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Moral Hazard Effects of Corporate Bond Guarantee Purchases: Empirical Evidence from China

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Abstract: This study examines corporate bond guarantees by developing a theoretical model that decomposes the overall impact of a guarantee into signalling and incentive effects and presenting empirical evidence based on data from China's corporate bond market. Our empirical research yields considerable evidence for the effects we posit in the model and provides some important insights into the problems of adverse selection and moral hazard in China's bond market. The empirical evidence shows that the bond issuer with lower credit rating are more willing to purchase a bond guarantee and guaranteed bonds have a higher issue spread yield than those non-guaranteed bonds, even though both have the same bond credit rating. Our findings suggest that moral hazard would be better than adverse selection to explain the self- selection of bond guarantees. Prior to bond issuance credit rating signal provides a mechanism to mitigate information inequality, while bond guarantees relieve information asymmetry afterwards.

Keywords: *Adverse selection; Bond guarantee; China; Information asymmetry; Moral hazard.*

1. Introduction

This paper examines the signalling and incentive effects of a bond guarantee mechanism mitigating problems of adverse selection and moral hazard in China's corporate bond market. It investigates whether a bond guarantee is used to signal the bond issuer's risk information, thereafter avoiding adverse selection, or to restrict the issuer's behavior by compensating for the loss of default, thereafter addressing the moral hazard problem between the issuer and investor. Information asymmetry between the issuer and investor in debt contracts can lead to adverse selection and moral hazard. A guarantee is an effective mechanism to alleviate the problem of information asymmetry (Akerlof, 1970; Wang and Zhou, 2014). Like collaterals in debt contracts, economic theory treats a guarantee as for the compensation of ex-ante information asymmetry or the method to reduce the ex-post agency problem (Berger et al., 2011), resulting in the formation of two opposite effects: adverse selection and moral hazard. These two effects provide different implications. Adverse selection is concerned with information asymmetry before the debt is issued; that is, a bond guarantee is considered as a signal sent by the debtor with an information advantage to the creditor, and thus the debtor with low risk can obtain a lower interest rate with the use of a guarantee.

Moral hazard is related to information asymmetry after the debt is issued; a bond guarantee is used to make up for the loss of creditor in case of debtor default, therefore the debtor with high risk needs to obtain a guarantee and is charged with higher issue cost. To alleviate information asymmetry problems in bond markets, bond issuers can purchase either bond insurance or bond guarantee. Bond insurance is an irrevocable guarantee by an insurer to pay bondholders' coupon and/or principal payments in the event of the issuer default. Bond insurance has enjoyed tremendous growth since its inception in 1971 in the US municipal bond market. The growth was greatly attributed to the role that bond insurance plays in reducing information asymmetry (Thakor, 1982; Kidwell et al., 1987; Gonas et al., 2004; Peng and Brucato, 2004; Kolasinski, 2009; Lu et al., 2010; Liu, 2012). Like bond insurance offered for municipal bonds, a growing number of corporate bonds have recently been issued with guarantees. A bond guarantee is issued by a third party on the instruction of the bond issuer and used as an insurance policy when the bond issuer fails to fulfil a contractual commitment. According to Chen et al. (2015), the portion of newly issued bonds with guarantees measured by par value increased significantly from 1.4% in 1993 to over 18% in 2012 and peaked.

Similar to a bond insurer, a bond guarantor receives a fee for creating a backup payer if a bond issuer is unable to fulfil its obligation. The data released by the Emergent FISD database (http://www.mergent.com) shows that bond guarantees, bond insurance and letters of credit accounted for 96%, 3% and 1% respectively of the total credit enhancement in the US bond market from 1993 to 2012. In Japan, guaranteed bonds constituted 34.5% of the Japanese corporate bonds issued recently (Pagano et al., 2015). Based on the data from Wind Data Feed

Service (http://www.wind.com.cn), it is estimated that over 60% of newly issued corporate bonds in China were bundled with guarantees during the period 2008 to 2014. In contrast to the popularity and significance of guaranteed bonds in the capital markets, bond guarantee research is surprisingly very limited. Previous studies on corporate bond yield spreads have deliberately excluded guaranteed bonds from research samples (e.g., Lu et al., 2010; Park et al., 2013). Only recently, a few studies have attempted to examine the information and economic value of bond guarantees. For example, Altieri et al. (2016) examine the effects of decision of parent companies to guarantee bonds issued by their subsidiaries and find the market value of the parent firms' outstanding bonds drops two times more when it issues a guarantee for its subsidiary's debt than when it issues a new bond in its own name. Studying corporate guaranteed bonds issued in Japan, Pagano et al. (2015) find evidence of self-selection where issuers with unrated bank-guaranteed bonds have higher levels of information asymmetry and poorer firm quality, and bond investors are willing to accept lower yields for guaranteed bonds than rated ones because of the perceived value of a guarantee to the bond issuer.

Chen et al. (2015) provide evidence that rating enhancement is not the only driver for corporations to issue guaranteed bonds and the role of agency problem and debt overhang can also play a significant part for issuing firms to purchase a bond guarantee. Two broad strands of theoretical arguments emerge to explain guarantees as arising from the existence of either ex-ante private information or ex-post incentive problems between bond issuers and investors. The first set of arguments considers a guarantee as a way for low-risk issuers to signal their quality under conditions of ex-ante private information, while the second set elucidates a guarantee as the strategic response of the issuers to ex-post effects. Although these theoretical effects are understandable in general, little evidence is presented in the literature about how they function and interact. In any realistic setting, both ex-ante information signalling and ex-post incentive effects are likely to be closely related. Earlier studies on bond guarantees mostly focused on the effects of a guarantee on interest rate cost and directly introduced a dummy variable (i.e., if the bond is guaranteed) into the model as one of the regressors (e.g., Qi et al., 2012; Han and Hu, 2015). However, it can be argued that if borrowers are economically rational, when faced with the option of purchasing a bond guarantee, they will do so only when it expects to lead to a lower net interest cost. Thus, the decision of a bond issuer to obtain a bond guarantee is not random but endogenous to the model. The interest cost differences measured by a naive dummy variable could be biased (Hsueh and Kidwell, 1988). To overcome this bias, this study follows Wooldridge, (2002) and Francesco and Cardamone, (2008) to use a probit model to estimate probabilities of choosing a guarantee and introduce the fitted probabilities as an instrumental variable in the second stage of regression for the determinants of yield spreads.

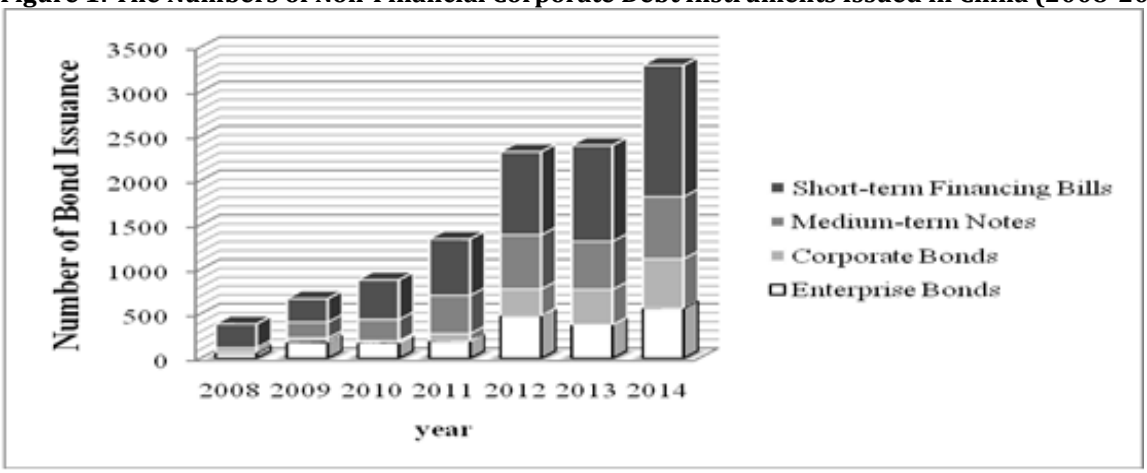
In addition, following Hsueh and Kidwell, (1988) and Sola and Palomba, (2015), this study carries out robustness tests by employing the 2-stage Heckman model, in which the inverse Mills ratio (IMR) from the first-stage probit model is used as an independent variable in a second stage regression model of yield spreads. This paper contributes to an understanding of the effects of a bond guarantee by presenting a simple model that decomposes the overall impact of a guarantee into signalling and incentive effects that reduce the borrower's default rate. Our empirical research yields evidence for the effects we posit in the model and provides important insights into the problems of adverse selection and moral hazard in China's corporate bond market. The empirical evidence based on a sample of China's bond market for the period of 2008 to 2015 shows that the bond issuers with lower credit rating are more willing to purchase a bond guarantee and guaranteed bonds have a higher issue spread yield than those non-guaranteed bonds, even both have the same bond credit rating. To the best of our knowledge, this is the first study of its kind to find the significance of moral hazard effects in explaining the choice of a guarantee by bond issuers. The rest of this paper is structured as follows. Section 2 provides the institutional background and market developments of China's guaranteed bond market. Section 3 reviews the relevant literature followed by presenting research hypotheses.

Institutional Background and China's Guaranteed Bond Market: In the last decade, the size of China's bond market has increased from virtually nonexistent into one of the largest markets in the world. There are four main types of bonds in the market: government bonds, central bank notes, financial bonds issued by financial institutions, and non-financial corporate debt instruments issued by non-financial organizations. Non-financial corporate debt instruments can be classified as enterprise bonds, corporate bonds, medium-term notes, and short-term financing bills. Unlike short-term financing bills and medium-term notes, enterprise bonds and corporate bonds provide companies with long-term debt financing instruments. China's enterprise bonds are quite different from corporate bonds. Enterprise bonds, which can be traded on both the Inter-bank and bond

exchange markets, are issued by institutions affiliated to various central government departments, enterprises solely funded by the state, state-controlled enterprises (SCEs), and other large-sized state-owned entities (SOEs). Enterprise bond issuance is subject to an administrative approval for a quota from the National Development and Reform Commission (NDRC), which is part of the central planning system in China. The raised funds from enterprise bonds are predominantly used for the government-guided projects. After the issuance of enterprise bonds, the issuers are no longer subject to any information disclosure and regulatory control.

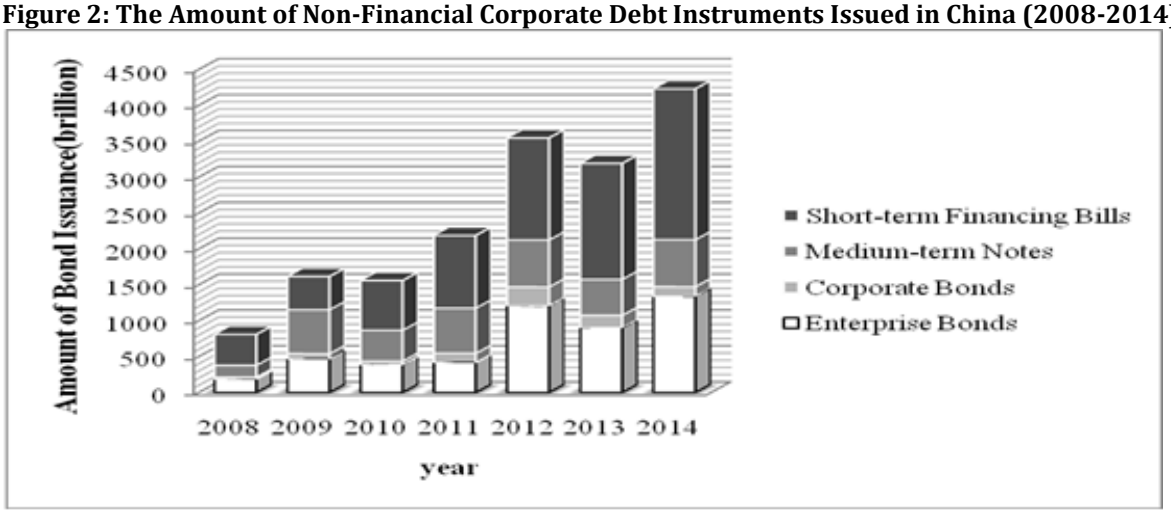
However, corporate bonds can be issued by any business organization without restrictions in terms of the type of ownership. Corporate bond issuance requires approval from the China Securities Regulatory Commission (CSRC) that regulates China's securities and futures markets. After the issuance, corporate bonds can only be traded on the exchange market and issuers make their own decision on the use of raised funds but are required to regularly disclose information to the public. Thus, corporate bonds are more market-oriented than enterprise bonds. Section 4 discusses the data and empirical methodology, while Section 5 presents empirical results. Section 6 concludes the study. In China, 385 non-financial corporate debt instruments were issued in 2008 while by the end of 2014, 3296 non-financial corporate debt instruments were issued and traded on the market as shown in Figure 1 with the amount of non-financial corporate debt instruments increasing from 807.6 billion RMB in 2008 to 4228.4 billion RMB in 2014 (Figure 2). The proportions of guaranteed bonds issued during the period of 2008 to 2014 are given in Table 1.

Figure 1: The Numbers of Non-Financial Corporate Debt Instruments Issued in China (2008-2014)



Source: Wind Data Feed Service.

Figure 2: The Amount of Non-Financial Corporate Debt Instruments Issued in China (2008-2014)



Source: Wind Data Feed Service.

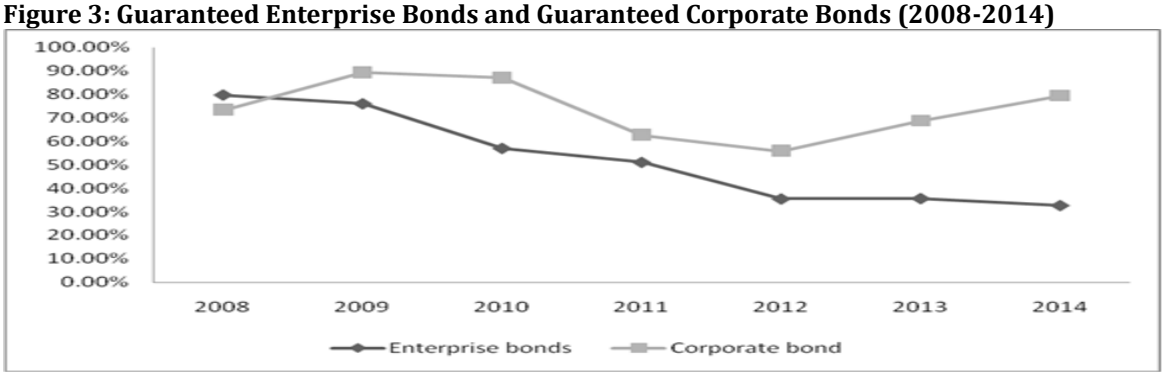
Table 1: The Proportion of Guaranteed Bond Issues

Year	Enterprise bonds	Corporate bond	Medium-term Notes	Short-term financing bills
2008	79.69%	73.33%	0.00%	1.50%
2009	75.98%	89.36%	4.44%	0.38%
2010	56.98%	86.96%	15.42%	2.69%
2011	51.04%	62.65%	9.74%	2.20%
2012	35.49%	55.85%	11.17%	2.25%
2013	35.64%	68.77%	8.69%	1.76%
2014	32.68%	79.46%	4.58%	1.08%

Source: Wind Data Feed Service.

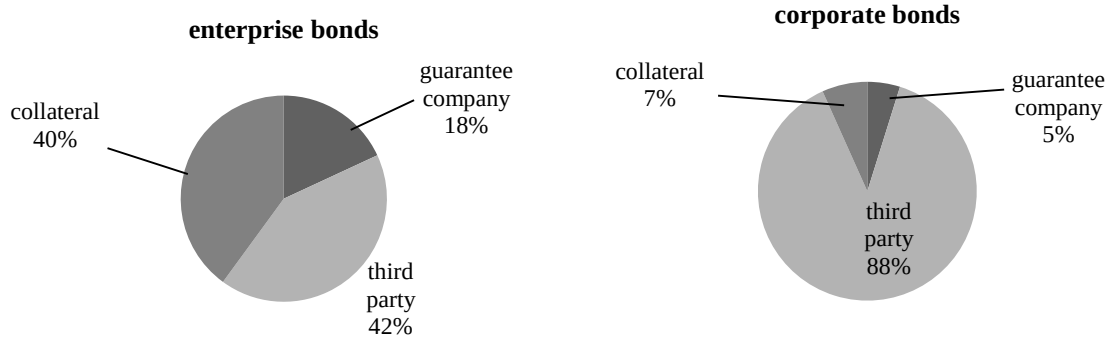
As shown in Table 1, over the period 2008 - 2014 only a few medium-term notes and short-term financing bills were issued with a guarantee. However, over 50% of enterprise bonds and corporate bonds were issued with a guarantee. Interestingly, the number of guaranteed enterprise bonds was decreasing over time while that of corporate bonds was standing at a high level of over 50% in the past seven years as shown in Figure 3. As enterprise bonds issuers are usually affiliated to central government departments, enterprises solely funded by the state, SCEs or other large SOEs, they are often creditworthy and considered "invisibly secured" at issuance. Unlike enterprise bonds, corporate bonds have no restrictions as to the status of controlling shareholders of bond issuers, as long as the bonds meet the relevant criteria set up by the authorities. Many corporate bond issuers are not owned or controlled by the state. They are less secured comparing to enterprise bonds. Most corporate bond issuers seek a guarantee as a way of credit enhancements with a view to making bond issues successful.

Figure 3: Guaranteed Enterprise Bonds and Guaranteed Corporate Bonds (2008-2014)



Source: Wind Data Feed Service.

Figure 4: Proportions of Types of Bonds Issued (2008-2014)



Source: authors' calculation based on data from Wind Data Feed Service.

There are different types of guarantees in China's bond market. Bond issuers can either use their own assets as collaterals or obtain a guarantee from a specialized guarantee company that is similar to a bond insurance firm or turn to a third-party enterprise that can be their parent company or business partner. As presented in Figure 4, over the period 2008 - 2014, 42% of the enterprise bonds used a guarantee from a third-party enterprise and 18% of them were from a guarantee company. The rest used collaterals as a credit-enhancing arrangement due to the prohibition of bank guarantees in 2007. For corporate bonds, most of them (88%) turned to a third-party enterprise for credit guarantees; only a few employed a guarantee from guarantee companies (5%) or used their own collaterals (7%). In empirical testing of guarantee signalling effects, we firstly use corporate bonds as a sample and then expand our sample to include enterprise bonds for a robustness test as guarantee effects of enterprise bonds may be influenced by an "invisible" guarantee from the authorities.

2. Literature Review and Hypotheses

Credit markets and bond markets possess the problem of asymmetric information. Two broad strands of theoretical literature explain bond guarantees as arising from the existence of either ex-ante private information or ex-post agency problems between bond issuers and investors. Ex-ante theories emphasize that collateral or guarantee is a signal sent by a borrower, which can reveal its high-quality. Stiglitz & Weiss (1981) document that default risk is private information known to borrowers and banks can't identify which is of higher risk. If banks price loan contracts with average default risk, higher-quality borrowers will exit the credit markets because of the high cost and the remaining lower-quality borrowers are willing to pay higher interest rates, which leads to adverse selection. In order to pay what that matches its true quality, in equilibrium, higher-quality (lower risk) borrowers have to choose secured debt with lower interest rates and low quality (high risk) borrowers need to self-select into unsecured debt with higher interest rates (Bester, 1985; Besanko & Thakor, 1987a & b; Chan & Kanantas 1987). While theoretical research on why bond issuers frequently issue guaranteed bonds is scarce in the literature, we could have some enlightenment from bond insurance research due to the similarity of both bond guarantee and insurance.

Thakor (1982) in a seminal paper concerning bond insurance presents a set of signalling models showing that bond issuers with higher-quality (lower risk) choose to buy more insurance. Thakor (1982) reveals that bond insurance can convey private information about issuers to lenders. Adopting Thakor's signalling equilibrium in the case of debt insurance, we predict that the ex-ante signalling of a bond guarantee provides a negative relationship between the borrower's risk and a guarantee, and between a guarantee and the bond interest rate. That is, a higher-risk borrower is more likely to issue guaranteed bonds, and the interest rate of a guaranteed bond is higher than that of a non-guaranteed bond. A review of extant literature on the ex-ante signalling theories of credit markets and bond markets reveals that most of the prior studies do not directly examine key predictions of the signalling. The literature argues that ex-ante information asymmetry between lenders and borrowers can be eliminated after the establishment of a long-term relationship between them. When the degree of information asymmetry lessens, the borrowers are less likely to obtain guarantees (Berger & Udell, 1995; Harhoff & Korting, 1998; Chakraborty & Hu, 2006; and Brick & Palia, 2007).

However, using the data of Japan's small and medium-sized enterprises (SMEs), Ono & Uesugi (2009) find a positive relationship between the cooperation time and collateral. Berger et al. (2011) report that the ex-post theories of collateral are empirically dominant although the ex-ante theories are also valid for customers with short borrower-lender relationships that are relatively unknown to the lender. As for tests for the signal effect of insurance in the bond market, the follow-up studies are mainly based on Thakor's (1982) models and most of them suggest that bond insurance can reveal default information (e.g., Hsueh & Liu, 1990; Kidwell et al., 1987; Liu, 2012; Moldogaziev & Johnson, 2011). Moldogaziev & Johnson (2011) find that the lower the credit rating of the issuer, the more likely insurance to be purchased. These results are contradictory to the prediction of Thakor's model that "issuer default rate is negatively related to the ratio of insurance", which could argue that a poorly rated issuer does not have the motivation of using a guarantee to send a signal. Hence, the question of whether a guarantee can solve the adverse selection problem remains to be explored. The ex-post theories indicate that lenders can observe the borrower's default risk, but the borrower's.

Efforts cannot be observed, which eventually leads to moral hazard (Boot et al., 1991; Weber, 2014). Compared to high-credit borrowers, the default risk of low-credit borrowers is higher. To avoid losses and overcome

incentive conflicts, lenders require risky borrowers to provide collateral as a tool that encourages borrowers to repay debt. In addition, due to the cost of selling off the collateral, moral risk and other "transaction costs", the value that banks get from the collateral will be far less than the value that the borrowers have (Barro, 1976). Once default, banks still suffer loss. Therefore, banks will raise the risk premium accordingly when pricing the loan contracts. The ex-post theories suggest that the borrower's risk is positively related to the use of guarantee, and a guaranteed bond has a higher interest rate. Empirical research finds evidence that borrower's risk is positively related to the use of guarantees. Gonas et al. (2004), show that firms with better public ratings are less likely to pledge collateral. Brick & Palia (2007), document that the observable risky borrowers are more likely to provide collateral. As for studies of bond markets, John et al. (2003) construct an agency cost model and reveal that the interest rates of collateral debts are significantly higher than that of unsecured bonds. Chen et al. (2015) also show that US companies issue guaranteed bonds for credit enhancement and easing the agency problem.

These two broad strands of theoretical arguments explain collateral as arising from the existence of either ex-ante private information or ex-post incentive effect. They can be used to make different predictions. However, the extant literature is mostly based on credit markets; few studies have discussed the economic functions of guarantee in bond markets. In credit markets, banks can use their professional skills to gather information about borrowers and to reduce information asymmetry by establishing long-term cooperation with borrowers, while lenders in bond markets are dispersed investors and collecting information by lenders about issuers is very difficult and the cost is significantly high. This provides a space for credit ratings. Credit ratings can reflect issuers' default risk and be used as an important reference to determine a bond interest rate as there is a negative relationship between ratings and a bond interest rate (Kisgen & Strahan, 2010). While bond insurance has the risk transfer function, the key assumption in Thakor's model is there is no other signal transmission mechanism in the market, which seemingly overlooks the effect of bond credit rating signal. In bond markets, credit ratings can facilitate the mitigation of asymmetric information in advance.

Accordingly, We Put Forward the Following Opposite Hypotheses:

Hypothesis 1a: Under the ex-post incentive theory, guaranteed bonds are more likely to be issued by higher-risk issuers.

Hypothesis 1b: Under the ex-ante signalling theory, guaranteed bonds are more likely to be issued by lower-risk issuers.

Within the framework of ex-ante signal theories, bond issuers send signals through a guarantee to reveal its high quality and low risk. Thus, the interest rate of a guaranteed bond should be lower than that of the unsecured bond. However, within the framework of ex-post theories, higher risk issuers expect to purchase a guarantee. While bond guarantees improve credit ratings, bond interest rates cannot be reduced to the same level of unsecured debt interest rates. Moreover, due to the cost of selling off collateral, the moral hazard of enterprise and other "transaction costs", the value that investors expect to obtain from collateral will be far less than the value of the collateral itself, thus once a bond defaults, the bond investors will suffer loss. Consequently, when setting interest rates, investors will take the above factors into account; eventually this improves guaranteed bond rates accordingly.

Hence, We Put Forward the Following Opposite Hypotheses:

Hypothesis 2a: Under the ex-post incentive theory, the interest rates of guaranteed bonds are higher than those of non-guaranteed bonds.

Hypothesis 2b: Under the ex-ante signalling theory, the interest rates of guaranteed bonds are lower than those of non-guaranteed bonds.

3. Data and Methodology

Sample Data: Bond issues and issuer information are obtained from the Wind Database. The Wind Database

also provides information that can be used to identify types of credit enhancements contained in issued bonds: i) third-party enterprise guarantees; ii) guarantees provided by a guarantee company; and iii) collaterals. The initial sample consists of 1,378 corporate bonds and 4,056 enterprise bonds issued from 2008 to September 2015. Then, we exclude bonds issued with a floating interest rate and bond issued by firms whose rating or bond rating is unidentifiable at the time of issuing. In accordance with the theoretical models, we focus on these bonds whose credit enhancements are provided by a guarantee from a third-party enterprise or a guarantee company and exclude collateralized bonds. After the above process, the final sample consists of 588 corporate bonds and 1,321 enterprise bonds. Of 1,909 bonds in total, 681 are guaranteed bonds, which account for 35.67% of the total sample.

Empirical Methodology: One way to resolve information asymmetry problems in credit markets for bond issuers is to use credit ratings to signal to the market the credit quality of bonds (Hsueh & Kidwell, 1988; Opp et al., 2013; Byoun, 2014). Ratings serve a dual role: they provide information to investors and are used to regulate institutional investors (Opp et al., 2013). There are two types of credit rating: Firm rating and bond rating. Firm rating or underlying rating reflects an 'unenhanced' credit quality of an issuer. The bond rating reflects an enhanced credit quality of a bond. Bond rating of a guaranteed bond is at least equal to its firm rating and usually it is higher than its firm rating. While for a non-guaranteed bond, bond rating is the same as the issuer's firm rating. Therefore, we conduct empirical tests of the theoretical model with two types of credit rating. Firstly, we use a probit model to examine Hypothesis 1 concerning the relationship between a bond issuer's underlying credit rating and the probability of purchasing a guarantee. Incorporating other control variables, we identify the determinants of a firm issuer of guaranteed bonds with a probit regression. For each bond issue, a firm either uses a guarantee (guar=1) or does not use a guarantee (guar=0). We consider a set of factors that can explain the option. Specifically, we model the probability that a bond issuer uses a guarantee with a probit function as follows:

$$prob(guar_i) = \Phi\left[\beta_0 + \beta_1 \cdot rating_i + \beta_2 \cdot instruments + \sum \beta_k \cdot Control_k + \varepsilon\right] \quad (1)$$

Φ [.] denotes the standard normal distribution. The set of parameters β reflects the impact of independent variables on the probability. The key independent variable is the issuer's underlying credit rating (rating). For empirical testing, we convert the ratings to a consistent numerical score, i.e., the rating variable is a numeric term that increases as the issuer's credit quality increases. Following the theoretical model above, rating varies over the open interval (0, 1). Thus, we create nine categories for rated bonds: the AAA rated bonds with a score of 0.9, and others are: below BBB = 0.1, BBB+ = 0.2, A- = 0.3,..., AA = 0.7, AA+ = 0.8. We expect the probability of purchasing a guarantee increases as ex-ante intrinsic credit risk (rating) decreases and accordingly the expected sign of the variable is negative.

Controlled variables, $Control_k$, that may also explain a bond issuer's propensity to use a guarantee will be discussed in the following sections. We estimate the probability of purchasing a guarantee by Equation (1) and then put the fitted value as an explained variable into the following Equation (2) to regress the issue spread. To avoid the endogenous problem, we introduce instrumental variables into Equation (1). We select two measures of credit rating transition and credit rating outlook. Both can indirectly measure default risk after the bond is issued; while at the same time have no impact on the yield spread at issue. Secondly, we explore the signalling effect of a bond guarantee by considering the bond issue yield spread. Although prior literature shows that a guarantee can reduce bond credit risk and improve bond ratings, investors may still treat a guaranteed bond differently from a non-guaranteed bond even both have the same bond rating. In other words, if a bond guarantee conveys the information about an issuer's default risk to the market, investors will ask for higher risk premium for a guaranteed bond than a non-guaranteed bond with the same bond rating.

We test the hypotheses with an OLS regression. One condition that makes the traditional OLS model an appropriate statistical technique is that an issuer's decision to acquire a guarantee is random. Given our previous discussion, however, this may not be the case. In line with the theoretical model, if an issuer is economically rational, when faced the option of purchasing a guarantee, the issuer will do so when it expects acquiring a guarantee leads to minimize the total borrowing cost. Thus, the issuer's decision to obtain a guarantee is not random but endogenous to the model. Due to the self-selection bias mentioned above, the traditional OLS model is inappropriate to test our second hypothesis. We estimate the self-selection bias in the

first stage (i.e., probit model) and correct it in the second stage. Specifically, we follow Wooldridge (2002) and Francesco & Cardamone (2008) and use the fitted probabilities estimated by the probit model above as an instrumental variable of the dummy endogenous variable guari. This IV estimator is more efficient than that of Two-Stage least squares (2SLS) regression model (Wooldridge, 2002). We regress the determinants of issue yield spreads as follows:

$$spread_i = \gamma_0 + \gamma_1 \cdot prob(guar_i) + \gamma_2 \cdot br_rating_i + \sum \gamma_k \cdot Control_k + \varepsilon \qquad (2)$$

For the above OLS regression model, the dependent variable is the issue yield spread between sample credit bonds and China's treasury bonds with a comparable maturity. One of the key independent variables that we test is prob (guar), which is estimated by the probit model above as an instrumental variable of the dummy endogenous variable guari. We expect that the yield spread of a guaranteed bond is higher than that of a non-guaranteed bond for the reason of a bond guarantee probably conveying information about an issuer's high default risk. The expected sign of prob(guar) should be positive. The other key independent variable is bond rating (br_rating), which is also numeric that increases as the credit quality of a bond increases. To be specific, A- = 0.3, A = 0.4, A+ = 0.5, …, AAA = 0.9; the higher the bond rating, the lower the default risk of a bond. So, the expected sign of br_rating is negative. We also consider a set of factors relating to bond features, issuer characteristics and macro-economy environments that influence both the determinants of Equations 1 and 2. They are defined respectively as follows:

LN (size): The natural log of the issued amount. Issue size can be used as a proxy for the measure of information asymmetry (Pagano et al., 2015). To lower the interest yield, firms with larger information asymmetry and poorer firm quality are more likely to issue bonds with a bank guarantee instead of obtaining a rating from rating agencies (Pagano et al., 2015). Thus, the expected sign of LN (size) in Equation 1 is negative. The amount issued can also be used as a liquidity variable (Yu, 2005). The larger the issued amount, the more liquid the bond, which expects to lead to a lower yield. Thus, the expected impact of LN (size) on yield spreads should be negative.

LN (term): the natural log of the maturity of a bond. The time to maturity is usually treated as a default risk measure as well as liquidity risk measure. Covitz & Downing (2007) note that classification as to whether the time to maturity is a liquidity or credit factor is somewhat ambiguous and they treat it as a liquidity measure. For most investment-grade bonds that are main constituents of our sample, a longer term means more uncertainty and higher default risk. The expected sign for this variable in Equation 1 is positive, suggesting that the longer the term of a bond, the more likely the bond is guaranteed. According to Long staff et al. (2005) and He & Milbradt (2014), shorter-maturity corporate bonds have a more liquid secondary market in general, thereafter a lower yield spread. Accordingly, the expected sign for the coefficient of maturity is positive, indicating that a higher yield is expected to compensate for a longer investment horizon.

Put: A dummy variable for a bond, equal to one if the bond has a put option. A put option reduces the risk for investors. The expected sign for this variable in Equation 1 is negative suggesting a bond with a put option is less likely to be issued with a guarantee than that without a put option. The expected sign for this variable in Equation 2 is positive, indicating that a bond issue with a put option expects to have a lower yield spread. Prepay/Callable: a dummy variable for a bond equal to one if the bond has a prepayment provision or a callable option. A prepay option (Prepay) increases the risk for investors and a bond issuer is likely to purchase a guarantee to enhance the credit of bond. The expected sign for this variable in Equation 1 is positive, suggesting that bonds with a prepay option are more likely to use a guarantee than those without such an option. The expected sign for this variable in Equation 2 is positive, indicating that a prepay option expects to increase the yield spread.
Coupon Adjustment: A dummy variable for a bond, equal to one if the bond has a coupon adjustment term.

Corp: A dummy variable equal to one if it is a corporate bond. As noted in Section 2, corporate bonds and enterprise bonds are different. The dummy variable Corp is used to investigate the impacts of different bonds. The expected signs of Corp in Equations 1 and 2 are unknown.

SOE: A dummy variable that is equal to one if an issuer is a SOE. Borisova et al. (2015) suggest that government ownership could carry an implicit debt guarantee reducing the chance of default and leading to a lower cost of

debt. The expected sign of SOE in Equation 2 is negative.

ROE: An issuer's return of equity at issuance. Financially constrained firms have difficulty in accessing capital because of their low creditworthiness. Thus, issuers with a higher level of financial constraints are more likely to purchase a guarantee (Chen et al., 2015). High levels of ROE indicate firms that are financially healthy and are likely to produce a low yield spread (Campbell & Taksler, 2003). The expected signs for this variable in Equations 1 and 2 are negative.

Long-Term Debt Ratio: An issuer's long-term debt to total assets at issuance. Issuers with more debt overhang are more likely to use guarantees to mitigate underinvestment (Kolasinski, 2009; Chen et al., 2015). An issuer with a high long-term debt ratio indicates that the issuer is highly leveraged with a high yield spread (Campbell & Taksler, 2003). The expected signs for this variable in both Equations 1 and 2 are positive.

Listed: A dummy variable for a bond equal to one if the bonds are issued by a company listed on the Shanghai or Shenzhen Stock Exchange. Because a listed company usually has better firm quality, lower risk and higher creditworthiness, bonds issued by a listed firm are of relatively low risk. The expected sign for this variable in Equation 1 is negative, indicating bonds issued by a listed company are less likely to be guaranteed. The expected sign for this variable in Equation 2 is negative, which implies that a listed company expects to decrease the yield spread. To control for time-varying macroeconomic and industry-specific factors, we consider year (yeari) and industry (industryi) dummy variables. Studies have also found mixed evidence on the relationship between risk-free interest rates and credit spreads. The capital structure model of Leland & Toft (1996) and the bond pricing models of Long staff & Schwartz (1995) and Dougal et al. (2015) contain a common prediction: in equilibrium, an increase in the risk-free rate decreases a firm's credit spread. However, empirical tests that include only non-callable bonds find no relationship between credit spreads and interest rates (e.g., Duffee, 1998; Jacoby et al., 2009). Neal et al. (2015) argue that the phenomenon is largely a statistical artefact caused by failing to take account of co-integration between treasury and corporate bond yields. Using a generalized impulse-response approach and conditioning on the current level of rates, Neal et al. (2015) find that large shocks to the treasury curve do not produce significant changes in corporate credit spreads, either contemporaneously or out to three years in the future.

Table 2: Distribution of Bond Guarantee and Firm-Rating

Issuer rating	AA+~AAA	AA	A+、AA-	Below A	Total
Guaranteed	166	379	321	6	872
Non-guaranteed	282	786	22	0	1090
Total number of bonds	448	1165	343	6	1962
Percentage of guaranteed bonds	37.05%	32.53%	93.58%	100.00%	44.44%

4. Statistics Summary and Empirical Results

Summary Statistics: Table 2 lists a distribution of guaranteed bond issues based on issuer ratings. Intuitively, there seems to be a relationship between underlying ratings and their choice of obtaining guarantees. The proportion of guaranteed bonds increases when underlying ratings rise. The issuers rated as AAA or AA+ choose to obtain guarantees account for 37.05%. 32.53% of the issuers with AA rating choose to issue guaranteed bonds, while 93.58% of the issuers rated AA- or A+ choose to do so. Furthermore, all the issuers rated below A choose to issue guaranteed bonds. Table 2 shows a negative relationship between underlying ratings and bond guarantees. The descriptive statistics of the variables used in this study are given in Table 3. The mean issue spread of the total sample is 295 basis points (BPS) with a standard deviation of 0.937. The dummy variable guar has a mean value of 0.444, implying that there are more non-guaranteed bonds than guaranteed bonds in the sample. The average size of bonds is 1.28 billion RMB Yuan and the average term is 6.691 years. In terms of issuer characteristics, the issuers' ROE at issuance ranges from -15.97% to 104.7% and has a mean value of 6.834%. The long-term debt ratio at issuance ranges from 0 to 99.45% and has a mean value of 42.35%. We use a one-year treasury rate at the time of issuing to investigate the impact of benchmark interest rate on the dependent variables (guar & spread). During the past seven years, one-year treasury rate ranged from 88.7 BPS to 423.1 BPS with a mean value of 296.3 BPS. For Chinese corporate and enterprise bond

issues, the most common embedded options are prepayment clauses or callable options with a mean value of 0.521. Issues with puttable options embedded or coupon adjustment terms also account for a considerable proportion of the total sample with the mean values of 0.367 and 0.361 respectively. The mean value of SOE is 0.856, indicating that only 14.4% of the bonds are issued by non-state-owned enterprises. 27.7% of the bond issuers are listed companies (listed), while the mean value of Corp is 0.308.

Table 3: Descriptive Statistics of Variables

Variable	Variable Description	Obs	Mean	Std. Dev.	Min	Max
Spread	Credit spread at issue	1962	2.950	0.937	0.513	6.966
Guar	Bond Guarantee Dummy(1=guaranteed)	1962	0.444	0.497	0.000	1.000
Size	Issue size	1962	12.82	10.99	0.500	160.0
Term	Issue term in years	1962	6.691	1.597	2.000	15.00
ROE	Return on shareholders' equity (%)	1962	6.834	7.176	-15.97	104.7
Long-term debt ratio	Long-term debt/total asset (%)	1962	42.35	25.41	0.000	99.45
One-year treasury rate	Benchmark interest rate	1962	2.963	0.677	0.887	4.231
Put	Dummy(1=bonds embedded with a put option)	1962	0.367	0.482	0.000	1.000
Prepay/Callable	Dummy(1=bonds with prepayment term)	1962	0.521	0.500	0.000	1.000
Coupon adjustment	Dummy(1=bonds with coupon adjustment term)	1962	0.361	0.481	0.000	1.000
SOE	Dummy (1=issued by a state-owned enterprise)	1962	0.856	0.351	0.000	1.000
Listed	Dummy (1=issued by a listed company	1962	0.277	0.448	0.000	1.000
Corp	Dummy (1=corporate bond)	1962	0.308	0.484	0.000	1.000
Rating outlook	Numeric (1=negative; 2=stable; 3=positive)	1962	1.962	0.202	1.000	3.000
Credit rating transition	Numeric(1=downgrade; 2=no transition; 3=upgrade)	1962	2.022	0.238	1.000	3.000

Table 4 reports the univariate t-test results of mean differences in credit spreads between guaranteed and non-guaranteed bonds when controlling bond ratings. The Breusch-Pagan (BP) test is used as it is one of the most common tests for heteroskedasticity. We regroup the sample into four groups according to bond ratings. The T-statistics in all the four groups (i.e., AAA, AA+, AA and AA-) indicate that the mean credit spreads of guaranteed bonds are significantly higher than those of non-guaranteed bonds. For example, in Group AA, the mean credit spread of guaranteed bonds is 358.5 BPS while that of non-guaranteed bonds is 315.3 BPS, and the t-statistics is -8.6424 showing that the mean difference between the two is significant at 1% level. Furthermore, Table 4 shows the mean issue spread of bonds is increasing with bond ratings decrease, probably suggesting that bond ratings are playing an informational role and bonds are priced according to bond ratings. The univariate t-test results of Table 4 confirm Hypothesis 2.

Table 4: T-Test on Credit Spreads Between Guaranteed and Non-Guaranteed Bonds under Different Bond Ratings

Bond ratings	guar=1(N=872)			guar=0 (N=1090)			
	N	Mean	Std	N	Mean	Std	T-statistics
AAA	189	1.8619	0.6483	97	1.6810	0.4511	-2.4588**
AA+	357	3.0239	0.7873	204	2.4911	0.7260	-7.9289***
AA	321	3.5856	0.8770	774	3.1536	0.6950	-8.6424***
AA-	5	5.3294	1.4469	15	4.4848	1.0705	-1.4042

Empirical Results: Table 5 reports the empirical results of probit models presented in Equation 1, where the dummy variable, guar, is the dependent variable. We conduct empirical studies on corporate bonds and enterprise bonds in one model and use a dummy variable Corp to identify two different types of bonds. Column (1) reports the results of regression that contains issuer characteristics while Column (2) shows the results that contain characteristics of bond issues and issuers. Column (3) displays the empirical results after controlling the characteristics of issues, issuers and macro-economy. All three columns indicate that rating has a negative impact on the independent variables. Most of the variables have the same signs in all three results. Specifically, in Column (3), Wald Chi2 statistics is 288.579, suggesting the probit model is significant at the 1% confidence level. Controlling issuer characteristics, the coefficient of the key variable, rating, is -0.538 with a significance level of 0.001. This result suggests that an issuer's rating is negatively related to the probability of obtaining a bond guarantee. In other words, the probability of choosing a guarantee decreases once credit quality improves.

Moreover, the coefficients of the long-term debt ratio show a negative relationship of long-term debt with the probability of purchasing a bond guarantee. The coefficient of the issue term in the natural log form is 0.644 with the 1% significance level, indicating that the issue term is positively related to the probability of obtaining a bond guarantee. The coefficient of the dummy variable listed is -0.840 with the 1% significance level, suggesting that a listed company is less likely to issue a guaranteed bond than a non-listed company. The coefficient of the dummy variable SOE is 0.633 with the significance level of 1%. We postulate that a SOE that normally maintains a good relationship with the state receives some kinds of governmental support (such as credit, favorable operation policy) at the time of issuing; such support is, to some extent, similar to a guarantee. Bonds with a prepayment clause are less likely to be issued with a guarantee. In addition, the dummy variable Corp is positively related to the dependent variable guar, indicating that a corporate bond issuer is more likely to issue guaranteed bonds. There is no evidence that issue size, coupon adjustment terms, issuers' ROE, and the benchmark interest rate have a significant influence on an issuer's guarantee choice.

Table 5: Relationship Between Probability of Bond Guarantee and Credit Rating

	Dependent variable: guar			
Independent variable	**Expected sign**	**(1)**	**(2)**	**(3)**
Rating	—	-0.430***	-0.647***	-0.538***
		(-12.02)	(-12.84)	(-10.16)
Credit rating outlook		-0.397**	-0.332**	-0.332**
		(-2.47)	(-2.04)	(-1.96)
Credit rating transition		0.111	0.032	0.011
		(0.87)	(0.25)	(0.08)
ROE		0.007	0.003	-0.003
		(1.37)	(0.62)	(-0.46)
Long-term debt ratio		-0.002	-0.002	-0.003*
		(-1.34)	(-1.57)	(-1.85)
Listed	—	0.840***	-0.691	-0.645
		(8.04)	(-1.10)	(-0.97)
SOE		0.598***	0.633***	0.547***
		(5.11)	(5.08)	(4.24)
Ln(size)	—		0.075	-0.082
			(1.14)	(-1.20)
Ln(term)	+		0.743***	0.644***
			(4.49)	(3.79)
Put			-0.652**	-0.811**
			(-1.96)	(-2.20)
Prepay/Callable			-1.345***	-0.995***
			(-10.24)	(-7.40)
Coupon adjustment			-0.277	-0.141
			(-0.85)	(-0.39)
Corp			1.401**	1.368**

		(2.24)	(2.06)
One year treasury rate			-0.081
			(-0.91)
_cons	2.060***	2.684***	3.514***
	(4.99)	(4.97)	(5.26)
Industry	Controlled	Controlled	Controlled
Year			Controlled
N	1962	1962	1962
r2_p	0.097	0.156	0.185
chi2	204.791	255.040	288.579

Note: This table presents the probit model results that examine the relationship between a bond issuer's underlying credit rating and probability of purchasing a guarantee in China. The dependent variable is a binary variable that takes value of 1 if a firm uses guarantee for a bond issue, 0 otherwise. Rating is the issuer's underlying credit rating. The rest of control variables are the same as described in Section 4. 2. Robust Z statistics in parentheses, *p< 0.1, **p< 0.05, ***p< 0.01.

Table 6 reports the empirical results of OLS regression models as shown in Equation 2, where a bond credit spread at the time of issuing is the dependent variable. Following Wooldridge's (2002) procedure to address the problem of self-selection, we use the fitted values estimated from the probit model of Column (3) in Table 5 as an instrumental variable of the issuers' guarantee choice guar. Regression (1) is the base OLS model with the ordinal bond rating variable. F statistics is 102.894, which suggests our probit model is significant at the 1% confidence level. The coefficient of prob (guar), which is estimated from Equation (1), is positive and statistically significant at the level of 1%. The coefficient of variable br_rating is also signed as expected and statistically significant. Regression (2) is the robust estimation and it converts bond ratings from an ordinal variable into a series of dummy variables. In this model, the bonds rated below AA are the omitted class. Regression (2) shows that prob (guar) is significantly positive. Three bond rating dummy variables provide important meanings: compared with the bonds below AA class, the bonds rated as AAA and AA+ class can lower the credit spread if holding other variables constant, which is the same for AAA bond class. These results suggest that the higher bond rating, the lower the credit spread, which is consistent with the coefficient of Br_rating in Regression (1). In addition, the results also indicate that the issue size and the dummy variables listed and Corp have no significant impact on the credit spread of corporate bonds at the time of issuing. Both Regressions (1) and (2) suggest that a bond guarantee plays a signalling role in predicting a bond issuer's default risk.

Table 6: Regression Results Between Bond Guarantees and Yield Spreads

	The dependent variable：spread		
Independent variable	**Expected sign**	**(1)**	**(2)**
Prob(guar)	+	1.807***	1.868***
		(13.62)	(13.96)
BR_AAA	—	-1.569***	
		(-6.30)	
BR_AA+	—	-1.297***	
		(-5.33)	
BR_AA	—	-1.044***	
		(-4.31)	
ROE	—	-0.003	-0.003
		(-1.07)	(-1.00)
Long-term debt ratio	+	0.002**	0.002**
		(2.26)	(2.53)
Ln(size)	—	-0.034	-0.034
		(-0.97)	(-0.97)
Ln(term)	+	-0.520***	-0.548***
		(-6.81)	(-6.93)
Put		0.331	0.384*

		(1.62)	(1.80)
Prepay/Callable		0.782***	0.819***
		(12.15)	(12.69)
Coupon adjustment		0.028	0.007
		(0.14)	(0.03)
Listed	—	-0.544	-0.514
		(-1.41)	(-1.35)
SOE	—	-0.806***	-0.837***
		(-12.11)	(-12.58)
Corp		-0.154	-0.192
		(-0.39)	(-0.50)
One year treasury rate		0.147***	0.151***
		(3.42)	(3.52)
Br_rating	—		-1.571***
			(-2.68)
Br_rating^2			8.298**
			(2.21)
_cons		3.726***	1.772**
		(10.05)	(2.37)
Industry		Controlled	Controlled
Year		Controlled	controlled
N		1962	1962
r2_a		0.558	0.554
F		102.894	106.683

Note: This table presents the OLS regression results that examine the relationship between bond guarantees and yield spreads in China. The dependent variable is a bond issue yield spread. Prob (guar) is estimated by the probit model in Table 5. The rest of control variables are the same as described in Section 4. 2. Robust Z statistics in parentheses, *p< 0.1, **p< 0.05, ***p< 0.01.

Robustness Test: To address the problem of selection bias and the dummy endogenous variable, Maddala (1983) and Pagano et al. (2015) estimate the probit model described in Equation (1) at the first stage and then use the inverse Mills ratio (IMR) as an independent variable in the second stage of regression model of credit spreads. This approach is similar to a Heckit Two-stage Model. We also adopt the similar approach to a robustness test in both the corporate bonds sample and enterprise bonds sample. As the results of the first stage probit model are the same as those presented before, we do not report the results here. Table 7 presents a robustness test of the second stage regression presented in Equation (2). Regressions (1) and (2) indicate that even controlling the selection bias with the inverse Mills ratio, the dummy variable guar is still positively related to credit spreads with significantly high t statistics. The inverse Mills ratio (IMR) is significantly different from zero, which confirms that issuers do self-select into guaranteed bonds (Pagano et al., 2015).

Table 7: Robustness Test on the Relationship Between Bond Guarantees and Yield Spreads

	The dependent variable: spread		
Independent variable	**Expected sign**	**(1)**	**(2)**
Guar	+	1.458***	1.516***
		(9.90)	(10.13)
IMR		0.121***	0.122***
		(4.84)	(4.80)
BR_AAA	—	-1.832***	
		(-7.36)	
BR_AA+	—	-1.466***	
		(-6.12)	
BR_AA	—	-1.123***	
		(-4.75)	

ROE	—	-0.004	-0.003
		(-1.23)	(-1.18)
Long-term debt ratio	+	0.001*	0.001**
		(1.82)	(2.09)
Ln(size)	—	-0.034	-0.034
		(-0.98)	(-0.98)
Ln(term)		-0.475***	-0.503***
		(-6.28)	(-6.43)
Put		0.261	0.312
		(1.29)	(1.48)
Prepay/Callable		0.691***	0.728***
		(10.38)	(10.91)
Coupon adjustment		0.029	0.008
		(0.15)	(0.04)
Listed	—	-0.560	-0.530
		(-1.49)	(-1.43)
SOE	—	-0.745***	-0.775***
		(-11.28)	(-11.73)
Corp		-0.086	-0.123
		(-0.23)	(-0.33)
One year treasury rate		0.144***	0.148***
		(3.37)	(3.47)
Br_rating	—		-1.615***
			(-2.80)
			7.993**
			(2.18)
Cons		4.061***	2.266***
		(10.98)	(3.07)
Year		Controlled	Controlled
Industry		Controlled	Controlled
N		1962	1962
r2_a		0.564	0.560
F		102.295	105.447

Note: This table presents the robustness test results that examine the relationship between bond guarantees and yield spread in China. The dependent variable is a bond issue yield spread. Guar is a binary variable that takes value of 1 if a firm uses a guarantee for a bond issue, 0 otherwise. IMR is the inverse Mills ratio (Maddala, 1983; Pagano et al, 2015) and the rest of control variables are the same as described in Section 4. 2. Robust Z statistics in parentheses, *p< 0.1, **p< 0.05, ***p< 0.01.

5. Conclusion

Given a large percentage of bonds issued with a guarantee in the past decade, there has been increasing policy interest in trying to understand the role of a guarantee for bond issues. Our study provides an important contribution to the limited literature seeking to understand the role of a guarantee for corporate bond issues. Based on a sample of China's bond market for the period of 2008 to 2015, our study shows that the corporate bond issuers with lower credit ratings are more willing to purchase a bond guarantee and guaranteed bonds have the higher issue spread yields than those non-guaranteed bonds with the same credit rating. Our findings imply that moral hazard would be the reason in explaining the choice of a guarantee by corporate bond issuers in China's capital market. Prior to a bond issue credit rating signal provides a mechanism to mitigate information inequality between bond issuers and investors, while a bond guarantee helps relieve information asymmetry afterwards. Our study has limitations. First, our model that examines the signalling and incentive effects of bond guarantees in the context of mitigating information asymmetry between borrowers and investors has not incorporated the uncertainty of the regulatory regime. It is a well-known fact that in China, bond issues and associated provision of bond guarantees by the state agents and third-party firms are largely

subject to governmental policies and regulatory changes. Second, we examine the effect of a bond guarantee on information asymmetry without reference to the actual guarantee costs. This choice was driven by the unavailability of bond guarantee fees data. Addressing these limitations would generate a quantum leap forward in our understanding of the role of a bond guarantee in the bond market and the issuers' behaviors.

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