Discount or Premium? Pricing of Structured Products: An Analysis of the Chinese Market

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Abstract: Structured products combine elementary instruments from the spot and derivative markets. The existing evidence on mature markets shows that structured products are commonly charged with large implicit premiums compared to their theoretical values. However, this paper finds that structured products in Chinese market are, on average, priced closely to their theoretical values, which no longer favors the issuing institution. This is reasonable as the issuing banks' market power in China is relatively low compared to those in mature markets, given three characteristics in Chinese market (the intense competition from Internet finance, strict short-sell constraints, and the lack of secondary market as well as redeemable claims). Specifically, based on a database including 126 structured products with various underlying assets and durations from two main structured products issuing banks in China, this paper finds two more interesting results. First, structured products with call option and double option components are generally issued at a small discount, while most structured products with put options components are issued at a small premium. Second, a significantly negative correlation is also found between implicit premium and duration, indicating that the implicit premium rates of short-term products are higher than those of long-term products. Overall, these findings suggest that issuing banks' market power is weakened by the competitive market and incomplete market structure.

Keywords: Structured products; Internet financial environment; Pricing mechanism; Chinese market; Incorporate option structures

1. Introduction

The structured product is an important innovation in financial products in the past three decades. It allows investors to take a position in the market on almost any asset class, while simultaneously protecting their original capital depending on their risk appetite. There is a long line of literature on structured products (Breuer and Perst, 2007; Baule et al., 2008; Döbeli and Vanini, 2010; Das and Statman, 2013; Pelster and Schertler, 2019), but structure products in mature markets such as the U.S., Germany and the U.K. are commonly investigated. In these mature markets, most of structured products are not "fairly" priced but with implicit premiums (Grünbichler and Wohlwend, 2005; Stoimenov and Wilkens, 2005; Hens and Rieger, 2014; Entrop et al., 2016; Pelster and Schertler, 2019). Thus, the mispricing favors issuing banks and customers may not be properly rewarded for risk they bear, at least with respect to the benchmark option pricing model. However, there is little evidence on the structured products in emerging markets.

This paper considers the characteristics of Chinese market and brings a new perspective to the literature. Structured products are first launched in China in 2004 and experienced rapid development in the past decade since 2010. For instance, by the end of 2010 the Chinese market has only issued 3998 structured products, while the total number of structured products reaches 33698 by 2019. Most importantly, there are unique characteristics of Chinese market that affecting the intensity market competition of issuing structured products, which changes the issuers' market power[1] and pricing strategies.

Firstly, the commercial banks are suffering considerable competitions because of the rapid development of Internet finance in China, while commercial banks issue the most financial products with less competitions from alternative investments in mature markets (Carlin, 2009; Entrop et al., 2016; Pelster and Schertler, 2019). The introduction of market competition can effectively enhance the bargaining power or the market power of investors, which may reduce the significance of implicit premiums in pricing structured products. In most mature markets, due to the market maker role of issuers, investors have to accept the implicit premium, bear its implied risks, and tend to get negative risk-adjusted return in structured products investments. However, in China, the continuous expansion of Internet financial products market is significantly

[1] Market power here is the ability of structured products issuers or investors to influence the market price of the structured products, as discussed in Carlin (2009) and Entrop et al. (2016).

crowding-out the market share of traditional banking (Gong, 2013; Chan et al., 2019). For example, the advent of various "Baobao" products in 2013 even led to the "money shortage" of banking institutions. In particular, this crowding-out effect can compete the issuers of structured products, given the following three aspects. First, commercial banks' products usually have higher purchasing thresholds for investors, and the financial needs of retail investors with small amount of investment are often not met. Internet finance, targeting retail customers, has expanded the new section of the finance product market in China and activated a large amount of idle funds. Second, the Internet financial platform has a greater cost advantage than banks in rent, equipment and manpower. Finally, the Internet financial platform can make full use of the network platform and grasp a large number of investors' attentions, such that they can relatively provide more personalized products and pricing for investors (Gao, 2016). Thus, in China, potential investors of structured products may have more alternative investment choices, leading that structured products pricing given by commercial banks is affected by a huge amount of structured and non-structured internet finance products. In this case, Chinese investors have higher market power than those in other mature markets. In order to attract more investors, issuing banks are forced to abandon the stable profit brought by the premium. It is worth mentioning that when institutions providing higher coupon return to investors, it is still skeptical whether customers actually benefit from it. In a word, the financial products of the Internet financial platform largely divert the bank's market share of finance products and the intense competition in the financial products market weakens the market power of banks.

Secondly, compared with mature markets, Chinese market have much stricter short-sell constraints, which may cause the different pricing performances between structured products embedded with call options that those with put options. The price of structured products is a combination of fixed income price and embedded option price. Therefore, the essence of structured product pricing is to price its embedded options. In the mature markets, there are mature derivative security markets and enough investment choices for both long and short positions. Thus, most existing literature does not distinguish the pricing of call and put options when studying the structured products in mature markets. However, the strict short-sell constraints in Chinese market lead that long positions are much accessible than short positions. In this case, the structured products with implicit put options are relatively popular, compared to structured products with implicit call options, as it legally offer the short-sell investment opotunities. Therefore, it is reasonable to suggest the different performances of products with implicit call from those with put options. Moreover, the more complex the product's embedded option structure, the lower the risk-adjusted return. Complexity increases the market power of the firms because it prevents investors from becoming knowledgeable about the market (Baule et al., 2008; Carlin, 2009; Dorn, 2012; Hens and Rieger, 2014; Entrop et al., 2016; Kunz et al., 2017; Anic and Wallmeier, 2019). Thus, it is also interesting to examine the pricing performance of structured products with double options and with different underlying assets.

Lastly, in China, financial products lack mature secondary market and redeemable treaties. Secondary market tends to have a certain calibration effect on the issuance in the primary market. The primary market and the secondary market have a mutual calibration effect on the pricing of similar products. Once a certain price loses its rationality, the arbitrage opportunities occurs, the price bias will eventually disappear with arbitrage transactions. Therefore, the pricing of similar products in primary and secondary markets should be consistent (Zhang, 2008; Hsu et al., 2015; Cullenward and Coghlan, 2016). Moreover, the existence of secondary market influences investors' preference on products' durations. In the mature markets where there are mature secondary markets, products liquidity is less limited because investors can easily sale it. Products duration is no longer an investor's concern (Geromichalos and Herrenbrueck, 2016; Mattesini and Nosal, 2016; Vanasco, 2017; Bruche et al., 2017). However, given the lack of well-developed secondary markets, it is also important to investigate the role of a structured product's duration on its pricing performance.

Therefore, considering the unique characteristics explained above in Chinese structured products market (intense competition from Internet finance, strict short-sell constraints and the lack of secondary market and redeemable claims), this paper undertakes the investigation of the structured products pricing behavior based on the 126 manually collected structured products sample data. We propose three hypotheses about structured products pricing mechanism in Chinese market. They are H1: structured products in Chinese market commonly are issued at their theoretical price; H2: The implicit premiums are higher for products with call option components compared to those with put option components; H3: The implicit premiums are higher for short-term products compared to long-term products. This paper based on the structured products data from two major Chinese structured products issuing institutions (Agriculture Bank of China and Bank of Communications) during March

2018 to September 2018, with different underlying assets (CSI 300, gold futures, crude oil futures) and different durations (one month, three months, and six months).

Accordingly, our findings can also be explained in three perspectives. First of all, structured products in Chinese market are overall issued at par, with no significant implicit premium rates on average. The deviation of the issuing price from the theoretical price is very limited, even negligible. These results confirm our hypotheses that investors have higher market power in a highly competitive market and issuing banks have to compress or even abandon premium return to attract investors. Furthermore, the immature market of structured products without secondary market and the lack of redeemable claims lead to low liquidity of structured products compared to those in mature markets, and issuers need to give investors more risk compensation.

Secondly, when subdivided the tests on pricing performances of structured products into those embedded with different options, an interesting empirical finding is that most structured products with call option and double option components are priced slightly under their theoretical value, while most structured products with put options components are priced slightly above theoretical values. The literature based on mature markets never find such different performances. This phenomenon also confirms the mechanism that the market power of issuers is relatively strong in a less competitive market. Although we above find evidence that competitions from alternative Internet financial products lead the banks' structured products overall priced at par, the strict short selling constraint in Chinese market still make structured products with implicit put options components have fewer competitive products.

Lastly, we find significantly negative correlation between product duration and the structured products premium rate. This phenomenon is also related to the low liquidity of structured products in Chinese market. In mature markets, the existence of secondary market and redeemable claims makes the products duration less affect the choice of investors' products.

The remainder of the paper is organized as following. Section 2 reviews the literature on pricing structured products and develops three hypotheses about the market performance of structured products with the unique characteristics of China's financial market. Section 3 introduces the sample and theoretical pricing method used in this paper, and Section 4 conducts empirical research based on Chinese data and verified the hypotheses. Section 5 concludes.

2. Literature Review and Hypotheses Development

There is a long line of literature on structured financial products, but the focus of existing research is mainly on the pricing methods of a certain product or a certain kind of product (Chen and Sears, 1990; Kang and Zheng, 2005; Benet et al., 2006; Chen and Wu, 2007; Wallmeier and Dietelm, 2009; Cui et al., 2012; Deng et al., 2014; Entrop et al., 2016; Jiao, 2016; Jiang, 2017). The price of structured products is a combination of fixed income price and embedded option price. Therefore, the essence of pricing structured products is to price embedded options. However, considering that different design of structured financial products will face different pricing methods and risks, it is difficult to find common methods and models. Based on this, in addition, some literature has studied the overall pricing performance of the whole market, and find that the product pricing tends to be biased towards the issuers. Although the degree of inclination will be different between different issuers and different product types, most of the literatures still draw the conclusion that there is commonly a issuance premium for the structured financial products (Burth et al.，2001；Grünbichler and Wohlwend，2005；Stoimenov and Wilkens，2005； Entrop et al.，2016；Fernandes，2017；Pelster and Schertler，2019).

Moreover, the pricing factors of structured products include product duration, target asset price volatility, risk-free interest rate and target asset return. Among these, the product duration affects the pricing of embedded options in structured products, and also gives the product embedded option time value. Thus, it draws the most researchers' attentions (Ruf, 2011; Petry, 2015; Ammann et al., 2016; Wang, 2017).

Accordingly, we develop three hypotheses on the implicit premium, option types and the product durations. First, studies such as Stoimenov and Wilkens (2005), Entrop et al. (2016), Fernandes (2017), Pelster and Schertler (2019) find the overpricing of structured products in mature market. In the mature markets, issuing banks of structured products are the pricing leaders in the structured products market (Baule et al., 2008; Hens and Rieger, 2014; Entrop et al., 2016; Kunz et al., 2017; Anic and Wallmeier, 2019). Thus, product pricing tends to favor commercial banks with a certain premium, and investors have to accept the premium and its implied risks. However, as we discussed above, the Chinese structured products market has unique characteristics from mature markets. The existence of various Internet platform products makes the market more competitive, and issuing banks' market power is weakened. The booming of Internet finance allows investors to be more selective and thus have a higher market power. If the pricing of the products issued by commercial banks are not competitive compared with the financial products of Internet financial platforms, commercial banks may lose their potential customers. Moreover, the Internet financial platform has a natural advantage in cost control and can give investors a higher rate of return. Therefore, the Internet finance environment[2] will inevitably force the issuers to reduce profits when pricing structured products, issuers tend to reduce the premium rate, and make the goal to attract investors a priority. Based on this special characteristic of the Chinese market, we give our first hypothesis as:

H1*: structured products in Chinese market are likely to be issued at their theoretical price.*

Second, the short-sell constraints in Chinese market make the premium rate uniquely sensitive to the product's embedded option structure. From one perspective, Garleanu et al. (2009), Zhu et al. (2016), and Li and Guo (2017) all mention the relationship of investor risk hedging ability and derivatives pricing, and the limitation of hedging can explain the pricing bias of derivatives to some extent. In Chinese market, special short-sell constraint limit investor risk hedging and arbitrage. When the stock market has short selling constraint, the reference price effect of irrational traders and the resale option effect of stock speculators will lead to overvaluation of put option prices. From another perspective, due to short-sell constraints, most non-structured products tend to be long on stock market or bond market. When investors are short on the market, the choice is very limited. Structured products with put options have fewer competitive substitutions. The issuer of structured products with implicit put options is the "market maker" and have enough market power to issue structured products at relatively high premium. Therefore, we further hypothesize that

H2*: The implicit premiums are higher for products with call option components compared to those with put option components.*

Finally, Stoimenov and Wilkens (2005) propose the life cycle theory of structured products, that is, in secondary market, the premium of structured products tends to zero as the product maturity date approaches. In mature markets, the duration of the product

[2] Considering the availability of data, it is difficult to have the full sample data to quantify the impact of Internet finance. However, we have looked up the literature before and after 2013 which is the first year of Internet finance development. Before 2013, Chen and Ren (2008, 2011) conclude the certain structured products they analyze in Chinese market are issued at premium. Cui et al. (2012) estimate the theoretical price of a structured issued by Bank of China and find it is issued at the premium of 0.81%. Ma (2012) uses Monte Carlo simulation of asset price process based on standard geometric Brownian motion to estimate the theoretical price of a certain structured product and conclude it is issued at premium. After 2013, Gu et al. (2017) find 90% of the sample structured products with underlying asset of stock are fairly priced.

affects investors' choice of products less, because investors can sale the longer-term product in the secondary market when need liquidity. Moreover, investors can also solve the problem of liquidity by redeeming in advance. However, in Chinese market, once a long-term structured product is purchased, especially if the product is not set up with an early redemption treaty, it means that it must be held to maturity. Therefore, long-term products are not attractive to investors worried about liquidity. The issuer may compress their profits, and attract investors by increasing the coupon return of the products. As a result, longer-term product premiums are lower than short-term products. We, therefore, give the last hypothesis:

***H3**: The implicit premiums are higher for short-term products compared long-term products.*

To sum up, in order to examine the three hypotheses above, this paper aims to demonstrate the following three questions: what is the relationship between the market pricing and theoretical pricing; what is the relationship between product pricing premium and product embedded option structure; and whether the product pricing premium is related to the product duration.

3. Data and Methodology

3.1 Data

This paper based on the structured products data from two major Chinese structured products issuing institutions[3] (Agriculture Bank of China, Bank of Communications) during March 2018 to September 2018[4], with different underlying (CSI 300 Index (CSI 300 Index consists of the 300 largest and most liquid A-share stocks), gold futures (AU), crude oil futures (SC)) and different products duration (one month, three months, and six months)[5]. The distribution of sample data is shown in the table below. AU1812 and AU1906 are gold futures due in December 2018 and June 2019, SC1906 is crude oil futures due in June 2019.

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[3] In Chinese market, there is no unified structural product database. All banks are issuing only on the website to publish the investor instructions, and the product information we need for research can only be manually collected in time once the bank issues. Moreover, not all bank financial products give enough information to estimate the theoretical price, e.g. embedded assets and embedded structure. Agriculture Bank of China, Bank of Communications are the two large and representative issuers. They provide specific information of products we need to estimate the theoretical price.

[4] In March 2018, China introduced new regulations for the management of financial products. From then on, bank financial products no longer promise fixed incomes. All the financial products have to some extent become floating income products. As one of the most representative floating interest rate products, structured products deserve special attention. Therefore, we focus on the pricing performance of structured products since March 2018. We also include structured products with underlying assets of futures due in June 2019. Thus, our sample ends in September 2018.

[5] See the appendix A for details.

Table 1 Distribution of sample data

Holding period	Sum	CSI300	AU1812	AU1906	SC1906
1Month	68	30	8	10	20
3Month	48	30	8	10	0
6Month	10	10	0	0	0

Note: CSI 300 Index consists of the 300 largest and most liquid A-share stocks, AU1812 and AU1906 are gold futures due in December 2018 and June 2019, SC1906 is crude oil futures due in June 2019

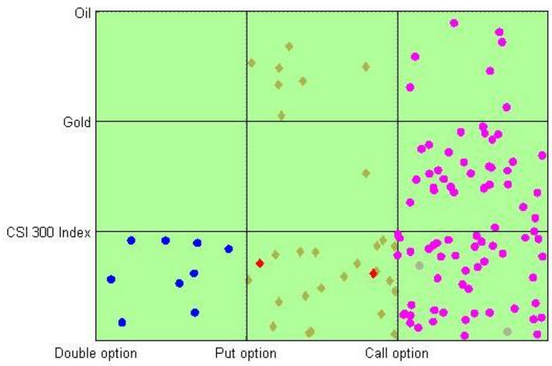

Figure 1: Distribution of sample data

Note: This figure illustrates the distribution of all 126 collected structured products during March 2018 to September 2018. They are grouped based on the type of underlying assets and the type of embedded options.

3.2 Model and Estimation Methods

The price of structured products is a combination of fixed income price and embedded option price. Therefore, the essence of pricing structured products is to price embedded options. Geometric Brownian motion is still widely used in the industry practice when simulating the dynamics of assets price process (Glasserman et al., 2002). Similarly, the Black and Scholes (1973) model (BS model hereafter) remains the industry's main option pricing model, and the BS model assumes that the asset price dynamic process follows the geometric Brownian motion. Benet et al. (2006) use the benchmark BS model to get the price of structured price. Ma (2012) uses Monte Carlo simulation and assume asset price follows Geometric Brownian motion to estimate the theoretical price of a certain structured product and conclude it is issued at premium. One drawback of Geometric Brownian motion is that it cannot capture the possibly stochastically of volatility. Therefore, in our empirical tests, we use SHIBOR over the approximate time window to represent the risk-free rate. For the underlying asset volatility, we use the historical volatility in the last time window, and the width of the time window is determined by the simulation length. Glasserman et al. (2002) use the BS formula and its extensions to value the option. They make the implied volatility consistent with the standard variation of asset price over the VaR horizon. More precisely, in this paper, under the risk-neutral assumption, the dynamics of underlying asset price follows the Geometric Brownian motion:

$$\mathrm{dlnS} = \left(r_f - \frac{\sigma^2}{2}\right)\mathrm{dt} + \sigma \mathrm{dz} \quad (1)$$

S is the underlying asset price. r_f is the risk free rate, SHIBOR of the approximate time window is to selected to represent the risk-free rate. σ is the underlying asset volatility, we use the historical volatility in the last time window, and the width of the time window is determined by the simulation length. dz follows the standard Brownian motion, $\mathrm{dz} = \varepsilon\sqrt{dt}, \varepsilon \sim N(0,1)$.

Moreover, when estimating the theoretical value of structured products, it should be very careful regarding its path dependency. The asset prices on the value date are not the starting point of the underlying asset price pat, but the middle point of the path. Therefore, for the pricing of structured products, in order to better capture the path dependency features and in order to better price some products with complex embedded structures, estimating numerical solutions using Monte Carlo simulation is more convenient and consistent than other methods for solving analytical solutions (Fink and Fink, 2005; Estember and Maraña, 2016; Fredriksson, 2018; Chan et al., 2019). Moreover, the comparison of product pricing performance is more effective when the same pricing method is adopted for different products.

To clearly explain our price pross, we take a crude oil-embedded one-month structured RMB financial products released by Bank of Communications on September 6, 2018 as an example. The product final return is linked with the closing price of SC1812, the return of this product ranged from 2.5% to 8.5%, its return structure is as follows:

$$r=\begin{cases} 2.5\%, & \text{if } \forall S_i<551.2,\ i=8,9,10,\cdots T \text{ and } S_T<520 \\ 2.5\%+100\%\times\left(\frac{S_T}{S_7}-100\%\right), & \text{if } \forall S_i<551.2,\ i=8,9,10,\cdots T \text{ and } S_T>520 \\ 4.8\%, & \text{if } \exists S_i>551.2,\ i=8,9,10,\cdots T \end{cases} \quad (2)$$

In the return structure equation, r is the final return of the structured product; S_i is the price of underlying asset on day i, S_7 is the price of underlying asset on the 7th day; S_T is the price of underlying asset on the expiry date. This paper use Monte Carlo method to simulate the moving path of underlying asset price, and then calculate the final return of this product according to the return structure.

Step1: simulate the closing price path of contract with underlying SC1812 from Sept. 6, 2018 to Oct. 17, 2018, Figure 1 below shows the simulated 100000 SC1812 contract closing price moving path.

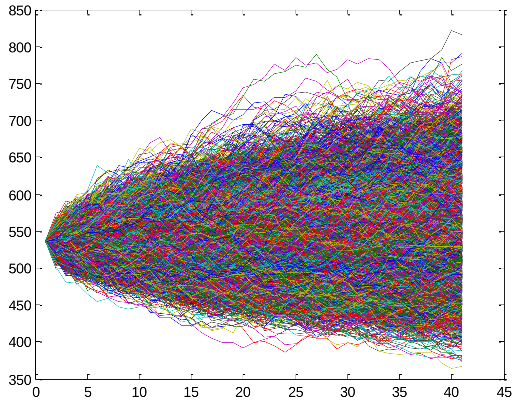

Figure 2: 100000 moving paths of SC1812 closing price

The parameters of the simulation are set as follows: the price of the target asset S_0 =535.7 at initial time T_0; the length of simulation T = 41 is the sum of interest-bearing time and the selling time; risk-free rate r_f =0.0271 equals to the SHIBOR during the same period as structured products, we choose the one-month SHIBOR on Sept. 6, 2018 as the risk-free rate; the volatility of the underlying asset σ=0.0540291.

Step2: Calculate the theoretical present value of the structured products based on the closing price moving path of underlying asset under a particular path;

Step3: Repeat step 1 and step 2 for N=100000 times (Generally, when N=100000, the standard deviation can be controlled within 10^{-2}, and the confidence can reach 95%);

Step4: Calculate the average theoretical present value by the return structure.

When we suppose the issuance price of the product is equal to 1, if the theoretical present value of the product is greater than 1, the structured products is issued at a discount; conversely, if the theoretical present value of the product is less than 1, the structured products is issued at a premium.

The simulated theoretical value of the product is 1.0008. The market issuance pricing, which is assumed to be 1, is very close to the theoretical value (parity issuance), it is even slightly lower than the theoretical pricing (discount issuance). This is consistent with our first hypothesis H1: structured products in Chinese market are likely to be issued at their theoretical price. We then replicate the price process to all 126 structured products

4. Empirical Results and Analysis

Using the sample and methodology introduced above, this section illustrates and discusses the empirical results.

4.1 Premium or Discount?

An expression that defines the implicit premium rate (Stoimenov and Wilkens, 2005) can more clearly quantify the relationship between market pricing (issuing pricing) and theoretical pricing of products.

$$\Delta V_i = (SP_i^{market} - SP_i^{Theo})/SP_i^{Theo} \qquad (3)$$

Obviously, when the premium rate $\Delta V_i = 0$, the product is issued at par; when the premium rate $\Delta V_i > 0$, the product is issued at a premium and when the premium rate $\Delta V_i < 0$, the product is issued at a discount. Based on 126 sample data, we simulate the underlying asset closing price moving path and the final underlying asset closing price at the expiration date, and obtain products theoretical value according to the revenue design structures (See Appendix A for detailed results).

The issuing banks in mature markets always tends to adopt pricing that is beneficial to themselves if possible; Discount issuance is relatively rare and only occurs when the market demand for the product is very low, the issuer has to attract investors by lowering the price of the product. Wasserfallen and Schenk (1996) conclude that the issue price and theoretical price bias are generally within 10%. The average premium rate is 2.35% and 1.67% in Swiss market and Germany market respectively (Burth et al., 2001; Rathgeber et al., 2011). Baule et al. (2011) find the implicit issue premium rate is between 1.98% and 3.50% based on 1057 sample products. Our results based on Chinese market data suggest the premium rate is between -1% and 1%, the average premium rate is 0.07%, and the standard deviation is 0.0038.

Compared with the deviation between the theoretical price and the issue price of financial products in other market, the pricing deviation in Chinese market is almost negligible. We conclude that the structured products of Chinese products are basically issued at par. This also verifies the hypothesis H1 proposed previously. In general, market pricing does not deviate from theoretical pricing. The intense competition from Internet finance, strict short-sell constraints and the lack of secondary market and redeemable claims are the reasons that have been analyzed that may result in parity issues.

4.2 The Implicit Premium Rates and Embedded Option Structure

Embedded options of sample products include call options, put options, and double options. We next pay extra attention to whether there are different performances between structured products with put option and those with call option. Figure 3 shows pricing performance of products with three embedded options.

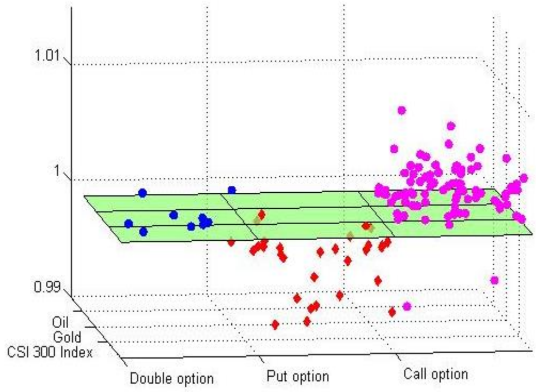

Figure 3: Pricing performance of products with three embedded options

Note: This figure illustrates the distribution of implicit premiums calculated for all 126 collected structured products during March 2018 to September 2018. They are grouped based on the type of underlying assets and the type of embedded options. A spot beyond 1 means its corresponding structured product has issuance price lower than the theoretical price; vice versa.

It is intuitively form Figure 3 that the premium rate and the embedded option structure have a close relationship. All the structured products with embedded call or double options have issuance price lower than the theoretical price, which means they are issued at a very small discount. On the contrary, structured products with embedded put options, the theoretical pricing of the final simulation and calculations are lower than the actual pricing, meaning that they are issued at a small premium. There is no existing literature documenting this interesting finding.

Thus, Hypothesis 2 has been confirmed. We attribute this phenomenon to the strict short-sell constraint, as the short-sell constraint tend to limit investor risk hedging and arbitrage and the issuers have higher market power in issuing products with put options components.

Moreover, given the high proportions of individual investor, Chinese investors exhibit strong herding behavior, which herding behavior is more pronounced under conditions of declining markets (Yao et al., 2014). During the periods when market crashes, investors have more motivation to do short on the market, and the structured products with implicit put option will be more popular. The increasing of demand leads to higher issuing price of the products. For example, in June 2015, the Shanghai stock index fell 30%. The demand for financial products that shorted markets is accordingly increased. Thus, the structured products issuers would issue the products with implicit put option at higher premium since they have more buyers. Therefore, we suggest that the conclusion in the market crash would be consistent.

4.3 The Implicit Premium Rates and Production Duration

Regardless of the underlying assets, any product with longer products duration is subject to higher theoretical pricing. In our analysis, the issuance pricing for all products is assumed to be 1, the higher the theoretical pricing, means that the issuance pricing gives investors more discounts. Table 2 shows the summary statistics:

Table 2: Statistics of premium rate ΔV of different production duration

Product Duration	N	Mean(%)	Std.(%)	Min(%)	Max(%)
1Month	68	0.114	0.204	-0.297	0.447
3Month	48	-0.116	0.498	-0.591	0.866
6Month	10	-0.192	0.527	-0.496	0.816

Note: This table summaries the implicit premium rates by grouping in different durations.

The statistics give an intuitive indication that as the product duration becomes longer, the average premium rate decreases and the standard deviation of the premium rate increases. One-month products have the highest average premium among three with implicit premium rate of 0.114%, and structured products with the duration of six month have the lowest premium rate -0.192%. At the same time, the standard deviation of one-month structured products is also the lowest among the three, indicating that its higher premium rate compared to products with longer duration is stable.

In order to statistically confirm the impact of different investment terms on product pricing, construct the following linear regression function:

$$\Delta \mathrm{V} = \mathrm{a} + \sum_{i=1}^{2} b_i M_i + \varepsilon \quad (4)$$

M_i is a term dummy variable. M_1=1 means the investment period is three months, and the coefficient b_1 correspondingly indicates the premium rate difference of three-month products compared to one-month products; similarly, M_2 =1 means the investment period is six months, and the coefficient b_2 indicates the premium rate difference of six-month products compared to one-month products. If $M_1 = M_2 = 0$, the investment period is one month, so the intercept term represents the premium rate when the investment period is one month.

There is a heteroscedasticity problem in estimating the above equation using the least squares method. Although the heteroscedasticity does not affect the unbiasedness and consistency of the least squares estimation results, the effectiveness of the estimates will be greatly compromised. In order to correct the heteroscedasticity to some extent, the steps are as follows:

Step 1: Use the Bootstrap method to resample the sample data;

Step 2: Fit the regression equation using the sampled data to estimate a_i, b_{1i}, b_{2i};

Step 3: Repeat Step 1 and Step 2 for 10,000 times to obtain 10,000 a_i, b_{1i}, b_{2i}, i=1, 2, ... 10000, then we have the distributions of a_i, b_{1i}, b_{2i}.

Step 4: Under confidence α, this estimate is considered valid as long as the estimate of the original sample estimate is within the confidence interval.

The following table shows the regression and the corresponding Bootstrap test results:

Table 3: Regression parameter significance

		Effect	p-value	
Maturity	coefficient	(%)	t-test	Bootstrap
1M	a	0.935	0.000	0.000
3M	b_1	-0.113	0.150	0.087
6M	b_2	-0.558	0.000	0.000

Note: This table shows the regression and the corresponding Bootstrap test results by grouping in different durations.

The regression coefficient is negative for both the three-month period and the six-month period. The premium rate of the structured products for the three-month period is on average 11.3% lower than the structured products for the one-month period; the premium rate of products with a six-month period is 55.8% lower than that of a one-month period. Both coefficients are significant under the Bootstrap test. From this, we have statistically confirmed the negative correlation between the issue premium rate and the investment term.

It is worth noting that there is no contradiction between the negative correlation between the issue premium and the product duration and the positive correlation between the product investment return and the product duration. The positive correlation between the product investment return and the product investment term inflects the additional return compensates for potential liquidity risks, while the negative correlation between the issue premium and the investment term reflects the price dominance. If investors have more power to choose financial products, then it is reasonable for issuers to increase the competitiveness of their products by decreasing premiums and offer higher return to their customers. This is also consistent with our Hypothesis H3.

5. Conclusions

The pricing performance of structured products in Chinese market have is very different from those documented in the literature on other mature markets. Empirically, we find that structured products in Chinese market are commonly issued at par, the deviation of the issuing price from the theoretical price is much smaller than the data of the developed countries. Specifically, most structured products with call option and double option components are issued at a very small discount and most structured products with put options components are issued at a small premium. Moreover, the implicit premiums are significantly higher for products with shorter product duration.

These results can be well explained by the unique environment of the Chinese market. First, Chinese market has different Internet financial characteristics from other markets. The booming online financial platforms weakened the market power of commercial banks. Second, Chinese market has relatively stricter short-sell constraints compared to mature markets. Third, Chinese market of structured products usually lacks secondary market and redeemable claims, resulting relatively lower liquidity. Thus, issuers of structured products generally have weaker pricing power than issuers in developed countries. The differences in market competition and the incomplete market structure lead to the reduction of the market power of issuing banks. The retail customers in Chinese market have higher bargaining power than the retail customers in the mature market. Traditional commercial banks no longer play the role of market maker in the structured products market. In order to attract more investors, banks have to abandon the stable profit brought by the premium and issue the products at a low price or even at a discount. In addition, incomplete market structure leads to different market power and pricing behavior of the issuing bank on different types of structured products.

Reference

[1] Ammann M, Arnold M, Straumann S. Illuminating the Dark Side of Financial Innovation: The Role of Investor Information Lacks. 2016.

[2] Anic V, Wallmeier M. Perceived Attractiveness of Structured Financial Products: The Role of Presentation Format and Reference Instruments. Journal of Behavioral Finance, 2019: 1-25.

[3] Baule R, Entrop O, Wilkens M. Credit risk and bank margins in structured financial products: Evidence from the German secondary market for discount certificates. Journal of Futures Markets: Futures, Options, and Other Derivative Products, 2008, 28(4): 376-397.

[4] Benet, N., Gianetti, A. and Pissaris, S., Gains from structured product markets: The case of reverse-exchangeable securities (RES). J. Bank. Finance, 2006, 30(1), 111–132

[5] Boehmer E, Wu J. Short selling and the price discovery process. The Review of Financial Studies, 2013, 26(2): 287-322.

[6] Breuer W, Perst A. Retail banking and behavioral financial engineering: The case of structured products. Journal of Banking & Finance, 2007, 31(3): 827-844.

[7] Bruche M, Segura A. Debt maturity and the liquidity of secondary debt markets. Journal of Financial Economics, 2017, 124(3): 599-613.

[8] Burth S, Kraus T, Wohlwend H. The pricing of structured products in the Swiss market. The Journal of Derivatives, 2001, 9(2): 30-40.

[9]Carlin B I. Strategic price complexity in retail financial markets. Journal of financial Economics, 2009, 91(3): 278-287.

[10] Chan R H, Guo Y Z Y, Lee S T, et al. Structured Products, Financial Mathematics, Derivatives and Structured Products. Springer, Singapore, 2019: 297-307.

[11] Chang E C, Luo Y, Ren J. Short-selling, margin-trading, and price efficiency: Evidence from the Chinese market. Journal of Banking & Finance, 2014, 48: 411-424.

[12] Chen, A.h., Kensinger, J.W., An analysis of market-index certificates of deposit. Journal of Financial Sercive Research. 1990. 4(2), 93-110.

[13] Chen, K.C., Sears, R.S., Pricing the SPIN. Financial Management, 1990, 19 (2,summer)，36-47.

[14] Chen J L, Ren M. A Study on the Pricing of Multi-Capital Stock-linked Capital-preserving Financial Products. Journal of Management Sciences in China, 2011, 11:67-74. *(in Chinese)*

[15] Cui, H. R., He, J. M., Hu, X.P. Designing and Pricing Structured Financing Products in order to Avoiding Inflation Risk. Journal of Management Science in China, 2012, 07 (02): 105-111. *(in Chinese)*

[16] Cullenward D, Coghlan A. Structural oversupply and credibility in California's carbon market. The Electricity Journal, 2016, 29(5): 7-14.
[17] Das S R, Statman M. Options and structured products in behavioral portfolios. Journal of Economic Dynamics and Control, 2013, 37(1): 137-153.
[18] Döbeli B, Vanini P. Stated and revealed investment decisions concerning retail structured products. Journal of Banking & Finance, 2010, 34(6): 1400-1411.
[19] Dorn D. Investors with too many options?. Available at SSRN 1571788, 2010.
[20] Entrop O, McKenzie M, Wilkens M, et al. The performance of individual investors in structured financial products. Review of Quantitative Finance and Accounting, 2016, 46(3): 569-604.
[21] Estember R D, Maraña M J R. Forecasting of Stock Prices Using Brownian Motion–Monte Carlo Simulation. Proceedings of the 2016 International Conference on Industrial Engineering and Operations Management Kuala Lumpur, Malaysia. 2016: 704-713.
[22] Fernandes AGL. Structured products insights: pricing reverse convertibles and discount certificates in the German market, 2017.
[23] Fredriksson M. Monte Carlo Simulations of Portfolios Allocated with Structured Products: A method to see the effect on risk and return for long time horizons. 2018.
[24] Fink J, Fink K. Monte Carlo Simulation for Advanced Option Pricing: A Simplifying Tool. Social Science Electronic Publishing, 2005. *(in Chinese)*
[25] Funke M , Paetz M . Financial System Reforms and China's Monetary Policy Framework: A DSGE-Based Assessment of Initiatives and Proposals. Social Science Electronic Publishing, 2012, 90(347):401-412.
[26] Gao, X. Y. Research on the Influence of Internet Financial Products in China on the Management of Commercial Banks. Shanxi Finance and Economics University, 2016. *(in Chinese)*
[27] Garleanu, N., Pedersen, L. H., Poteshman, A. M. Pricing options in an extended Black-Scholes economy with illiquidity: Theory and empirical evidence. The Review of Financial Studies, 2009, 22(10): 4259-4299.
[28] Geromichalos A, Herrenbrueck L. Monetary policy, asset prices, and liquidity in over-the-counter markets. Journal of Money, Credit and Banking, 2016, 48(1): 35-79.
[29] Glasserman P, Heidelberger P, Shahabuddin P. Portfolio value-at-risk with heavy-tailed risk factors. Mathematical Finance, 2002, 12(3): 239-269.
[30] Gong. Internet Financial Model and its influence on traditional Banking. Southern Finance Journal, 2013 (5): 86-88. *(in Chinese)*

[31] Grünbichler, A., Wohlwend, H. The valuation of structured products: Empirical findings for the swiss market. Financial Markets and Portfolio Management, 2005, 19(4), 361-380.
[32] Gu J, Cheng X, Zhou Y. Pricing Model and Deviation Test of Interval Stock Hook Structured Product. Systems Engineering, 2017, 35(6): 18-25. *(in Chinese)*
[33] Hens T, Rieger M O. Can utility optimization explain the demand for structured investment products? Quantitative Finance, 2014, 14(4): 673-681.
[34] Holmstrom B, Tirole J. Financial intermediation, loanable funds, and the real sector. the Quarterly Journal of economics, 1997, 112(3): 663-691.
[35] Hsu P H, Lee H H, Liu A Z, et al. Corporate innovation, default risk, and bond pricing. Journal of Corporate Finance, 2015, 35: 329-344. *(in Chinese)*
[36] Jiang, Z. W., Lyu, Q. Y. The Design and Pricing of the Structured Product of Baoben. Times Finance, 2016 (21): 225. *(in Chinese)*
[37] Kunz A H, Messner C, Wallmeier M. Investors' risk perceptions of structured financial products with worst-of payout characteristics. Journal of behavioral and experimental finance, 2017, 15: 66-73.
[38] Li, P. J., Guo, Y. F. The basis difference and liquidity of Securities Market. Journal of Management Science in China, 2017, 30(4): 151-160. *(in Chinese)*
[39] Mattesini F, Nosal E. Liquidity and asset prices in a monetary model with OTC asset markets. Journal of Economic Theory, 2016, 164: 187-217.
[40] Ma Y. Analysis on Pricing of Stock-linked Structural Financial Products -- Based on Monte Carlo Simulation. Theory and Practice of Development Reform. 2012(3):54-56. *(in Chinese)*
[41] Meng, Q B, Zhou, Y, Hou, D S Can the short selling mechanism restrain the listed company from violating the rules? Economic Research Journal. 2019, 54 (06):89-105. *(in Chinese)*
[42] Pelster M, Schertler A. Pricing and issuance dependencies in structured financial product portfolios. Journal of Futures Markets, 2019, 39(3): 342-365.
[43] Petry S. Determinants of secondary market prices for structured products during the 2007-2009 financial crisis. 2015.
[44] Rathgeber A, Wang Y. Market pricing of credit linked notes: The case of retail structured products in Germany. The Journal of Credit Risk, 2011, 7(4): 73-101.
[45] Ren M, Chen J L. Research on Pricing of Capital-preserving Stock Linked Structured Foreign Exchange Financial Products. Studies of International Finance, 2011, 11:67-74. *(in Chinese)*
[46] Ruf T. The dynamics of overpricing in structured products. Available at SSRN 1787216, 2011.

[47] Stoimenov, P. A., & Wilkens, S. Are structured products 'fairly' priced? An analysis of the german market for equity-linked instruments. Journal of Banking & Finance, 2005, 29(12), 2971-2993.

[48] Sun, G. P. The Pricing and Risk Analysis of Structured Product——A Case Study of Stock Index-linked Capital Protected Product. Technical Economics and Management Research, 2015, 10 (20): 67-72 *(in Chinese)*

[49] Vanasco V. The downside of asset screening for market liquidity. The Journal of Finance, 2017, 72(5): 1937-1982.

[50] Wang. Analysis on the Influencing Factors of the Pricing of the Gold-linked Structured Financial Products in the Commercial Bank of China. Jing Ji Shi, 2017(12):132-134. *(in Chinese)*

[51] Wasserfallen, W., Schenk, C. Portfolio insurance for the small investor in Switzerland. The Journal of Derivatives, 1996, 3(Spring), 37-43.

[52] Yao J, Ma C, He W P. Investor herding behaviour of Chinese stock market. International Review of Economics & Finance, 2014, 29: 12-29.

[53] Yi-xiang, T., Qiu-ping, Y., & Jing-tao, Y. An empirical study of the pricing of reverse floating interest rate-linked products. China Finance Review International, 2013, 3(2), 186-202.

[54] Zhang. Analysis of discount phenomenon and arbitrage opportunity of closed-end funds. Economic forum, 2008 (16): 106-108. *(in Chinese)*

[55] Zhu, H. Q., Yu, J., Chen, L. Heterogeneous Beliefs, Short Selling Restriction and Stock Earnings: An Analysis Based on Chinese Securities Market. Journal of Management Sciences in China, 2016, 19(7): 115-126. *(in Chinese)*

Appendix A

Summary Statistics for All Collected Structured Products

S_0	Risk-free rate	Volatility	Issuer	Starting date	Underlying	Structure	Present value	Implicit premium rate
557.7000	0.0280	0.0567	COMM	2018-9-27	SC1812	Put	0.9961	0.0039
557.7000	0.0280	0.0567	COMM	2018-9-27	SC1812	Call	1.0007	-0.0007
267.4000	0.0284	0.0278	COMM	2018-9-27	AU1812	Call	1.0041	-0.0041
267.4000	0.0280	0.0143	COMM	2018-9-27	AU1812	Call	1.0014	-0.0014
3403.5900	0.0280	0.1090	COMM	2018-9-27	CSI300	Call	1.0033	-0.0033
3403.5900	0.0280	0.0566	COMM	2018-9-27	CSI300	Call	1.0010	-0.0010
3403.5900	0.0284	0.1090	COMM	2018-9-27	CSI300	Put	0.9916	0.0085
3403.5900	0.0280	0.0566	COMM	2018-9-27	CSI300	Put	0.9980	0.0020
3417.2400	0.0327	0.1424	COMM	2018-9-26	CSI300	Call	0.9921	0.0080
3417.2400	0.0283	0.1090	COMM	2018-9-26	CSI300	Call	1.0027	-0.0027
3417.2400	0.0277	0.0566	COMM	2018-9-26	CSI300	Double	1.0006	-0.0006
271.9500	0.0283	0.0263	COMM	2018-9-25	AU1906	Call	1.0053	-0.0053
268.2000	0.0277	0.0131	COMM	2018-9-25	AU1906	Call	1.0023	-0.0023
535.9000	0.0275	0.0479	COMM	2018-9-20	SC1812	Call	1.0008	-0.0008
535.9000	0.0275	0.0479	COMM	2018-9-20	SC1812	Call	0.9963	0.0037
272.2500	0.0275	0.0138	COMM	2018-9-20	AU1906	Call	1.0018	-0.0018
272.2500	0.0281	0.0259	COMM	2018-9-20	AU1906	Call	1.0038	-0.0038
3310.1300	0.0281	0.1092	COMM	2018-9-20	CSI300	Call	1.0033	-0.0033
3310.1300	0.0275	0.0516	COMM	2018-9-20	CSI300	Call	1.0010	-0.0010
3310.1300	0.0281	0.1092	COMM	2018-9-20	CSI300	Put	0.9918	0.0082
3310.1300	0.0275	0.0516	COMM	2018-9-20	CSI300	Put	0.9979	0.0021
3312.4800	0.0324	0.1387	COMM	2018-9-19	CSI300	Call	1.0043	-0.0042
3312.4800	0.0282	0.1092	COMM	2018-9-19	CSI300	Call	1.0027	-0.0027
3312.4800	0.0282	0.1092	COMM	2018-9-19	CSI300	Double	1.0030	-0.0030
270.5500	0.0284	0.0259	COMM	2018-9-10	AU1906	Call	1.0054	-0.0054
270.5500	0.0272	0.0207	COMM	2018-9-10	AU1906	Call	1.0017	-0.0017
520.0000	0.0270	0.0540	COMM	2018-9-6	SC1812.	Call	1.0009	-0.0009
520.0000	0.0270	0.0540	COMM	2018-9-6	SC1812.	Put	0.9961	0.0039
266.4000	0.0285	0.0283	COMM	2018-9-6	AU1812	Call	1.0040	-0.0040
266.4000	0.0270	0.0209	COMM	2018-9-6	AU1812	Call	1.0013	-0.0013
3262.8800	0.0285	0.1119	COMM	2018-9-6	CSI300	Call	1.0032	-0.0032
3262.8800	0.0270	0.0597	COMM	2018-9-6	CSI300	Call	1.0011	-0.0011
3262.8800	0.0285	0.1119	COMM	2018-9-6	CSI300	Put	0.9919	0.0081
3262.8800	0.0270	0.0597	COMM	2018-9-6	CSI300	Put	0.9982	0.0018
3298.1400	0.0320	0.1386	COMM	2018-9-5	CSI300	Call	1.0045	-0.0044
3298.1400	0.0285	0.1121	COMM	2018-9-5	CSI300	Call	1.0026	-0.0026
3298.1400	0.0285	0.1121	COMM	2018-9-5	CSI300	Double	1.0010	-0.0010
270.6500	0.0289	0.0199	COMM	2018-9-3	AU1906	Call	1.0059	-0.0059

270.6500	0.0272	0.0272	COMM	2018-9-3	AU1906	Call	1.0014	-0.0014
522.8000	0.0273	0.0752	COMM	2018-8-30	SC1812.	Call	1.0007	-0.0007
522.8000	0.0273	0.0752	COMM	2018-8-30	SC1812.	Put	0.9958	0.0043
267.4500	0.0289	0.0281	COMM	2018-8-30	AU1812	Call	1.0039	-0.0039
267.4500	0.0273	0.0200	COMM	2018-8-30	AU1812	Call	1.0013	-0.0013
3351.0900	0.0289	0.1109	COMM	2018-8-30	CSI300	Call	1.0031	-0.0031
3351.0900	0.0273	0.0703	COMM	2018-8-30	CSI300	Call	1.0011	-0.0011
3351.0900	0.0289	0.1109	COMM	2018-8-30	CSI300	Put	0.9921	0.0079
3351.0900	0.0273	0.0703	COMM	2018-8-30	CSI300	Put	0.9983	0.0017
3386.5700	0.0321	0.1376	COMM	2018-8-29	CSI300	Call	1.0044	-0.0044
3386.5700	0.0290	0.1109	COMM	2018-8-29	CSI300	Call	1.0025	-0.0024
3386.5700	0.0290	0.0722	COMM	2018-8-29	CSI300	Double	1.0006	-0.0006
271.4500	0.0290	0.0270	COMM	2018-8-27	AU1906	Call	1.0051	-0.0051
271.4500	0.0275	0.0186	COMM	2018-8-27	AU1906	Call	1.0017	-0.0017
508.0000	0.0273	0.0726	COMM	2018-8-23	SC1812.	Call	1.0008	-0.0008
508.0000	0.0273	0.0726	COMM	2018-8-23	SC1812.	Put	0.9958	0.0042
266.2000	0.0289	0.0186	COMM	2018-8-23	AU1812	Call	1.0048	-0.0048
266.2000	0.0273	0.0280	COMM	2018-8-23	AU1812	Call	1.0012	-0.0012
3320.0300	0.0289	0.1121	COMM	2018-8-23	CSI300	Call	1.0031	-0.0031
3320.0300	0.0273	0.0674	COMM	2018-8-23	CSI300	Call	1.0010	-0.0010
3320.0300	0.0289	0.1121	COMM	2018-8-23	CSI300	Put	0.9920	0.0081
3320.0300	0.0273	0.0674	COMM	2018-8-23	CSI300	Put	0.9983	0.0017
3307.9500	0.0308	0.1386	COMM	2018-8-22	CSI300	Call	1.0050	-0.0050
3307.9500	0.0288	0.1121	COMM	2018-8-22	CSI300	Call	1.0026	-0.0026
3307.9500	0.0288	0.0674	COMM	2018-8-22	CSI300	Double	1.0006	-0.0006
557.7000	0.0280	0.0567	COMM	2018-9-27	SC1812	Put	0.9963	0.0037
557.7000	0.0280	0.0567	COMM	2018-9-27	SC1812	Call	1.0009	-0.0009
267.4000	0.0284	0.0278	COMM	2018-9-27	AU1812	Call	1.0043	-0.0043
267.4000	0.0280	0.0143	COMM	2018-9-27	AU1812	Call	1.0016	-0.0016
3403.5900	0.0280	0.1090	COMM	2018-9-27	CSI300	Call	1.0035	-0.0035
3403.5900	0.0280	0.0566	COMM	2018-9-27	CSI300	Call	1.0012	-0.0012
3403.5900	0.0284	0.1090	COMM	2018-9-27	CSI300	Put	0.9918	0.0083
3403.5900	0.0280	0.0566	COMM	2018-9-27	CSI300	Put	0.9982	0.0018
3417.2400	0.0327	0.1424	COMM	2018-9-26	CSI300	Call	0.9923	0.0078
3417.2400	0.0283	0.1090	COMM	2018-9-26	CSI300	Call	1.0029	-0.0029
3417.2400	0.0277	0.0566	COMM	2018-9-26	CSI300	Double	1.0008	-0.0008
271.9500	0.0283	0.0263	COMM	2018-9-25	AU1906	Call	1.0055	-0.0055
268.2000	0.0277	0.0131	COMM	2018-9-25	AU1906	Call	1.0025	-0.0025
535.9000	0.0275	0.0479	COMM	2018-9-20	SC1812.	Call	1.0010	-0.0010
535.9000	0.0275	0.0479	COMM	2018-9-20	SC1812.	Put	0.9965	0.0035
272.2500	0.0275	0.0138	COMM	2018-9-20	AU1906	Call	1.0020	-0.0020
272.2500	0.0281	0.0259	COMM	2018-9-20	AU1906	Call	1.0040	-0.0040
3310.1300	0.0281	0.1092	ABC	2018-9-20	CSI300	Call	1.0035	-0.0035
3310.1300	0.0275	0.0516	ABC	2018-9-20	CSI300	Call	1.0012	-0.0012

3310.1300	0.0281	0.1092	ABC	2018-9-20	CSI300	Put	0.9920	0.0080
3310.1300	0.0275	0.0516	ABC	2018-9-20	CSI300	Put	0.9981	0.0019
3312.4800	0.0324	0.1387	ABC	2018-9-19	CSI300	Call	1.0045	-0.0044
3312.4800	0.0282	0.1092	ABC	2018-9-19	CSI300	Call	1.0029	-0.0029
3312.4800	0.0282	0.1092	ABC	2018-9-19	CSI300	Double	1.0032	-0.0032
270.5500	0.0284	0.0259	ABC	2018-9-10	CSI300	Call	1.0056	-0.0056
270.5500	0.0272	0.0207	ABC	2018-9-10	CSI300	Call	1.0019	-0.0019
520.0000	0.0270	0.0540	ABC	2018-9-6	CSI300	Call	1.0011	-0.0011
520.0000	0.0270	0.0540	ABC	2018-9-6	CSI300	Put	0.9963	0.0037
266.4000	0.0285	0.0283	ABC	2018-9-6	AU1812	Call	1.0042	-0.0042
266.4000	0.0270	0.0209	ABC	2018-9-6	CSI300	Call	1.0015	-0.0015
3262.8800	0.0285	0.1119	ABC	2018-9-6	CSI300	Call	1.0034	-0.0034
3262.8800	0.0270	0.0597	ABC	2018-9-6	CSI300	Call	1.0013	-0.0013
3262.8800	0.0285	0.1119	ABC	2018-9-6	CSI300	Put	0.9921	0.0079
3262.8800	0.0270	0.0597	ABC	2018-9-6	CSI300	Put	0.9984	0.0016
3298.1400	0.0320	0.1386	ABC	2018-9-5	CSI300	Call	1.0047	-0.0046
3298.1400	0.0285	0.1121	ABC	2018-9-5	CSI300	Call	1.0028	-0.0028
3298.1400	0.0285	0.1121	ABC	2018-9-5	CSI300	Double	1.0012	-0.0012
270.6500	0.0289	0.0199	ABC	2018-9-3	AU1906	Call	1.0061	-0.0061
270.6500	0.0272	0.0272	ABC	2018-9-3	AU1906	Call	1.0016	-0.0016
522.8000	0.0273	0.0752	ABC	2018-8-30	CSI300	Call	1.0009	-0.0009
522.8000	0.0273	0.0752	ABC	2018-8-30	CSI300	Put	0.9960	0.0041
267.4500	0.0289	0.0281	ABC	2018-8-30	CSI300	Call	1.0041	-0.0041
267.4500	0.0273	0.0200	ABC	2018-8-30	AU1906	Call	1.0015	-0.0015
3351.0900	0.0289	0.1109	ABC	2018-8-30	CSI300	Call	1.0033	-0.0033
3351.0900	0.0273	0.0703	ABC	2018-8-30	CSI300	Call	1.0013	-0.0013
3351.0900	0.0289	0.1109	ABC	2018-8-30	CSI300	Put	0.9923	0.0077
3351.0900	0.0273	0.0703	ABC	2018-8-30	CSI300	Put	0.9985	0.0015
3386.5700	0.0321	0.1376	ABC	2018-8-29	CSI300	Call	1.0046	-0.0046
3386.5700	0.0290	0.1109	ABC	2018-8-29	CSI300	Call	1.0027	-0.0026
3386.5700	0.0290	0.0722	ABC	2018-8-29	CSI300	Double	1.0008	-0.0008
271.4500	0.0290	0.0270	ABC	2018-8-27	AU1906	Call	1.0053	-0.0053
271.4500	0.0275	0.0186	ABC	2018-8-27	AU1906	Call	1.0019	-0.0019
508.0000	0.0273	0.0726	ABC	2018-8-23	AU1906	Call	1.0010	-0.0010
508.0000	0.0273	0.0726	ABC	2018-8-23	AU1906	Put	0.9960	0.0040
266.2000	0.0289	0.0186	ABC	2018-8-23	AU1906	Call	1.0050	-0.0050
266.2000	0.0273	0.0280	ABC	2018-8-23	AU1906	Call	1.0014	-0.0014
3320.0300	0.0289	0.1121	ABC	2018-8-23	CSI300	Call	1.0033	-0.0033
3320.0300	0.0273	0.0674	ABC	2018-8-23	CSI300	Call	1.0012	-0.0012
3320.0300	0.0289	0.1121	ABC	2018-8-23	CSI300	Put	0.9922	0.0079
3320.0300	0.0273	0.0674	ABC	2018-8-23	CSI300	Put	0.9985	0.0015
3307.9500	0.0308	0.1386	ABC	2018-8-22	CSI300	Call	1.0052	-0.0052
3307.9500	0.0288	0.1121	ABC	2018-8-22	CSI300	Call	1.0028	-0.0028

Note: S_0 is the underlying asset price at the starting date; SHIBOR of the approximate time window is to selected to represent the risk-free rate; Volatility is calculated from history volatility of underlying assets during the last time window; COMM and ABC is the abbreviation for Bank of Communications and Agricultural Bank of China; The present value is the theoretical pricing of products, it is calculated based on the underlying asset price simulation (100000 times) and the product revenue structure. We assume products are issued at 1. Implicit premium rate quantifies the relationship between issuing pricing and theoretical pricing of products: $\Delta V_i = (SP_i^{market} - SP_i^{Theo})/SP_i^{Theo}$.