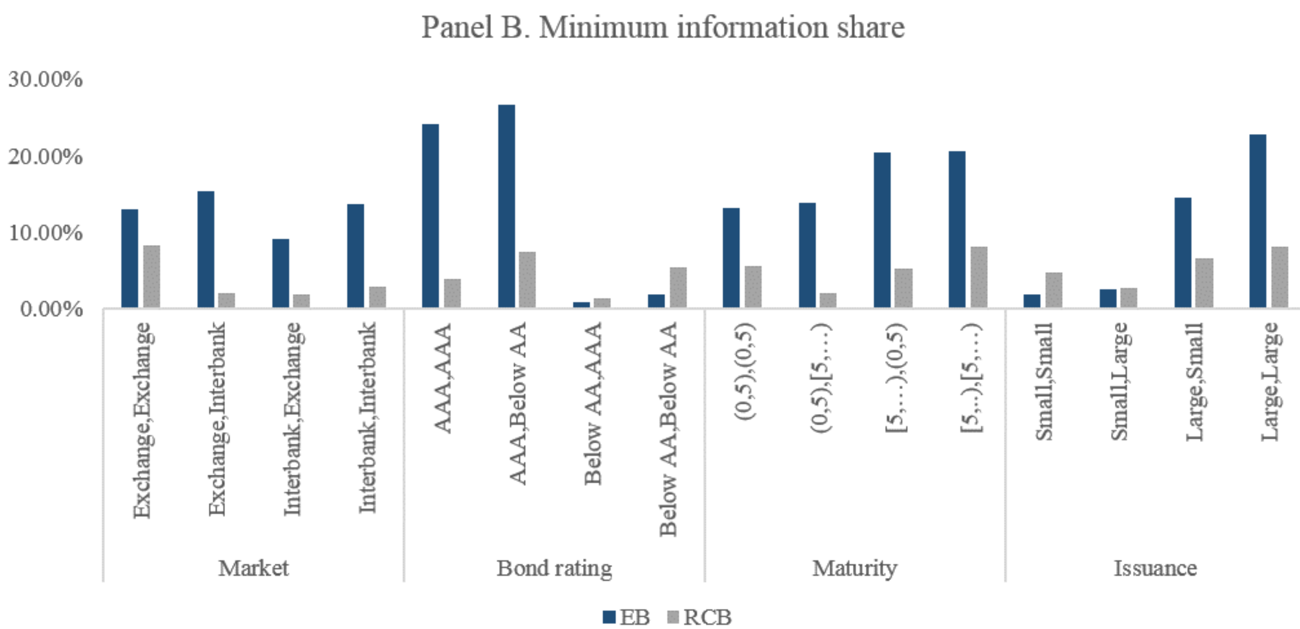


Figure 6.
Price discovery in subsamples by bonds' characteristics.
This figure summarizes the results of variance decompositions in subsamples sorted by bond characteristics: trading market, bond rating, bond maturity and issuance. Panel A presents the maximum information share attributable to MCB in EB or RCB. Panel B presents the minimum information share. Sample period is from January 2010 to June 2019.

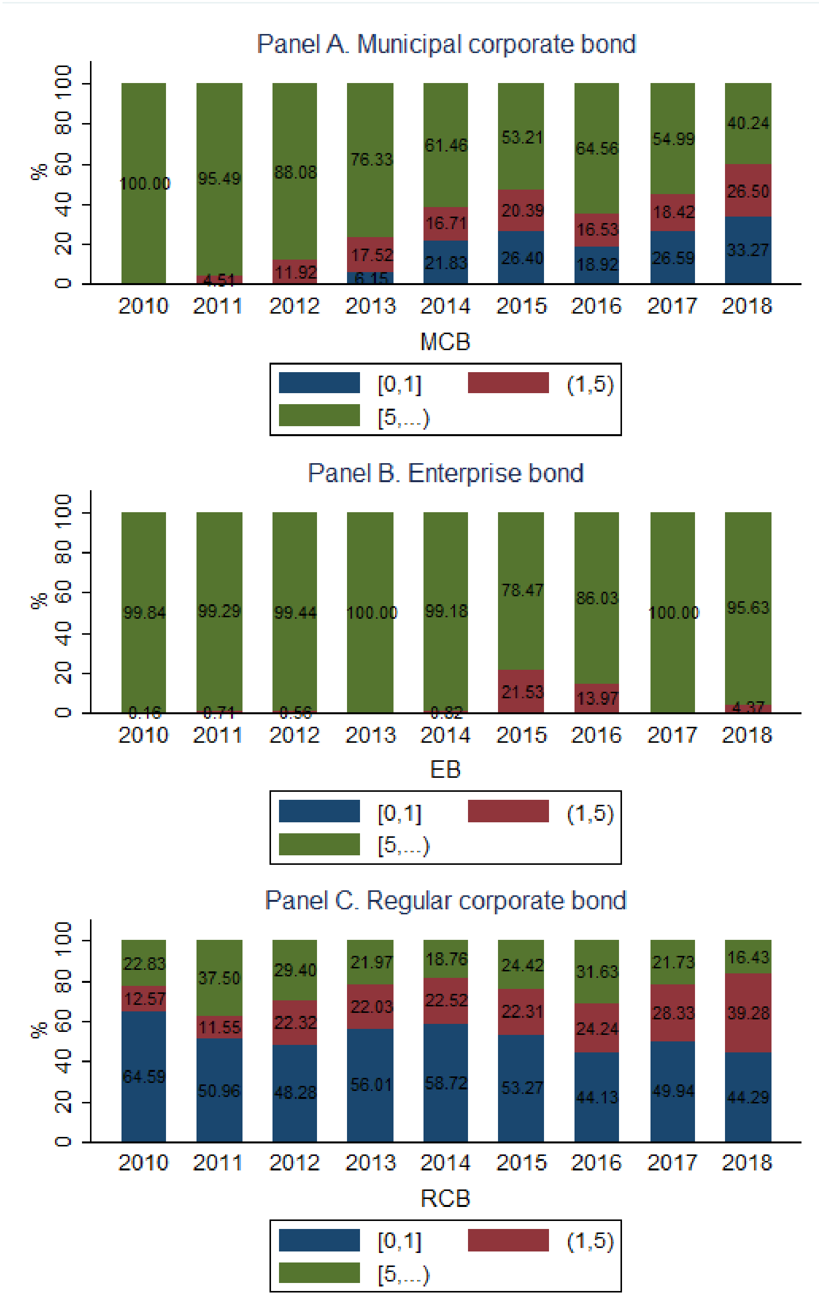


Figure 7.

Fraction of bonds issuance of each maturity bin.

This figure depicts the distribution of MCBs, EBs and RCBs issuance across maturities by year. All the bond securities issued by the non-financial corporations are included in the sample, such as commercial papers, private placement notes, asset-backed securities and other credit instruments. Regular corporate bonds issued by corporations which ever issued enterprise bonds are dropped to ensure a clean sample of regular corporate bond maturity structure. Sample period is from year 2010 to 2018.

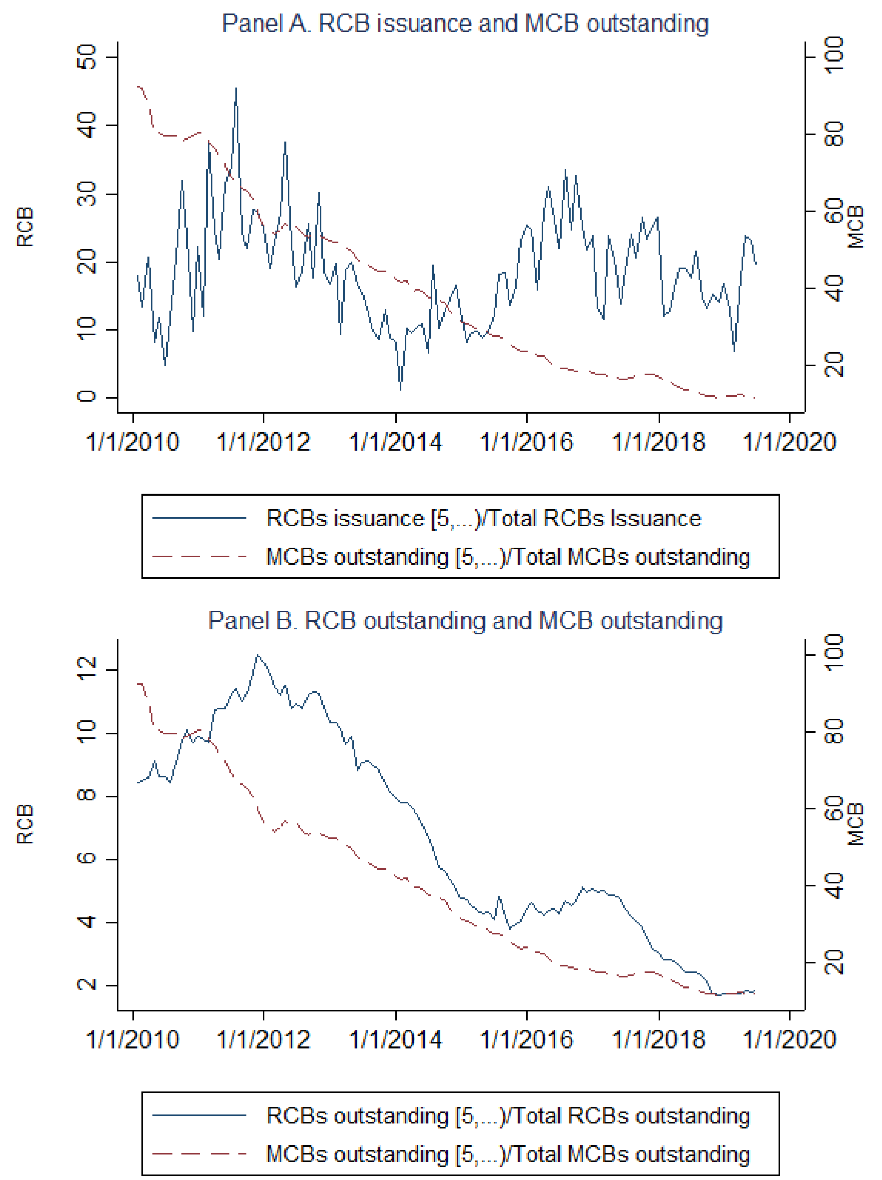


Figure 8.
RCBs maturity and MCBs maturity.
This figure compares the RCBs maturity and MCBs maturity. All the bond securities issued by the non-financial corporations are included in the sample, such as commercial papers, private placement notes, asset-backed securities and other credit instruments. Regular corporate bonds issued by corporations which ever issued enterprise bonds are dropped to ensure a clean sample of regular corporate bond maturity structure. The solid line, plotted on the left axis, is the share of long-term RCBs issuance as a fraction of total RCBs issuance in Panel A, and share of long-term RCBs outstanding as a fraction of total RCBs outstanding in Panel B. The dashed line, plotted on the right axis in each Panel, is the share of MCBs outstanding of total MCBs outstanding. Sample period if from January 2010 to June 2019..

Table 1.
Comparisons among MCBs, EBs, and RCBs.
This table presents the features of MCBs, EBs, and RCBs in four aspects: issuers, regulators, use of funds and credit guarantee. CBRC: China Banking Regulatory Commission. CSRC: China Securities Regulatory Commission. NAFMII: National Association of Financial Market Institutional Investors. NDRC: National Development and Reform Commission. MOF: Ministry of Finance. PBC: People's Bank of China.

	Municipal corporate bond	Enterprise bond	Regular corporate bond
Issuers	LGFVs	Government agencies, enterprises under collective ownership, and state-owned enterprises	Non-financial corporations (excluding LGFVs)
Regulator	Enterprise bonds: PBC, NDRC Exchange-traded corporate bonds: CSRC Commercial papers, medium-term notes, Private placements notes: NAFMII Asset-backed securities: CBRC, PBC	PBC, NDRC	Exchange-traded corporate bonds: CSRC Commercial papers, medium-term notes, Private placements notes: NAFMII Asset-backed securities: CBRC, P-BC International institution bonds: P-BC, MOF, NDRC, CSRC Convertible bonds: PBC, CSRC Privately placed small and medium enterprise notes: Shanghai and Shenzhen stock exchange
Use of Funds	Local economic and social development	Projects in line with national industrial polices	Companies' operational needs
Credit guarantee	Related to government	Related to government	Corporate performance

Table 2.
Summary statistics.
This table reports the summary statistics for MCBs, EBs and RCBs. Bonds characteristics include: number of unique issuers, number of bonds, daily yield spread (Spread), weekly bond return (Return), spread at issue (Ispread), Coupon rate, Bond rating at issue (1= AAA, 2=AA+, 3=AA, etc.), Maturity, Issuance (Billion RMB), SOE with 1 indicating that the issuer is SOE and 0 otherwise, List with 1 indicating that the issuer is a listed firm and 0 otherwise. Distribution statistics include mean, median, standard deviation. Sample period is from January 2010 to June 2019.

Type	MCBs			EBs			RCBs		
	Mean	Median	Std	Mean	Median	Std	Mean	Median	Std
NumIssuers	745			177			1383		
NumBonds	2065			399			3962		
Spread	1.85	1.76	0.73	1.42	1.36	0.65	2.01	1.73	1.14
Return	0.13	0.10	0.63	0.12	0.09	0.87	0.12	0.09	0.60
Ispread	1.42	1.31	0.75	0.99	0.81	0.66	1.47	1.20	1.00
Coupon	5.27	5.27	1.07	4.95	4.90	0.86	5.22	5.10	1.25
Bond Rating	2.13	2.00	0.89	1.16	1.00	0.50	1.89	2.00	0.96
Maturity	4.64	5.00	1.51	9.70	10.00	4.14	4.04	3.00	1.55
Issuance	1.12	1.00	0.92	2.73	1.50	3.04	1.78	1.00	2.57
SOE	1.00	1.00	0.00	0.97	1.00	0.16	0.75	1.00	0.44

Table 3.
Spanning enhancement.
This table reports the results about whether MCB improves the opportunity set relative to EB and RCB. Test asset is the equal weighted portfolio of MCBs. The constituents of benchmark assets are labelled in the first row. The spanning hypothesis is that benchmark asset returns span test asset returns. We employ six spanning test statistics in Kan and Zhou (2012) using the weekly bond portfolio returns. W is the Wald test under conditional homoscedasticity; We is the Wald test under the IID elliptical; Wa is the Wald test under the conditional heteroscedasticity; J_1 is the Bekaert-Urias test with the Errors-in-Variables (EIV) adjustment; J_2 is the Bekaert-Urias test without the EIV adjustment; J_3 is the DeSantis test. All six tests have an asymptotic chi-squared distribution with $2N$ ($N = 1$) degrees of freedom. We also present the annualized Sharpe ratios of portfolios of bench assets alone (λ_B) and bench assets plus test assets (λ_{B+T}), and the number of weekly observations (T). Sample period is from January 2010 to June 2019.

Benchmark	W	We	Wa	J_1	J_2	J_3	λ_B/λ_{B+T}	T
EB+RCB	58.202	49.399	51.370	44.666	42.542	55.199	2.501/2.521	487
p-value	0.000	0.000	0.000	0.000	0.000	0.000		
EB+RCB+Treasury	54.897	45.097	47.615	43.885	42.280	53.730	3.022/3.043	487
p-value	0.000	0.000	0.000	0.000	0.000	0.000		
EB+RCB+Treasury+CDB	49.756	41.589	40.560	39.951	38.528	48.706	3.068/3.093	487
p-value	0.000	0.000	0.000	0.000	0.000	0.000		

Table 4.
Step-down test.
This table reports the step-down test results. Test asset is the equal weighted portfolio of MCBs. The constituents of benchmark assets are labelled in the first row. F test examines the null hypothesis ($H_0 : \alpha = 0$ and $\delta = 0$). F_1 test examines $\alpha = 0$. The rejection of F_1 will indicate that MCB statistically improves the tangency portfolios. F_2 test examines $\delta = 0$ conditional on the constraint $\alpha = 0$. The rejection of F_2 indicates that MCB statistically improves the global minimum-variance portfolios. Sample period is from January 2010 to June 2019.

Bench					Step-Down Test			
	α	δ	F-test	p-value	F_1	p-value	F_2	p-value
EB+RCB	-0.000127	-0.256	28.922	0.000	3.740	0.054	53.799	0.000
EB+RCB+Treasury	-0.000124	-0.260	27.223	0.000	3.545	0.060	50.635	0.000
EB+RCB+Treasury+CDB	-0.000111	-0.248	24.623	0.000	2.790	0.096	46.285	0.000

Table 5.
Spanning enhancement in different sets of benchmarks.
This table presents the spanning enhancement of MCB in different type of benchmark assets. Benchmark assets are set to be: value weighted portfolio of EB, RCB, treasury and CDB (test asset is value weighted MCB portfolio); market/ maturity/ rating sorted equal weighted portfolios of EB, RCB, treasury and CDB (test asset is equal weighted municipal corporate bond portfolio). Panel A reports the six spanning test results. Panel B reports the step-down results. Sample period is from January 2010 to June 2019.

Panel A. Spanning test

Benchmark	W	We	Wa	J_1	J_2	J_3	λ_B/λ_{B+T}	T
Value weighted portfolio	10.048	9.633	10.076	10.013	10.265	10.188	2.166/2.353	487
	0.007	0.008	0.006	0.007	0.006	0.006		
Market sorted portfolio	58.573	47.420	43.984	40.561	38.559	51.912	3.350/3.366	467
	0.000	0.000	0.000	0.000	0.000	0.000		
Maturity sorted portfolio	41.237	31.861	26.990	28.040	27.005	39.017	3.299/3.322	478
	0.000	0.000	0.000	0.000	0.000	0.000		
Rating sorted portfolio	24.494	23.115	19.934	17.691	19.439	18.463	1.687/2.377	484
	0.000	0.000	0.000	0.000	0.000	0.000		

Panel B. Step-down test

Benchmark	α	δ	F-test	p-value	F_1	p-value	F_2	p-value
Value weighted portfolio	0.000133	-0.058	4.973	0.007	2.823	0.094	7.095	0.008
Market sorted portfolio	-0.000142	-0.279	28.785	0.000	4.367	0.037	52.816	0.000
Maturity sorted portfolio	-0.000197	-0.378	20.230	0.000	7.222	0.007	32.804	0.000
Rating sorted portfolio	0.000356	0.079	12.095	0.000	24.070	0.000	0.115	0.734

Table 6.
Spanning enhancement in subsamples.
This table presents the spanning test results for two sub periods: January 2010 to December 2014, and January 2015 to June 2019. Test asset is the equal weighted portfolio of MCB. Benchmark assets contain the equal weighted bond portfolio of EB, RCB, treasury and CDB. Panel A reports the six spanning test results. Panel B reports the step-down results.

Panel A. Spanning test Bench: EB+RCB+Treasury+CDB	W	We	Wa	J_1	J_2	J_3	λ_B/λ_{B+T}	T
2010.1.1-2014.12.31	31.639	28.381	29.180	27.772	27.166	33.384	3.101/3.138	258
	0.000	0.000	0.000	0.000	0.000	0.000		
2015.1.1-2019.6.30	24.934	16.450	20.968	19.620	17.356	25.796	5.910/5.996	229
	0.000	0.000	0.000	0.000	0.000	0.000		

Panel B. Step-down test Bench: EB+RCB+Treasury+CDB	α	δ	F-test	p-value	F_1	p-value	F_2	p-value
2010.1.1-2014.12.31	-0.000085	-0.301	15.513	0.000	0.625	0.430	30.445	0.000
2015.1.1-2019.6.30	-0.000155	-0.194	12.195	0.000	5.469	0.020	18.552	0.000

Table 7.
Price discovery.
This table presents the variance decompositions using the daily orthogonalized yield spreads via VARs. We estimate VAR for MCB and EB, MCB and RCB, separately. Panel A reports the information share in EB attributable to MCB. Panel B reports the information share in RCB attributable to MCB. The column labeled Max denotes the variance decomposition with MCB ordered first in the system; the column labeled Min denotes the variance decomposition with MCB ordered last in the system. N is the number of daily observations. Sample period is from January 2010 to June 2019.

VAR	Sample period	Max	Min	N
Panel A. Price discovery of MCB in EB				
VAR: MCB and EB, decompose EB	2010.1.1-2019.6.30	36.33%	26.52%	2308
	2010.1.1-2014.12.31	19.73%	15.83%	1212
	2015.1.1-2019.6.30	16.23%	13.06%	1096
Panel B. Price discovery of MCB in RCB				
VAR: MCB and RCB, decompose RCB	2010.1.1-2019.6.30	19.46%	5.58%	2313
	2010.1.1-2014.12.31	36.93%	9.36%	1212
	2015.1.1-2019.6.30	6.55%	0.11%	1101

Table 8.
Placebo test.
This table examines the price discovery of EB (RCB) in RCB (EB) using the daily residual portfolio spreads. Panel A presents the information share in EB attributable to RCB, which is in contrast with Panel A in Table 7. Panel B presents the information share in RCB attributable to EB, which is in contrast with Panel B in Table 7.

VAR	Sample period	Max	Min	N
Panel A. Price discovery of RCB in EB				
VAR: RCB and EB, decompose EB	2010.1.1-2019.6.30	1.36%	0.10%	2309
	2010.1.1-2014.12.31	11.68%	5.08%	1213
	2015.1.1-2019.6.30	1.47%	1.03%	1096
Panel B. Price discovery of EB in RCB				
VAR: EB and RCB, decompose RCB	2010.1.1-2019.6.30	3.44%	1.49%	2309
	2010.1.1-2014.12.31	6.09%	1.16%	1213
	2015.1.1-2019.6.30	0.48%	0.45%	1096

Table 9.
Price discovery in industry and location dimension.
This table compares the price discovery impact of MCB and EB in RCB. We examine the information share in RCB attributable to MCB through the VAR consisting of RCB and MCB (as shown in Column 2 to Column 4), and the information share in RCB attributable to EB through the VAR consisting of RCB and EB (as shown in Column 5 to Column 7). Panel A reports the variance decomposition results where RCB are matched with MCB (EB) in the same industry. Panel B reports the results where RCB are matched with MCB (EB) in the same industry and same areas. There are typically seven geographical areas in China: North China, East China, South China, Center China, Northeast, Northwest, and Southwest. Panel C reports the number of bonds, and the number of portfolio observations for VAR estimation in the same industry and same area. Sample period is from January 2010 to June 2019.

	VAR: MCB, RCB Decompose RCB			VAR: EB, RCB Decompose RCB		
Panel A. Same industry						
	Max	Min	N	Max	Min	N
Same industry	6.57%	2.96%	2187	8.83%	6.10%	2295
Panel B. Same industry and same area						
	Max	Min	N	Max	Min	N
North China	20.50%	15.80%	2025	12.30%	8.83%	2293
East China	3.51%	3.65%	1863	0.45%	0.25%	1560
South China	2.18%	1.92%	851	9.32%	6.86%	1105
Panel C. Number of bonds and portfolio observations in the same industry and same area						
	Bonds Num. (RCB)	Bonds Num. (MCB)	Portfolio Obs.	Bonds Num. (RCB)	Bonds Num. (MCB)	Portfolio Obs.
North China	284	117	2025	536	138	2293
East China	107	306	1863	268	38	1560
South China	60	49	851	103	15	1105
Central China	28	59	608	45	6	123
Northeast	23	18	741	54	3	367
Northwest	4	53	0	47	4	74
Sourthwest	28	128	806	39	10	476

Table 10.
Price impact of MCBs issuances.
This table reports the estimated impact of the newly issuance of MCBs on the spreads of existing enterprise bonds and regular corporate bonds. By regressing the spreads of EBs and RCBs on a dummy variable $Post_t$ denoting the issue event, we examine the spreads of EBs and RCBs for two event categories, i.e., high-supply and low-supply. The estimation is performed for four event windows, each ranging from 4 to 1 weeks before and after the issue date. Panel A and Panel B present the results for EBs and RCBs, respectively. We report the coefficient of the dummy variable $Post_t$, the t-stat (corrected based on Newey and West (1987)), the number of daily observations and the number of events for each event category and maturity bin. Sample period is from January 2010 to June 2019. *p <0.10,**p <0.05,***p <0.01.

	Over supply				Under supply			
	[-1w,+1w]	[-2w,+2w]	[-3w,+3w]	[-4w,+4w]	[-1w,+1w]	[-2w,+2w]	[-3w,+3w]	[-4w,+4w]
Panel A. Price impact on EBs								
Post	0.000	0.006	-0.005	-0.008	-0.013	-0.018*	-0.028***	-0.026***
t-stat	(0.03)	(0.75)	(-0.82)	(-1.35)	(-1.00)	(-1.87)	(-3.60)	(-3.75)
Obs	4,394	8,491	12,552	16,558	2,998	5,895	8,761	11,763
Num of Events	66	66	66	66	46	46	46	46
Panel B. Price impact on RCBs								
Post	0.018**	0.013**	-0.000	-0.019***	-0.015*	-0.019***	-0.013**	-0.009**
t-stat	(2.51)	(2.36)	(-0.03)	(-4.71)	(-1.73)	(-3.03)	(-2.55)	(-2.02)
Obs	40,690	79,449	116,386	152,616	24,622	48,936	72,413	96,232
Num of Events	66	66	66	66	46	46	46	46

Table 11.
Price impact of MCBs issuances: by maturity bin.
Following the event study procedure in Table 10, this table reports how the spreads of EBs and RCBs react to MCB issuances by maturity bin. Each panel reports the results for the corresponding maturity bin and event category. Sample period is from January 2010 to June 2019. *p <0.10,**p <0.05,***p <0.01.

		Over supply				Under supply			
		[-1w,+1w]	[-2w,+2w]	[-3w,+3w]	[-4w,+4w]	[-1w,+1w]	[-2w,+2w]	[-3w,+3w]	[-4w,+4w]
Panel A. Price impact on EBs									
(1,5)	Post	0.020	0.024*	-0.002	-0.006	-0.014	-0.012	-0.014	-0.011
	t-stat	(1.18)	(1.85)	(-0.15)	(-0.65)	(-0.60)	(-0.69)	(-1.04)	(-0.89)
	Obs	1,783	3,522	5,248	6,820	1,131	2,269	3,363	4,500
	Num of Events	31	31	31	31	19	19	19	19
[5,)	Post	-0.009	-0.001	-0.004	-0.007	-0.012	-0.019*	-0.037***	-0.035***
	t-stat	(-0.86)	(-0.14)	(-0.51)	(-0.99)	(-0.88)	(-1.87)	(-4.11)	(-4.49)
	Obs	2,555	4,889	7,187	9,618	1,828	3,556	5,327	7,167
	Num of Events	35	35	35	35	27	27	27	27
Panel B. Price impact on RCBs									
(1,5)	Post	0.019**	0.011*	-0.002	-0.021***	-0.019**	-0.023***	-0.016***	-0.011**
	t-stat	(2.44)	(1.88)	(-0.43)	(-5.19)	(-2.08)	(-3.41)	(-2.82)	(-2.19)
	Obs	37,734	73,803	108,129	141,731	22,067	44,095	65,313	86,767
	Num of Events	31	31	31	31	19	19	19	19
[5,)	Post	-0.001	0.027**	0.022*	0.022**	-0.000	-0.003	-0.005	-0.006
	t-stat	(-0.05)	(2.04)	(1.96)	(2.23)	(-0.02)	(-0.17)	(-0.38)	(-0.51)
	Obs	2,556	4,878	7,224	9,646	2,224	4,209	6,260	8,409
	Num of Events	35	35	35	35	27	27	27	27

Table 12.
Price impact of MCBs issuances using residual spreads.
To address the endogeneity problems caused by LGFV timing, this table examines the pricing impact of MCBs issuances using residual spreads, which are estimated by regressing enterprise or regular corporate bond spreads on the default structure and municipal corporate bond portfolio spread. Then following the event study procedure in Table 10, we investigate how residual spreads of EBs and RCBs react to MCB issuances.

	Over supply				Under supply			
	[-1w,+1w]	[-2w,+2w]	[-3w,+3w]	[-4w,+4w]	[-1w,+1w]	[-2w,+2w]	[-3w,+3w]	[-4w,+4w]
Panel A. Price impact on EBs								
Post	0.004	0.007	0.001	0.003	-0.002	-0.003	-0.004	-0.000
t-stat	(0.49)	(1.15)	(0.30)	(0.60)	(-0.21)	(-0.50)	(-0.72)	(-0.08)
Obs	4,386	8,491	12,547	16,549	2,995	5,890	8,757	11,752
Num of Events	66	66	66	66	46	46	46	46
Panel B. Price impact on RCBs								
Post	0.010**	0.007**	0.004	-0.003	-0.014***	-0.009**	-0.000	0.004
t-stat	(2.53)	(2.29)	(1.46)	(-1.52)	(-2.76)	(-2.43)	(-0.06)	(1.48)
Obs	40,644	79,359	116,265	152,440	24,522	48,712	72,086	95,836
Num of Events	66	66	66	66	46	46	46	46

Table 13.
Price impact of MCBs issuances using residual spreads: by maturity bin.
Following the event study procedure in Table 11, we investigate how residual spreads of EBs and RCBs react to MCB issuances by maturity bin. Each panel reports the results for the corresponding maturity bin and event category. Sample period is from January 2010 to June 2019. *p <0.10,**p <0.05,***p <0.01.

		Over supply				Under supply			
		[-1w,+1w]	[-2w,+2w]	[-3w,+3w]	[-4w,+4w]	[-1w,+1w]	[-2w,+2w]	[-3w,+3w]	[-4w,+4w]
Panel A. Price impact on EBs									
(1,5)	Post	0.002	0.012	0.004	0.008	0.001	0.011	0.020*	0.024**
	t-stat	(0.11)	(1.12)	(0.48)	(1.04)	(0.08)	(0.82)	(1.84)	(2.44)
	Obs	1,795	3,548	5,278	6,848	1,141	2,283	3,385	4,527
	Num of Events	31	31	31	31	19	19	19	19
[5,)	Post	0.007	0.004	0.000	-0.001	-0.008	-0.011	-0.019***	-0.015***
	t-stat	(0.87)	(0.69)	(0.03)	(-0.15)	(-0.80)	(-1.49)	(-3.11)	(-2.75)
	Obs	2,542	4,871	7,160	9,590	1,820	3,546	5,311	7,138
	Num of Events	35	35	35	35	27	27	27	27
Panel B. Price impact on RCBs									
(1,5)	Post	0.011**	0.006**	0.003	-0.004*	-0.016***	-0.010**	-0.001	0.005
	t-stat	(2.49)	(1.99)	(1.33)	(-1.68)	(-2.92)	(-2.53)	(-0.16)	(1.58)
	Obs	38,016	74,339	108,881	142,680	22,225	44,368	65,697	87,297
	Num of Events	31	31	31	31	19	19	19	19
[5,)	Post	0.001	0.014	0.006	0.004	-0.005	-0.004	-0.000	-0.002
	t-stat	(0.08)	(1.34)	(0.72)	(0.58)	(-0.36)	(-0.39)	(-0.01)	(-0.27)
	Obs	2,440	4,712	7,006	9,316	2,123	4,062	6,050	8,117
	Num of Events	35	35	35	35	27	27	27	27

Table 14.
Impact of MCBs on corporate debt maturity choice: OLS regression, aggregate level. This table examines the impact of MCBs on corporate debt maturity by regressing long-term MCBs on long-term RCBs. Long-term RCBs is measured by long-term RCBs issuance (d_L^{RCB}/d^{RCB}), or the long-term RCBs outstanding (D_L^{RCB}/D^{RCB}). Long-term MCBs is measured by long-term MCBs outstanding (D_L^{MCB}/D^{MCB}), or face-value weighted maturity of principal (MCBmat). t-statistics are adjusted based on Newey and West (1987). *p <0.10,**p <0.05,***p <0.01.

	d_L^{RCB}/d^{RCB}			D_L^{RCB}/D^{RCB}		
	(1)	(2)	(3)	(4)	(5)	(6)
D_L^{MCB}/D^{MCB}	0.102*	0.209*		0.120***	0.088***	
	(1.85)	(1.66)		(8.23)	(3.80)	
MCBmat			0.049*			0.021***
			(1.91)			(5.10)
$yield_{10yr}^{CDB}$		-0.064***	-0.054**		-0.004	-0.000
		(-3.20)	(-2.42)		(-1.13)	(-0.02)
Term		-0.096***	-0.097***		-0.020***	-0.020***
		(-2.85)	(-2.82)		(-3.79)	(-4.24)
AA-AAA		0.027	0.036		0.006	0.010
		(0.67)	(0.79)		(0.91)	(1.60)
Constant	0.197***	0.460***	0.258	0.019***	0.071**	-0.016
	(9.53)	(2.83)	(1.07)	(4.17)	(2.23)	(-0.40)
Observations	114	114	114	114	114	114
5-Year FE	No	Yes	Yes	No	Yes	Yes
R_2	0.0553	0.216	0.233	0.736	0.852	0.883

Table 15.
Logit models of long-term RCB issues.
This table presents logit models of long-term RCB issues where the dependent variable takes a value of one if the bond has a maturity of [5,) years, and zero otherwise. Panel A displays the coefficient estimates of the logit model. Panel B shows the marginal effects for D_L^{MCB}/D^{MCB} where the other control variables are evaluated at the mean values of the indicated subsamples. We only include bonds with rating information in the sample. Column 1 presents the results for the rated sample. Column 2 and 3 presents the heterogeneities. HighRating equals to 1 if the bond rating belongs AAA, and 0 otherwise. SOE denotes whether the bond issuer is SOE. Control variables include term, credit spread, 10-year CDB yield spread, log of bond issuance, log of issuers size, issuers leverage, ROA, and GDP growth which is the growth in real GDP over the past four quarters and measured quarterly. Issuers characteristics (log of size, leverage, and ROA) and GDP growth are lagged one quarter relative to the quarter when the bond is issued. t-statistics are in parentheses below the corresponding coefficient estimates. *p <0.10,**p <0.05,***p <0.01.

	(1)	(2)	(3)
Panel A. Logit regressions			
D_L^{MCB}/D^{MCB}	0.003	0.086***	0.026***
	(0.83)	(11.59)	(4.91)
$D_L^{MCB}/D^{MCB} \times HighRating$		-0.095***	
		(-16.41)	
$D_L^{MCB}/D^{MCB} \times SOE$			-0.024***
			(-5.82)
HighRating	-1.766***	0.867***	-2.025***
	(-27.87)	(4.39)	(-29.36)
SOE			1.722***
			(8.51)
Term	-0.235**	-0.096	-0.373**
	(-2.04)	(-0.50)	(-2.04)
$Term \times HighRating$		-0.034	
		(-0.14)	
$Term \times SOE$			0.077
			(0.34)
AA-AAA	0.025	-0.24	0.148
	(0.25)	(-1.36)	(0.96)
$(AA - AAA) \times HighRating$		-0.406*	
		(-1.82)	
$(AA - AAA) \times SOE$			-0.342*
			(-1.71)
$yield_{10yr}^{CDB}$	-0.366***	-0.367***	-0.377***
	(-5.95)	(-5.84)	(-5.94)
Log(Issuance)	0.770***	0.656***	0.729***
	(16.56)	(13.88)	(15.34)
Log(Size)	-0.054*	0.031	-0.021
	(-1.72)	(0.97)	(-0.65)
Leverage	-0.937***	-0.951***	-0.751***
	(-8.39)	(-8.38)	(-6.55)
ROA	0.008	-0.003	0.041***
	(0.88)	(-0.29)	(4.27)
GDP growth	1.204***	0.381	1.121***
	(3.53)	(0.86)	(3.19)
Constant	1.256	-2.399***	-0.77
	(1.60)	(-2.91)	(-0.93)
Observations	8,475	8,475	8,317
5-Year FE	Yes	Yes	Yes
Pseudo R-squared	0.2	0.251	0.222
Panel B. Marginal Effects Evaluated at Means for Different Subsamples			
AAA	-0.000825	Below AAA	0.0231***
	(-1.55)		(8.84)
	Obs. = 5600		Obs. = 2875
SOE	0.00146	Non-SOE	0.00242**
	(1.51)		(2.18)
	Obs. = 4532		Obs. = 3785