Analysis on the Profits of "Le-Ying Gold" Structured Financial Products

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Abstract: The complex design terms of structured financial products and the wide variety of linked objects make it difficult for investors to grasp the real returns of the products. In this paper, we choose the 1148 issue of "Le-Ying Gold" Structured financial Products issued by China CITIC Bank as an example to analyze its income and use Monte Carlo simulation method to make an empirical analysis on the expected profits of the "Le-Ying Gold" Structured financial Products. The conclusions of this paper are: firstly, compared with ordinary financial products, structured financial Products have more "investment" attributes, and the expected maximum return is not equal to the actual return. Secondly, the Monte Carlo simulation based on the GARCH family model is more accurate in predicting the returns of structured financial Products, which confirms the feasibility of this method in analyzing the returns of structured financial Products. Finally, it puts forward investment advice for investors in the Structured financial Products.

Keywords: Structured financial products; profits; The monte carlo simulation

1. Introduction

The essence of structured financial products is an innovative financial investment product integrating fixed income bonds and financial derivatives based on financial engineering means, and the product design is highly flexible. Not only are there more and more targets, but also the product's pegging direction, product term, and income structure are becoming increasingly diverse. As a result, it is becoming increasingly difficult to measure the returns of Structured financial Products. Most of the existing studies analyze the pricing of Structured financial Products from the perspective of commercial banks, and few scholars have studied the issue of the returns of Structured financial Products. But for investors, the product's future gains and possible losses are the factors they focus on. This paper analyzes the benefits of commercial Banks' Structured financial Products based on the "Le-Ying Gold" linked financial products of China CITIC Bank, which has certain practical significance.

2. Review of Literature

David P, Helms B[1](2005) believes that due to serious information asymmetry, ordinary investors cannot have a deep understanding of the pricing and quality of financial products like professional financial investment institutions, so ordinary investors are likely to invest irrationally and cause capital losses. Stefan B, Thomas K and hanspeter w[2] (2005) analyzed the pricing of Structured financial Products in Swiss financial market, and concluded that the premium issue of Structured financial Products in Switzerland is a labor compensation for the financial institutions that issue the products. K. C. Chen and Lifan Wu[3] (2007) conducted a price analysis on the equity-linked financial products issued by Swiss Bank and concluded that the pricing of this product was relatively reasonable. Carole B and Phelim[4] (2008) found that the more complex the product structure, the more likely the risk-neutral investors were to overestimate the investment value and underestimate the existing risks. Ronghua Luo, Huazhen Lin, Lihong Zhai[5](2013) used the semi parametric model with random effect to describe the yield of financial products with different risk levels and estimate the corresponding yield curve. Zhaoxue Sun[6] (2009) believed that linked notes were actually a structured financial product embedded with options on the basis of fixed income bonds, and finally demonstrated the rationality of the product through empirical evidence. Xueying Zhang[7] (2010) believes that it is understandable for Banks to issue Structured financial Products at an appropriate premium. For product combinations that do not exist in the market, the price is often higher than the theoretical value. Rongzhen Xu and Wei Zhang[8] (2015) believe that the targets of several existing Structured financial Products in China are mainly stock index, interest rate, exchange rate and gold, with outstanding product homogeneity. Chen Wang and Jiayin Gu[9](2015) solved the problem of independent increment in the search process, and summarized the pricing method of Structured financial Products with trigger conditions, but did not conduct empirical analysis based on actual cases. Xiaojun Duan[10] (2014) deduced the pricing theory of Structured financial Products and analyzed the benefits of six Structured financial Products by the Monte Carlo simulation.

3. Overview of Structured Financial Products

3.1 Design Parameters and Characteristics of Structured Financial Products

Design parameters of Structured financial Products:Product duration, Linked subject, Observation day, Income clause, Participation rate, Principal guarantee degree, Expected maximum income.

Features of Structured financial Products: Complex product structure, Flexible design, High product income and high risk, closed operation and poor liquidity.

3.2 The Development of Structured Financial Products in China

China's structured financial Products came into being relatively late, the earliest of which was in the form of foreign currency financial management.

According to the analysis of bank structure, issuance quantity and product income, in 2018, China's structured financial products market witnessed rapid development, with multiple product types meeting investors' individual investment needs.

At present, the product design capability of China's commercial Banks is not very high, especially the small and medium-sized banks which are the main force of the issuance of Structured financial Products.

4. Case Selection

4.1. Introduction of “Le-Ying Gold”1848 Financial Products

CITIC bank's structured wealth management products are mainly divided into five series. CITIC “Le-Ying Gold” series focus on the short and medium term, mainly linked to the gold price, non-break-even floating income, closed products. The case selected in this paper is the “Le-Ying Gold” 1848 RMB structured financial products of CITIC Bank.

Table 1. Caculation of product yield under different scenarios

Different Scenarios	Trigger event	Yield to maturity
Fixed income situation	R less than -2.00% or greater than 1.00%	Expected yield=5.05%
Floating return situation I	R is greater than or equal to -2.00%, and the decrease is greater than 0.00%	5.05%+1×(100%-R)
Floating return case II	R is greater than 0.00% and less than or equal to 1.00%.	5.05%+1×(R-100%)

According to the profit clause in the product specification, the following table sorts out three scenarios of the product's profit calculation. Suppose R is the range of rise and fall of the price on the observation date relative to the observed price on the value date of the product. Here are three scenarios for calculating their return levels.

4.2. Selection Reasons of “Le-Ying Gold”1848 Financial Products

Firstly, the product is representative. “Le-Ying Gold”1848 structured financial Products have the typical characteristics of structured financial Products, and can use the analysis model of structured financial Products for targeted analysis. Research on it is in line with the development trend of financial products.

Secondly, the product has the feasibility of research. The structure complexity of the 1848 “Le-Ying gold” Structured financial Products is moderate, and the historical price data of the linked target assets is easy to obtain. The linkage relationship between the product income and the linked assets is simple and clear, which is convenient for the establishment of a suitable model for analysis.

5. Empirical Analysis on the Profits of “Le-Ying Gold”1848 Financial Products

5.1. Descriptive Statistics of Data

In this case, the maturity yield of the product is linked to the closing price of the main gold futures contract of Shanghai Futures Exchange (AU1812) on October 18, 2018. So, in order to predict the yield of the product, it is necessary to analyze the closing price of the main gold futures contract of Shanghai futures exchange.

The data used in this paper is the closing price of main gold futures contracts from May 4, 2012 to May 4, 2018, with a total of 1440 historical data.

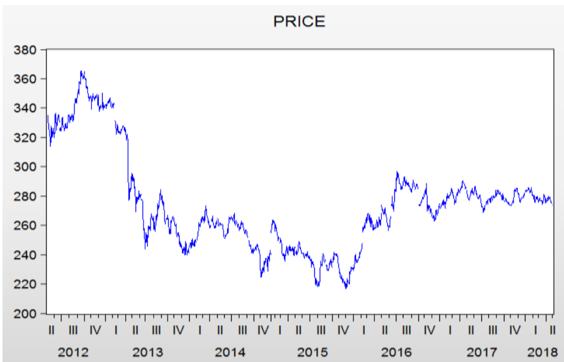

Figure 1. Gold futures main contract closing price chart

Data source: wind database

“Figure 1,” shows the main contract price trend of gold futures is a non-stationary sequence.

This paper defines the daily logarithm yield of the main contract of gold futures as:

$$R = \ln P_t - \ln P_{t-1} \quad (1)$$

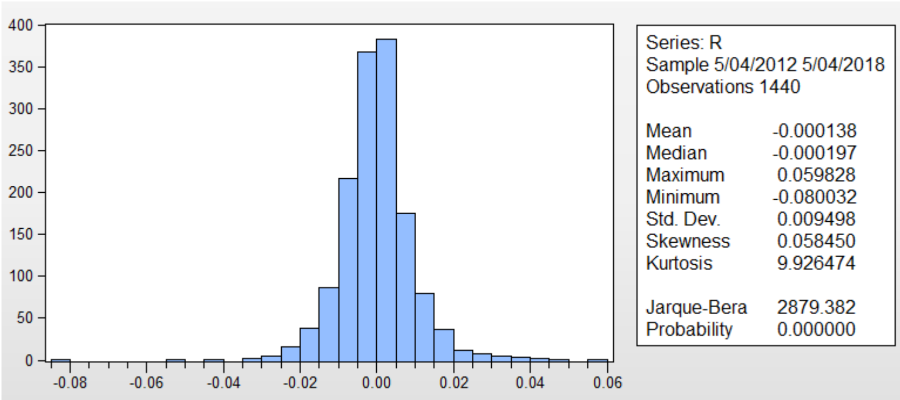

Figure 2. Statistical chart of daily logarithmic rate of return

Table 2. DAILY lOGARITHMIC YIELD DESCRIPTION STATISTICS

Mean	-0.000138
Median	-0.000197
Maximum	0.059828
Minimum	-0.080032
Std.Dev.	0.009498
Skewness	0.058450
Kurtosis	9.926474
Jarque-Bera	2879.382
P value(Probability)	0.000000

According to "Figure 2" and "Table II," the mean daily yield of the main contract of gold futures is -0.000138, the standard deviation is 0.009498, and the skewness is 0.058450 > 0, indicating that the distribution of this series is characterized by right skewness with a long right trailing tail. The kurtosis is up to 9.926474, which is much higher than the kurtosis of normal distribution 3, indicating that the distribution of this sequence has the feature of "peak and thick tail". The j-b statistic is 2879.382 and the P value is 0, which shows that this sequence significantly rejects the assumption of normal distribution. Therefore, this paper adopts the GARCH family model to simulate and predict the volatility of the underlying asset.

5.2. Data Stability Test--Adf Test

Because the modeling of non-stationary time series may lead to the problem of data "pseudo-regression", this paper conducts ADF test on the logarithmic yield sequence of closing price to investigate the data stability of the sequence.

According to "Figure 3,"the daily logarithmic yield of gold futures price fluctuates around 0, which has obvious "clustering effect".

"Table III." shows the t statistic of ADF test for the series of daily logarithmic return of gold futures price is -39.27981, which is far less than the critical value of ADF statistic at the significance levels of 10%, 5% and 1%, and the P value is 0, indicating that the null hypothesis of unit root of this series is significantly rejected, and the series of daily logarithmic return of gold futures price is stable.

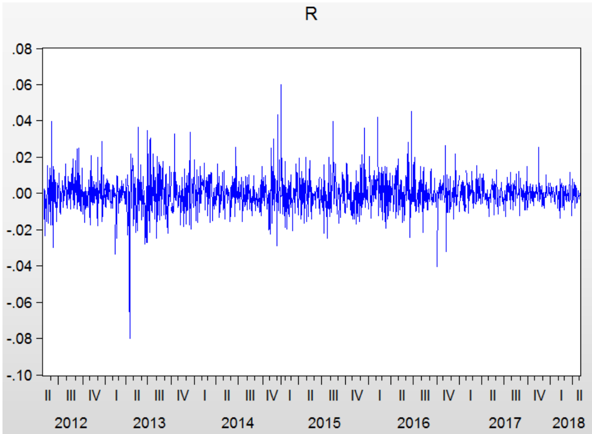

Figure 3. Daily logarithmic yield trend chart of gold futures closing price

Table 3. Results of stability test of logarithmic rate of return series

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-39.27981	0.0000
Test critical values	1% level	-3.434686	
	5% level	-2.863342	
	10%level	-2.567778	

5.3. Autocorrelation and Partial Autocorrelation Test According to "Table IV," the significance index p value of the autocorrelation and partial autocorrelation Q statistics of the daily logarithm yield series of gold futures is greater than 0.05, which shows that there is no low-order autocorrelation in the time series, that is, the change of the logarithm yield series follows the white noise process. So, the conditional mean value equation established in this paper is:

$$r = c + \mu_t = c + \sigma_t \varepsilon_t \quad (2)$$

5.4. Arch Effect Test of Data

According to "Figure 4," the residual fluctuates above and below the two dotted lines, indicating that the regression effect of the equation is good.

In this paper, the ARCH test of the residual term of the equation is used to determine whether the ARCH effect exists. The test results are as Table 5.:

Table 4. Logarithmic yield autocorrelation and partial autocorrelation test

order	AC	PAC	Q statistic	P value	order	AC	PAC	Q statistic	P value
1	-0.036	-0.036	1.8227	0.177	13	-0.056	-0.053	13.980	0.375
2	0.015	0.013	2.13	0.345	14	-0.017	-0.024	14.399	0.420
3	-0.008	-0.007	2.2262	0.527	15	0.003	0.006	14.416	0.494
4	-0.008	-0.008	2.3128	0.678	16	-0.010	-0.008	14.572	0.556
5	0.028	0.027	3.4106	0.637	17	-0.024	-0.028	15.446	0.563
6	0.014	0.016	3.6865	0.719	18	-0.073	-0.074	23.162	0.184
7	0.01	0.01	3.8236	0.8	19	0.048	0.047	26.567	0.115
8	-0.008	-0.007	3.9139	0.865	20	-0.019	-0.013	27.071	0.133
9	0.014	0.014	4.1981	0.898	21	0.033	0.026	28.617	0.124
10	-0.028	-0.028	5.3748	0.865	22	0.003	0.011	28.635	0.156
11	-0.015	-0.018	5.7096	0.892	23	-0.052	-0.048	32.533	0.090
12	0.05	0.049	9.3601	0.672	24	0.007	-0.001	32.600	0.113

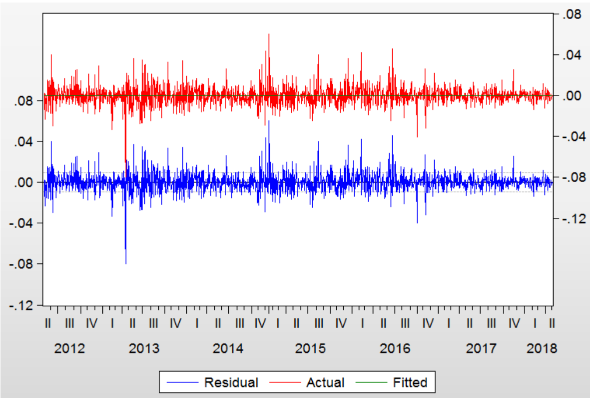

Figure 4. Residual graph of conditional mean equation

Table 5. Arch test of residual error of logarithmic yield series equations

Heteroskedasticity Test: ARCH			
F-statistic	4.270102	Prob.F(20,1399)	0.0000
Obs*R-squared	81.69681	Prob. ChiSquare(20)	0.0000

"Table V."shows the F statistic is 4.270102, nR2 is 81.69681, and all P values are 0, indicating that the assumption that there is no ARCH effect is rejected at a given significance level of 5%, that is, there is an ARCH effect in the sequence.

Table 6. Statistic table of20 order significance of equation residual arch test lag

Lag order	Coefficient	Standard deviation	T - statistic	P value
1	0.188332	0.026735	7.044354	0.0000
2	-0.053832	0.027197	-1.979342	0.0480
3	0.081861	0.027228	3.006515	0.0027
4	-0.01191	0.027301	-0.436259	0.6627
5	0.014845	0.027277	0.544232	0.5864
6	0.02253	0.027279	0.825912	0.4090
7	0.043344	0.027282	1.588764	0.1123
8	0.008153	0.027302	0.298639	0.7653
9	0.00474	0.027301	0.173618	0.8622
10	0.079834	0.027292	2.925118	0.0035
11	0.024887	0.027291	0.911931	0.3620
12	0.008641	0.027297	0.316559	0.7516
13	-0.017855	0.027297	-0.654098	0.5132
14	-0.008417	0.027274	-0.30862	0.7577
15	-0.007507	0.027269	-0.275281	0.7831
16	0.043887	0.027263	1.609799	0.1077
17	-0.029949	0.027255	-1.098864	0.2720
18	0.017564	0.027178	0.646276	0.5182
19	0.008739	0.027145	0.321924	0.7476
20	-0.00055	0.026684	-0.02063	0.9835

According to "Table VI," the p-values of the first, third and tenth order of lag are all less than 0.05, indicating the existence of ARCH effect.

5.5. Model Establishment

In this paper, the GARCH model, TGARCH model and EGARCH model are respectively regressive to compare the fitting effect and select the optimal model.

According to AIC and SC criteria, both the GARCH and TGARCH models do not meet the requirements. Due to the excessive length of the test results selected by the model, this paper only lists the test results of the EGARCH model. As follows:

Table 7. "Egarch (2,2)" model modeling results

parameter significance results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.000297	0.000218	-1.363121	0.1728
Variance Equation				
C(2)	-0.157522	0.043836	-3.593402	0.0003
C(3)	0.224392	0.02749	8.162629	0.0000
C(4)	-0.125276	0.032207	-3.889704	0.0001
C(5)	-0.068376	0.00968	-7.063389	0.0000
C(6)	0.428607	0.09759	4.391933	0.0000
C(7)	0.562374	0.096663	5.817903	0.0000

According to "Table VII," all parameters of the model are significant, and the sum of residual term and variance term coefficients of the equation is 0.864199, less than 1, which meets the parameter constraint conditions, indicating that "EGARCH (2,2)" model has a good fitting effect.

According to the operation results in "Table VII," the conditional mean equation and variance equation are established as follows:

$$Rt = -0.000297 + \mu_t\ ,\ \ \mu_t = \sigma_t\varepsilon_t\ ,\ \ \varepsilon \sim N(0,1) \quad (3)$$

$$ln(\sigma_t^2) = -0.157522 + 0.224392\left|\frac{\mu_{t-1}}{\sigma_{t-1}}\right| - 0.125276\left|\frac{\mu_{t-2}}{\sigma_{t-2}}\right| - 0.068376\frac{\mu_{t-1}}{\sigma_{t-1}} + 0.428607\ln(\sigma_{t-1}^2) + 0.562374\ln(\sigma_{t-2}^2) \quad (4)$$

In this paper, the ARCH-LM effect test is conducted on the residual of "EGARCH (2,2)" model to further verify whether the "EGARCH (2,2)" model eliminates the ARCH effect.

Table 8. ARCH-LM test results

Heteroskedasticity Test: ARCH			
F-statistic	0.513959	Prob. F(20,1399)	0.9623
Obs*R-squared	10.35737	Prob. Chi-Square(20)	0.9612

According to "Table VIII," the F statistic was 0.513959, the nR2 was 10.35737, and the P values were both much higher than 0.05, indicating that the assumption of no ARCH effect was accepted at a given significance level of 5%, indicating that the "EGARCH (2,2)" model eliminated the ARCH effect well. So, "EGARCH (2,2)" model has the best fitting degree.

5.6. Monte Carlo Simulation Based on Garch Model

5.6.1. Parameter Determination

According to the fitting results in the previous section, "EGARCH (2,2)" model is determined as the basic model of price simulation. From "formula (1)", we can get:

$$Pt = \exp(R + \mu_t)Pt - 1 \quad (5)$$

According to the modeling results in "Table VIII," substitute R=-0.000297 into "formula (5)" to obtain:

$$Pt = \exp(-0.000297 + \mu_t)Pt - 1 \quad (6)$$

The Monte Carlo simulation method can simulate the change path of the underlying asset price, and can calculate and predict the underlying asset price through multiple simulations.

5.6.2. Results Statistics and Analysis

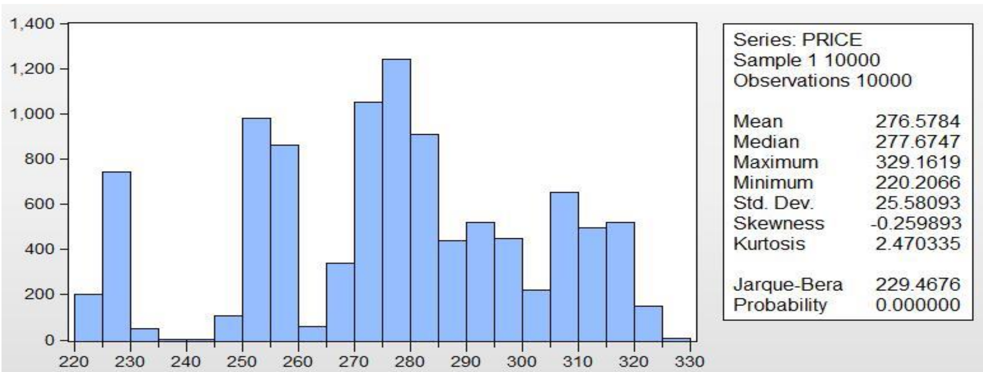

Figure 5. Statistical chart of simulated closing price on observation day

According to MATLAB2018 software simulation data, "Figure 5" shows the simulated closing price statistics of gold 1812 contract observation day.

The following results were obtained by ranking the prices of 10,000 simulated observation days: 8,365 simulated prices fell within the price range of the fixed-income scenario, that is, there is an 83.63% probability that the closing price of the gold 1812 contract will rise more than 1% of the closing price of the value date or decline more than 2% of the closing price of the value date on the observation day (22 October 2018).There are 1,045 simulated prices falling within [268.81, 274.30), that is, the closing price of the gold 1812 contract fall but the probability that the decline on the observation day does not exceed 2% of the closing price on the value day is 10.43%; There are 590 simulated prices falling within (274.30, 277.04], that is, the closing price of the gold 1812 contract rising, but the probability that the range of increase on the observation day does not exceed 1% of the closing price on the value day is 5.94%.

Table 9. Different situations to achieve the probability

and return calculation

Different situations	probability	Annualized rate of return	Cash flow to maturity
Fixed income situation	83.63%	5.05%	51,182.95
Floating return situation I	10.43%	5.95%	51,393.77
Floating return situation II	5.94%	5.57%	51,304.75
Expected return	83.63%×5.05%+10.43%×5.95%+5.94%×5.57% =5.17%		

According to the income calculation rules, for investors, there is an 83.63% probability of 5.05% fixed annualized return, a 10.45% probability of 5.95% annualized return and a 5.94% probability of 5.57% annualized return. Finally, the expected annualized rate of return of the product was calculated to be 5.17%. From the empirical results, although not reached the highest expected return on or close to 7.05%, but forecast earnings was one year deposit interest rates (according to central bank data, the deposit interest rate of 1.5% a year) of 3.45 times, even if "Le-Ying Gold" maturity can get only 5.05% expected the lowest income, the income is also one year deposit interest rate 3.37 times, so from the perspective of income, "Le-Ying Gold" has a certain value.

6. Research Conclusions and Suggestions

6.1. Research Conclusions

The design of structured financial management of "Le-Ying Gold" 1848 was generally reasonable. Although the liquidity was poor and investors could not redeem in advance, the product had relatively high returns and moderate risks. As long as the fund was properly arranged, the product had certain investment value.

Compared with ordinary financial products, structured financial Products have more "investment" properties, and the highest expected return is not equal to the actual return.

In the descriptive statistics of the logarithmic return sequence of underlying assets, this paper finds that it has the feature of "peak and thick tail", which does not follow the classical normal distribution. Therefore, the price trend of underlying assets does not conform to the geometric Brownian motion, which is consistent with the empirical analysis of financial data by many scholars.

6.2. Investment Advice on Structured Financial Products

6.2.1. Careful Selection of Linked Target Assets

For ordinary investors, they should try to choose financial products that are linked to the underlying assets they are familiar with or have investment experience, and can make a certain judgment on their future price trend based on the macroeconomic situation. After investment, they should also pay close attention to the price trend and market information of the underlying assets linked to, and analyze the potential impact of various factors on the returns of the products.

6.2.2. Treat "Expected Maximum Income" Rationally

"Expected maximum income" is the upper limit of the income range of Structured financial Products. Taking "Le-Ying Gold" 1848 in this paper as an example, although the expected maximum return of this product is 7.05%, but we can know that both the predicted return and the actual return are close to the expected minimum return, which is far from the maximum return, from which we can see the deviation between the actual return and the expected maximum return.

6.2.3. Choose Products according to Your Risk Tolerance and Risk Preference

Risk tolerance refers to a person's ability to bear the maximum loss without affecting normal life. When choosing structured financial Products, investors should choose appropriate financial products according to their risk preference and investment objectives on the basis of objective and reasonable evaluation of their risk tolerance.

References

[1] David P, Helms B. "Protecting microfinance borrowers," .R. Focus Note 27, Washington, D.C: CGAP, 2005
[2] Stefan B, Thomas K, Hanspeter W, "The pricing of structured products in the swiss market," .J. Journal of Derivative, 2001, 9(2): 30-40
[3] K. C. Chen and R. Stephen Sears, "Pricing the SPIN,".J. Financial Management, 1990(2): 36-48
[4] Carole B, Phelim, "Structured investment products and the retail investor," .EB/OL. Working Paper, 2008(11): 134
[5] Ronghua Luo, Huazhong Lin, Lihong zhai, "The construction and analysis of yield curve of bank financial products-based on stochastic effect semi-parametric model,".J.Journal of Financial research, 2013(07): 99-112
[6] Zhaoxue Sun,"Pricing research on an innovative gold derivative," .J.Journal of Financial research, 2009 (03): 171-177
[7] Xueying Zhang, "Pricing research on structured financial products of banks," .M. Beijing: China financial press, 2010: 33-35
[8] Rongzhen Xu, Wei Zhang ."Design and pricing of structured financial products linked to treasury bond futures," .J. Communication of Finance and Accounting, 2015 (35): 3-6 + 129
[9] Chen Wang, Jiayin Gu, "Research on pricing of triggered structured financial products,".J. Times Finance, 2015 (03): 45-46
[10] Xiaojun Duan, "Research on the benefits and risks of structured financial products," .D. Weihai: Shandong University, 2014.