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A Study on Prepayment Risk of Residential Mortgage-backed Securitization in China

—A Case of "JIAMEI 2018-1 MBS Program"

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Abstract: The Residential Mortgage-Backed Securities market (RMBS) has played a large role in enhancing the liquidity of mortgages, and in relieving the pressure of capital constraints on commercial banks. There are three main risks associated with residential mortgage-backed securitization: prepayment risk, interest rate risk, and default risk. This paper analyzes the prepayment risk in the "JIAMEI 2018-1"RMBS, the largest single RMBS product of the Postal Saving Bank of China (About 14 billion RMB). We introduce the JIAMEI 2 018-1 and study the factors that affect its prepayment risk. Using data, we conclude that the products involved in this case have comparatively low prepayment risk, even under the double influence of the housing finance policy tightening and the impact of the COVID-19 Pandemic.

Keywords: RMBS market in China; prepayment risk

1. Introduction

1.1. Introduction to RMBS Market

The United States is the earliest and most developed country in the world today for RMBS business. The U.S. MBS market is one of the largest and most liquid fixed-income markets in the world, with more than $11 trillion of securities outstanding and an average daily trading volume of nearly $300 billion. Issuance of MBS securities grew at an average annual rate of 43.7% from 1990 to the end of 2003 [1].

Over the past decade, China has strongly supported the development of the real estate industry, by gradually improving market policies to give residents more opportunities to purchase housing on the one hand, and strengthening financial support for the real estate industry on the other. The real estate boom continues to greatly increase the scale of commercial banks' residential mortgage loans. The

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Residential Mortgage-Backed securities market has played a large role in enhancing the liquidity of assets, relieving the pressure of capital constraints on commercial banks, optimizing the development of housing finance and promoting interest rate marketization.

Also, it played a great role in promoting the issuance of subsequent products in China's RMBS market. At the same time, China's real estate regulation and density reached the highest ever in 2018, which also is one of the important periods for RMBS market in China. Plus, the Covid-19 pandemic, with a great impact on the RMBS market in China, gives the market lots of challenges.

There are three main risks associated with residential mortgage-backed securitization: prepayment risk, interest rate risk, and default risk. And the subject we are researching is mainly the prepayment risk.

RMBS loans increased by 1.47 trillion yuan from March to April 2021, 229.3 billion yuan less than in the same period of the previous year and 452.5 billion yuan more than in the same period of 2019. By sector, household loans increased by 528.3 billion yuan, of which short-term loans increased by 36.5 billion yuan and medium- and long-term loans increased by 491.8 billion yuan.

RMBS loans increased by RMB 645.4 billion from March to April 2022, RMB 823.1 billion less than the same period last year. From March to April, by sector, Household loans decreased by 217 billion yuan,745.3 billion yuan less than the same period last year. Among them, housing loans decreased by 60.5 billion yuan, 402.2 billion yuan less year-on-year; consumer loans excluding housing loans decreased by 104.4 billion yuan, 186.1 billion yuan less year-on-year; business loans decreased by 52.1 billion yuan, 156.9 billion yuan less year-on-year [2].

The reason for the significant decrease in loan data is quite simple: more and more people are paying off their mortgages early.

It is very important for us to analyze and find ways to preclude the prepayment. Prepayments can make it more difficult to forecast cash flows from the underlying assets. At the same time, it affects the sale of mortgages and the pricing of mortgage-backed securities and increases the risk of securities issuance.

According to our research, there are many articles about the risks of prepayment here. However, it's hard to find the most effective way about the method to deal with or preclude the prepayment, especially in China. Therefore, we plan to start with the case of " JIAMEI 2018-1" to define and analyze the risk of prepayment in the current RMBS market in China.

The main purpose of the research is to design the most appropriate policy based on data and information we get from the government, to prevent the prepayment from happening or to punish those who have prepaid. In this way, we can minimize the potential threat it poses to the market.

1.2. Introduction to JIAMEI 2018-1

On April 13, 2018, Postal Savings Bank of China focused on promoting the issuance of JiaMei's 2018 Phase I individual home mortgage asset-backed securities. The "JiaMei 2018-1" is the largest RMBS product of market scale issued by commercial banks in China for the first time. This product is based on 67,440 RMB personal housing mortgage loans and its total issuance amount reached 14.297 billion RMB(China Securitization Analytics, n.d.).

The borrowers of the program are located in 19 different provinces, municipalities, and autonomous regions in China. Their average age is 38 years old. It is worth noting that the loan amount for borrowers aged 30-40 reached 35.29% of the total amount which stems from the relatively mature financial situation of this age group and their more intense need for a home loan.

The "JiaMei 2018-1" could be divided into 3 categories, senior A1 RMBS products(18JiaMei1A1), senior A2 RMBS products(18JiaMei1A2), and subordinated RMBS products(18JiaMei1C). The principal balance of Senior A1 securities is ¥2.00 B, representing 13.99% of the total size. The principal balance of senior A2 securities was $10,740 million, representing 75.12% of the total size.

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The principal balance of subordinated securities was over $1,557 million, representing 10.89% of the total size. Senior A1 RMBS products are issued at an issuance rate of 5.00%, and the issuance rate of the senior A2 RMBS products is 5.20%. The issuance rate of the subordinated securities is 0. Since the bank does not sell these products to avoid risk, they are all held by Postal Savings Bank of China and do not bear interest.

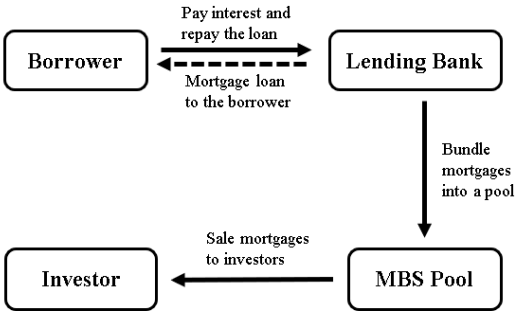

Figure 1: The transaction structure of "Jiamei 2018-1" from CNABS.

As shown in Figure 1, the basic transaction structure of " JiaMei 2018-1" involves multiple transaction entities. The general process of issuance is that Postal Savings Bank of China, as the originator, gives the housing loans it holds to the issuer of this product, CITIC Trust, and signs a Trust Contract with it. After the contract is signed, the trustee institution restructures the housing loans and then forms the asset pool. In addition, there are also other service providers such as tax advisors and legal advisors involved to ensure the successful issuance of RMBS.

2. Prepayment Risk

Prepayment risk refers to the risk that the principal amount or a portion of the principal amount outstanding on a loan is prematurely paid back. In other words, prepayment risk is the risk of early prepayment of a loan by a borrower. (CFI team, 2020)

Prepayment Impact Analysis. Understanding and forecasting future cash flows play a particularly important role in analyzing prepayment risk. Prepayment behaviour can lead to unstable MBS cash flows since asset-backed securities are priced by discounting future cash flows to obtain a theoretical present value. Prepayment behaviours have an impact on all parties involved in the MBS, and we discuss this point below:

Impact on Investors. First, prepayment behaviours will result in a reduction in interest income for investors if rates go down or new loans are not taken. Because the borrower pays off the principal early, the interest based on the principal will be reduced accordingly. Second, prepayment behaviour can disrupt the cash flow distribution of MBS, which can affect investors' income. To get the profits they want, it is necessary to make a new investment.

In this way, investors will have difficulty finding profitable investments, so their overall investment returns will be reduced.

Impact on Agencies. Prepayment behaviour can cause the cash flow of the MBS unstable, the service and guarantee fees earned by the agencies are based on the total revenue of the MBS. Therefore, the unstable cash flow of the MBS can lead to unpredictability in the total revenue of the MBS, which in turn affects the profit of the agencies. In addition, they lose some opportunity cost, i.e., they forgo the possibility of profit from servicing other types of products because they choose to service this MBS product.

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Impact on MBS Originators. The originators of MBS are usually commercial banks, they sell the underly asset to SPVs, and successfully transfer most risk to the SPVs and investors. Due to the short history of MBS development in China, many domestic MBS do not achieve complete risk transfer. Generally, the originator will repurchase a portion of the home mortgage securities. In addition, to make more profit, the originator generally acts as the MBS product servicer and receives loan servicing fees. As we can see, the originator acts as both an investor and a third-party servicer, so, the originators have to take on risks arising from both aspects of investor and servicer.

2.1. The Particularity of Prepayment Behavior in China

2.1.1. Payment Source

Like in America, people in many countries prepay mainly by refinancing. When the interest rate goes down, people tend to apply for a new loan and use it to prepay the old one. However, refinancing is not the main factor of prepayment in China, and prepayment behaviour in China is mostly based on people's own wealth. For example, if someone gets an excess fortune, he is probably going to prepay his mortgage with it to release from future pressure, but this case rarely happens in America. Also, mainstream banks don't offer refinancing services in China, which is different from the circumstances in America.

According to research [3], most borrowers in China are not sensitive to the change in interest rate, and they do not qualify for refinancing at the same time. Also, the cost of refinancing is rather high in China, so many of them cannot raise enough money to do it. It is uneconomical to refinance in most cases.

At the present stage of China, the compensation for house demolition, access to low-interest rate provident fund loans, and selling and moving houses (in many cases, people move near to school for children) are some of the major sources of prepayment in China. This is determined by the concrete national conditions of China. According to documents from the financial institution, many residences put prepayment in the first place when they receive the compensation for house demolition.

2.1.2. Influence of Culture

The idea "Out of debt, out of burden" is deeply grounded in Chinese culture. Many Chinese people believe that " Happy is he who owes nothing". Influenced by this culture, Chinese people tend to prepay their loans when they get spare money.

2.2. Prepayment Risk Factors Analysis

Many factors affect prepayment risk, including macroeconomic factors and subjective personal factors. In this paper, we focus on four aspects of prepayment risk:

1. the level of interest rate,
2. remaining loan life (time to maturity),
3. changes in real estate prices, and
4. income level of borrowers.
5. relocation.

2.2.1. The Level of Interest Rate

Here we first introduce a concept, the mortgage spread is the difference between the contract rate and the market rate. The mortgage spread can be reflected in the borrower’s reinvestment behaviour [4]. When the difference between the contract rate and the market rate is positive, the larger the difference, the higher possibility the borrowers will choose to make the prepayment [5]. Then, we analyze the

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former concisely, when the mortgage spread is positive, which also means the contract rate is larger than the market rate, in this situation, the borrowers are more likely to make prepayments since they can borrow at a low market rate to pay the mortgage, which could help them save some money. On the contrary, if the contract rate is lower than the market rate, borrowers are less likely to make the prepayment.

Mortgage rates are mainly lent in two ways, a fixed rate and a floating rate. Under floating rate conditions, the contract rate will change with the market rate, so the mortgage spread will usually be very small [6]. As we mentioned above, when the mortgage spread is very small, the borrowers are less likely to make the prepayment.

2.2.2. Time to Maturity

According to research [7], prepayment rates for personal housing loans are low in the first and last years of loan repayment. When house buyers are in the early stages of borrowing, their need for money is very strong and they are less likely to resell their homes, so they are less likely to make prepayments at this time. As the remaining repayment years become shorter, the principle that the borrower should pay becomes less as time goes by, and the interest fee generated with the principal also becomes less and less, so that the borrower's expenses arising from the mortgage have less and less impact on them. In this way, the borrower's prepayment behaviour decreases.

2.2.3. Changes in Real Estate Prices

Because real estate is the underlying asset of a home mortgage, changes in real estate prices have a significant impact on whether borrowers make a prepayment. Generally, people buy houses for two purposes, owner-occupied homes and investment properties. When a house is purchased for investment purposes, most investors expect to sell the property when its value appreciates gaining investment income from the property. Here we explain this concisely. When house prices rise, borrowers will want to sell their houses at a high price to obtain investment income, since the mortgage has to be paid off before they can sell the property, so they will make the prepayment to make this profit. On the contrary, when house prices are stable or even go down, borrowers do not make prepayments. Instead, they will continue to make mortgage payments on time and wait for property prices to rebound.

What is more, according to a paper [8]. She researched the relationship between house prices and prepayment behaviour. She used the weighted average monthly chained new residential price index (POH) of three cities, Shenzhen, Quanzhou, and Fuzhou, from 2010-2018 as a variable for house prices and the single-month early repayment rate (SMM) as a variable to measure prepayment behaviour. Finally, she concludes that the changes in SMM and POH are largely consistent. This is also the same conclusion we came to in the previous paragraph. Or we can say that there is a generally positive relationship between the house price and the prepayment behaviour.

2.2.4. Income Level of the Borrowers

Residents' income is a key factor influencing borrowers' prepayment behaviour. Income affects residents' judgment of the future economic situation, which will in turn influence borrowers' consumption, saving and investment behaviours, so as to affect residents' prepayment behaviour. When the economy grows and borrowers' income rises, borrowers will have a positive attitude toward future income, when borrowers have surplus money, they will be more likely to make the prepayment. When the economy declines and borrowers' income declines, borrowers will have less money, and therefore are less likely to make the prepayment. Generally speaking, there is a positive relationship between borrowers' income level and prepayment behaviour.

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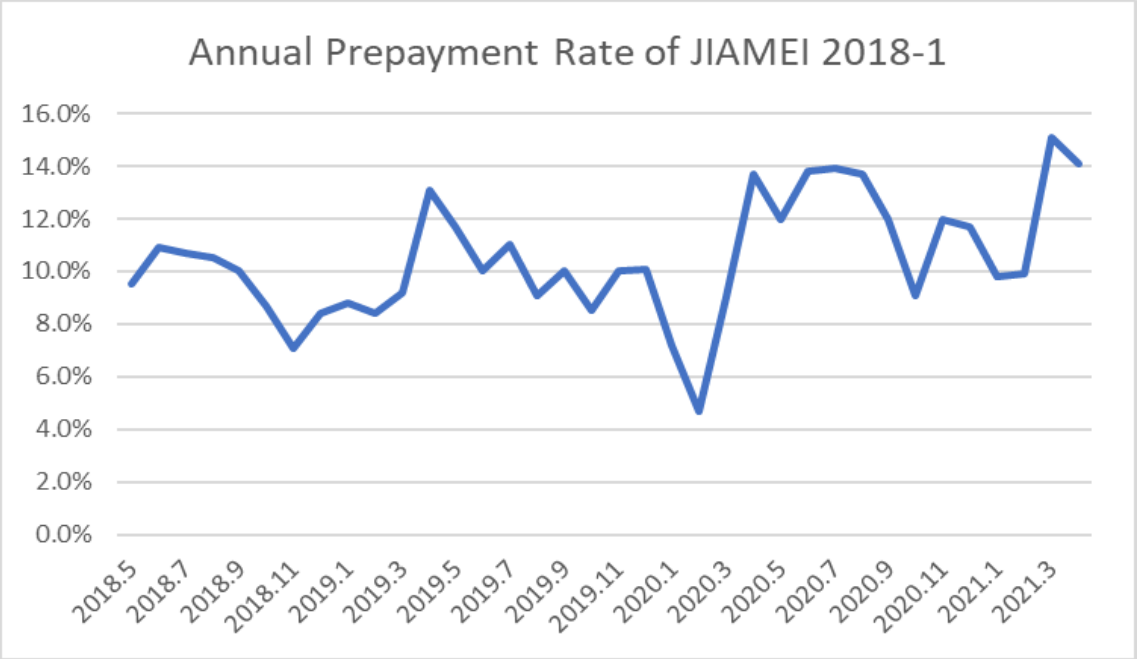
2.3. Prepayment Risk in JIAMEI 2018-1

As mentioned in the last part, multiple factors make prepayment risk indeterminate. Principle factors include the level of interest rate, time to maturity, changes in real estate prices, income level of the borrowers, etc. In the following paragraphs, we are going to analyze the impact of each factor one by one. Figure 2 shows the annual prepayment rate of JIAMEI 2018-1.



Data in this picture are from the assessment report of JIAMEI 2018-1, published by China Lianhe Credit Rating Co.,Ltd.

Figure 2: Annual prepayment rate of JIAMEI 2018-1.

2.3.1. The Level of Interest Rate

Jiamei 2018-1 is a floating rate note, which means the mortgage rate of the underlying assets in the asset pool of Jiamei 2018-1 is a floating interest rate. Consequently, the impact of changes in interest rates is not significant. Figure 3 shows the trendline of two kinds of loan prime rate (LPR), and we don't find obvious connection between it and the annual prepayment rate of JIAMEI 2018-1.

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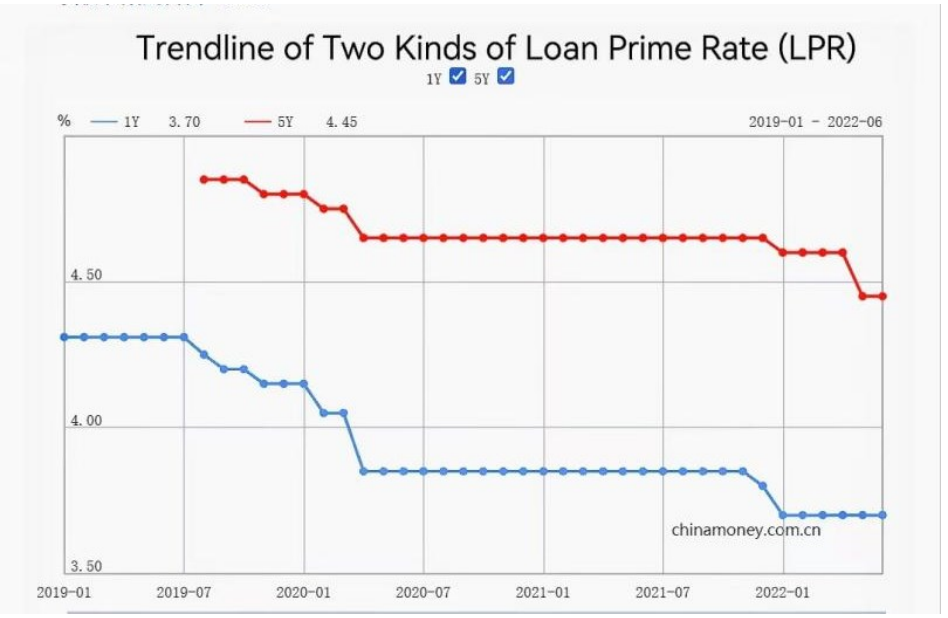


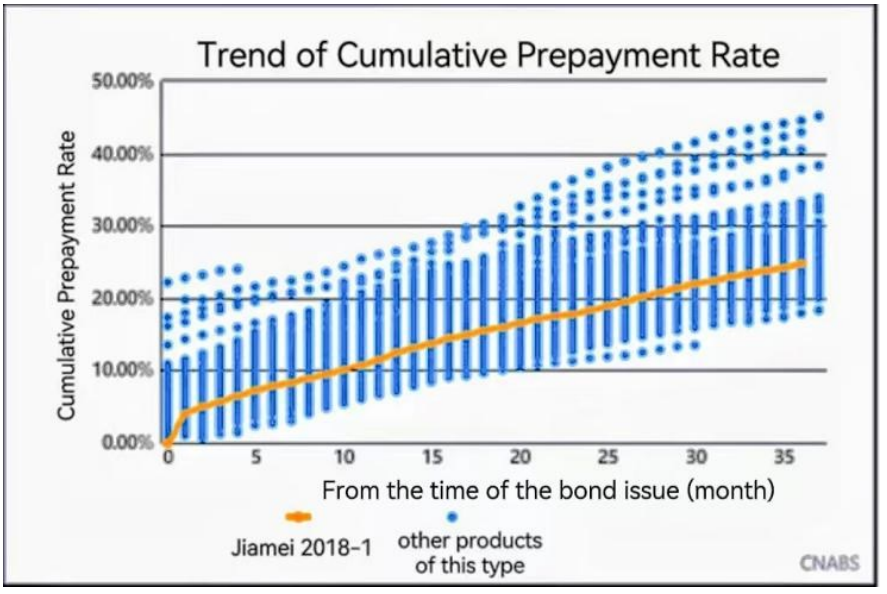
Figure 3: Trendline of two kinds of loan prime rate (LPR).

2.3.2. Time to Maturity

As shown in Figure 4, the cumulative prepayment rate of Jiamei 2018-1 has seen a steady rise since it was issued.

Compared with other products of this type, Jiamei is in the middle and lower reaches when it comes to the cumulative prepayment rate. This might be because it has a rather long time to maturity overall.

According to the tracking rating report for 2021, conditional prepayment risk reaches 11.46%, while annual prepayment risk reaches 12.13%.



(The picture is from CNABS)

Figure 4: Trend of cumulative prepayment rate.

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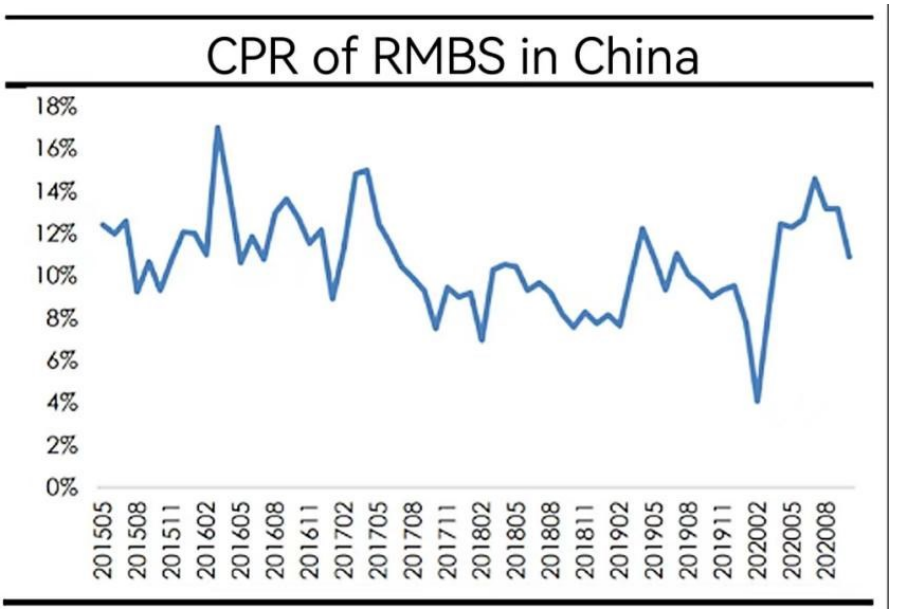

(This picture is from the report of the People's Bank of China)
Figure 5: CPR of RMBS in China.

2.3.3. Income Level of the Borrower

In Jiamei's case, we see that it basically remained stable in the first year, but dropped dramatically at the beginning of 2020. (From Figure 2). As shown in Figure 5, similar phenomenon happened to the CPR of RMBS in China.

This is probably because of the Covid-19 pandemic, which caused an economic downturn, leading to decreased income for the borrowers. Consequently, fewer people have spare money to prepay the mortgage bond.

2.3.4. Changes in Real Estate Prices

From 2018 to 2020, house prices are still rising in most places in China. The Limited Suite policy, however, stimulated a changing house tide in some places. With the rising house prices and the desire to change houses, the prepayment rate rises along.

However, after Mr. Xi's idea that housing residents instead of vicious speculation and tons of policies limiting it, the housing market is not as promising as before. On the other hand, there hasn't been a widely recognized way to maintain and increase the value of assets. So it is likely that the prepayment risk Jiamei 2018-1 will not rise too high in a few years.

2.3.5. Relocation

According to Busser and Hendershott's research [9] on the prepayment option, prepayment can be regarded as a call option. A call option is a contract between a buyer and a seller to purchase a certain stock at a certain price up until a defined expiration date. The buyer of a call has the right, not the obligation, to exercise the call and purchase the stocks, and in this scenario, make the prepayment. When the market interest rate is lower than the contract rate, the borrower can execute their call option and refinance to reduce the cost of buying a house. This relationship between the value of such call option (or the benefit of prepayment) and prepayment risk is later examined and highlighted by other researchers. Aside from the value of such call options, Quigley's research [10] on America's mortgage market in 1987 revealed that relocation of a family is another significant factor that contributes to

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prepayment. Additionally, this factor is positively related to the number of family members, and the education level of the borrower; while the age of the borrower and the loan balance is negatively related to the prepayment risk.

The mainstream International academic community considers the value of the call option (of prepayment) as a significant factor in the modelling of prepayment risk. And based on the model constructed by Calhoun and Deng in 2000 [11],

$$C\ (t0) = \frac{\sum_{t=1}^{T-t0} \frac{P(t)}{[1+R'(t)]^t} - \sum_{t=1}^{T-t0} \frac{P(t)}{[1+R(t)]^t}}{\sum_{t=1}^{T-t0} \frac{P(t)}{[1+R'(t)]^t}} = \frac{\frac{1-\frac{1}{[1+R'(t)]^{T-t0}}}{R'(t)} - \frac{1-\frac{1}{[1+R(t)]^{T-t0}}}{R(t)}}{\frac{1-\frac{1}{[1+R'(t)]^{T-t0}}}{R'(t)}} \quad (1)$$

In this formula, C (t0) is the value of the call option at t0; P(t) is monthly payment by contract at time t; R'(t) is the market interest rate; R(t) is the contract interest rate [12]. This formula implies that the value of the call option equals the difference between the present value of monthly payment based on the market interest rate and the present value of monthly payment based on the contract interest rate. In other words, if C (t0) >0, then the present value of the monthly payment based on the market rate is higher, and the borrower can reduce the cost of buying the house by prepaying and refinancing. However, the option of refinancing is not so applicable in the Chinese mortgage market for two reasons. Firstly, the rate of personal housing loans is floating which changes with the legal rate of interest (determined by the People's Bank). Secondly, the Chinese mortgage market does not have any channels for refinancing. Loans with discounted rates are only granted for residential housing. Therefore, those who decide to refinance their mortgage would not receive a new loan that has a lower interest rate.

2.3.6. How Prepayment Risk Affects the Price of the Bond

The pricing of any bond is essentially the discounting of projected cash flows. There are three main prepayment pricing models to determine the spread of asset securitization products, namely the Static cash flow yield method(SCFY), Static spread method(SS), and option-adjusted spread analysis(OAS). Different from Western countries, In the specific conditions of the Chinese system, the pricing concept of the static revenue pricing method is more practical for the current MBS product market in China. In the case of prepayment risk, the cash flows of the Jiamei 2018-1 mortgage asset pool will become volatile, which could most likely increase the difficulty of pricing MBS. The risk of prepayment is taken into account at the time of MBS issuance, and the price of MBS will usually fall if the prepayment is faster than expected.

2.4. Policy and Future Outlook

RMBS was first introduced to the Chinese financial market in 2005 with the issuance of “Jianyuan-2005”. However, the following 2008 financial crisis took a toll on this financial instrument and the Chinese government shut down new issuances of MBS products until 2014. Compared to the markets in the U.S. and other developed countries, the RMBS market in China is yet to be developed but has huge potential. In 2021, 21 banks in China issued 62 RMBS products valued at 499.3 billion Yuan. The total trading volume of this product in 2021 also increased significantly compared to the years before, reaching 600 billion Yuan. RMBS products counted for 80% of the total trading volume of the asset-backed securities market within China, and in 2010, this number was less than 1%.

While the Chinese RMBS market is booming and receiving increased attention, it is also crucial to identify the underlying risks. We have discussed in much detail one of these risks, the prepayment risk, in the previous text. However, we need to notice how this risk is also affected by government policy. Government policies can both, directly and indirectly, affect prepayment. Though it is the

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borrowers' right to prepay their debt, government policies can be put in place to set a price on such behaviour to protect the benefits of the investors and lenders. For instance, if the debtor prepays the interest, they will be fined a certain percentage of the principal. Furthermore, government policies can also indirectly affect the prepayment risk. Take the Housing Provident Fund as an example: The operation of the fund proceeds from mandatory contributions by workers and employers into the fund, for later withdrawal for the express purpose of the home purchase. However, the recent policy changes allowed debtors to transfer part of their payment to the fund to pay off their mortgage principal once every year, which increases the possibility of debtors paying off their mortgage before the due day.

Overall, we can see that the Chinese RMBS market is expanding exponentially, and the future outlook is also very hopeful. As the market becomes more mature, additional policies will be put in place to make sure its stability and the interests of consumers. As of this very specific issue of prepayment risk, we are sure that more policies will be introduced to minimize this concern.

3. Conclusion

The Residential Mortgage-Backed Securities market has played a critical role in enhancing the liquidity of mortgages, and in relieving the pressure of capital constraints on commercial banks. Though this market in China was established rather recently, we see huge potential in it. With our in-depth discussion of "JIAMEI 2018-1" RMBS, the largest single RMBS product of the Savings Bank that has huge typicality, we revealed the five major factors that contribute to the prepayment risk of RMBS products: the level of interest rate, time to maturity, income level of the borrower, changes in real estate prices, and relocation. After a detailed examination of all five factors, we concluded that the prepayment risk of "JIAMEI 2018-1" RMBS is very mild. Similar procedures can be done to examine the prepayment risk of other RMBS products. Last but not the least, government policies would also influence the prepayment risk. However, considering the Chinese government holds a supportive opinion on the MBS market and has well-designed policies already put in place to ensure the stability of the market, we conclude that the Chinese RMBS market is heading into a bright future.

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Xinran Jiang is the first author, Zhichuan Yin is the second author. Yinan Lin, Nuo Lei and Kangning Wu contribute the same, they three are considered as third authors.

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