

# *Research on Pricing Efficiency of Treasury Bond Futures Market*

**Lixia Gao, Li Han\***

*Qufu Normal University, Rizhao, Shandong, 276800, China*

*\*Corresponding author email: hanli@qfnu.edu.cn*

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**Abstract:** Since the listing of China's treasury bond futures, the fluctuation of the Treasury bond market is more frequent, and the pricing efficiency of the Treasury bond market has attracted more and more attention. Therefore, based on the development status of the Treasury bond futures market, this paper studies and analyzes the pricing efficiency of China's treasury bond futures market through the implied repo interest rate IRR, and summarizes the targeted suggestions to improve the information efficiency and pricing ability of China's treasury bond futures market.

## **1. Introduction**

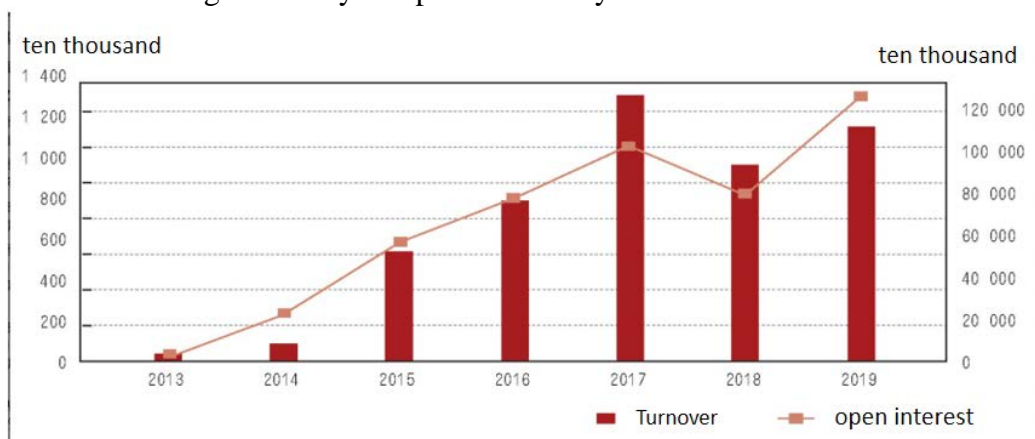
With the acceleration of China's interest rate marketization process, the volatility of China's interest rate financial products has gradually increased, and the demand of all kinds of investors to manage interest rate risk exposure is increasing. Treasury bond futures financial derivatives with risk management function came into being. In September 2013, March 2015 and August 2018, China Financial Futures Exchange (hereinafter referred to as "CICC") successively launched 5-year, 10-year and 2-year treasury bond futures products. The super long-term 30-year treasury bonds are also ready to be taken. China has established a relatively perfect treasury bond futures product system.

## **2. Development Status of Treasury Bond Futures Market**

Since the launch of treasury bond futures by CICC in 2013, China's treasury bond futures market has operated steadily, the market liquidity has been continuously improved, the types of participating institutions have been continuously enriched, and the trading mechanism has been continuously improved, showing the following characteristics:

First, the depth of the market continues to improve. Since its listing, the turnover of China's treasury bond futures market has increased from 0.31 trillion yuan in 2013 to 14.82 trillion yuan in 2019. The trading volume and year-end position have increased from 328800 and 3600 hands in 2013 to 13032100 and 131200 hands in 2019. The liquidity of China's treasury bond futures market has been continuously improved and the market depth has been continuously improved.

Second, banks and insurance institutions have been approved to participate in the Treasury bond futures market. According to the data released by China national debt depository and Clearing Corporation, as of the end of March 2020, the balance of book entry treasury bonds registered and entrusted with China national debt depository and Clearing Corporation was 14.89 trillion yuan, of which the balance of book entry treasury bonds held by commercial banks and insurance institutions were 10.05 trillion yuan and 36 million yuan respectively, accounting for 67.48% and 2.43% respectively. As the largest institutional investor in China's book entry treasury bonds, banks and insurance institutions were approved to participate in the Treasury bond futures market in February 2020, which enriched and improved the investor structure of China's treasury bond futures market. The two types of institutional investors reflect their own judgment and information expectation on the future interest rate market trend into the Treasury bond futures price through trading behavior, which not only enriches and expands the information content of the Treasury bond futures market, but also strengthens the information linkage and information exchange between the inter-bank market and the exchange market, and improves the information efficiency of the Treasury bond futures market Pricing efficiency and price discovery function.



*Fig.1 The Annual Trading Volume and Year-End Position of Treasury Bond Futures Market Show an Upward Trend*

Third, the government has launched the cash transfer system of treasury bond futures. According to the trading demands and trading characteristics of different investors, CICC has established a multi-level trading and delivery system. For example, in 2019, CICC launched the cash transfer trading of treasury bond futures, expanding the deliverable bonds of treasury bond futures to local government bonds and policy financial bonds. As a supplement to the centralized trading method, the forward to cash transaction negotiated by both parties enriches the trading and delivery mechanism of treasury bond futures, makes up for the defects of the “short hands up” system of treasury bond futures, meets the needs of institutional investors for refined risk management, reduces the impact of large orders on the market and reduces the execution cost of trading strategies, It has enhanced the market depth of the Treasury bond futures market. According to the data of CICC, by the end of March 2020, the cumulative trading volume (calculated unilaterally) of treasury bond futures has reached 2940, of which the cumulative trading volume of 10-year, 5-year and 2-year treasury bond futures is 1640, 800 and 500 respectively, accounting for 55.78%, 27.21% and 17.01% respectively.

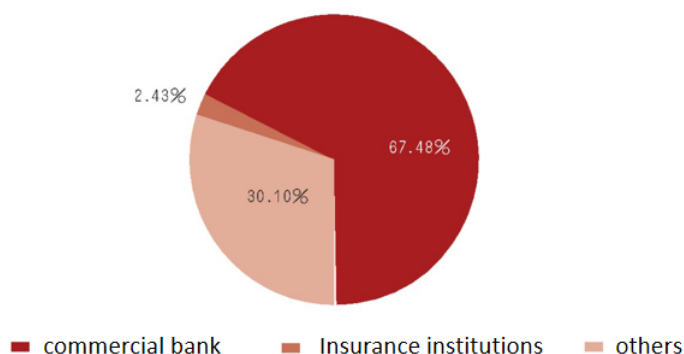


Fig.2 Holder Structure of Bookkeeping Treasury Bonds in China

### 3. Research on Pricing Efficiency of Treasury Bond Futures Based on Irr

#### (1) Relationship between IRR and capital cost

The implied repo interest rate (IRR) of treasury bond futures refers to the risk-free rate of return obtained by forward cash arbitrage, that is, the theoretical rate of return realized by investors buying the cheapest deliverable CTD group bonds while shorting treasury bond futures and using CTD bonds for the delivery of short futures. According to the calculation formula of IRR, when  $LRR < 0$ , theoretically, investors can also realize arbitrage income through reverse forward arbitrage. However, because the seller of treasury bond futures contract has the option to participate in the delivery of bonds, the bonds obtained by reverse forward arbitrage through long treasury bond futures contract may not be the same as the bonds shorted at the initial stage, This leads to the risk exposure of reverse spot arbitrage, so reverse spot arbitrage is not risk-free arbitrage.

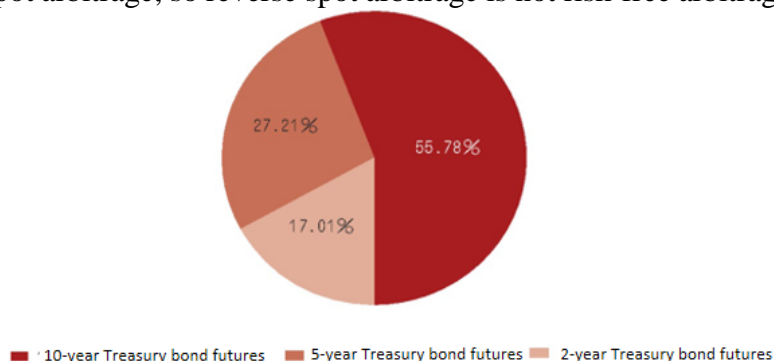


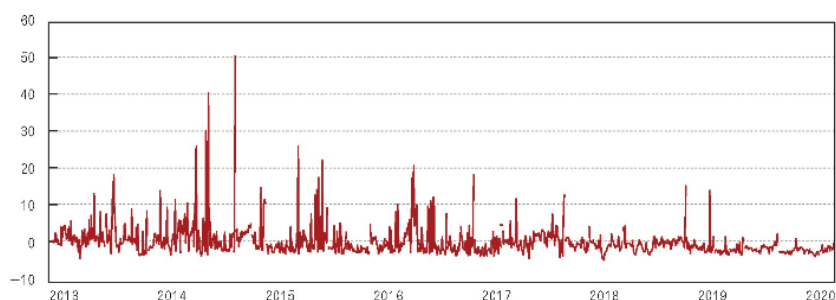
Fig.3 Proportion of Cash Transfer Transactions of 10-Year, 5-Year and 2-Year Treasury Bond Futures in China

To sum up, when  $IRR > \text{capital cost}$ , investors can realize the forward or reverse forward cash arbitrage of treasury bond futures by long or short basis. For example, the significant discount of treasury bond futures in February 2017 and the significant rise of treasury bond futures in the third and fourth quarters, arbitrage investors can realize the forward or reverse forward cash arbitrage income of treasury bond futures through the convergence of game premium.

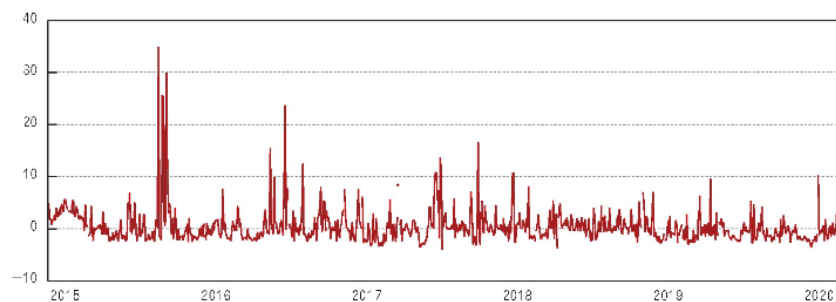
#### (2) IRR studies the pricing efficiency of treasury bond futures market

Implied repo rate IRR is an important index to measure the pricing efficiency of treasury bond futures market. Theoretically, according to the one price law, in an efficient treasury bond futures market, LRR should converge to the arbitrage financing cost of investors, that is, the risk-free arbitrage opportunity will gradually disappear.

In order to study the pricing efficiency of treasury bond futures market through IRR, the IRR interest rate series of five-year treasury bond futures from September 6, 2013 to March 31, 2020 and the contracts with the largest trading volume and positions of 10-year Treasury bond futures from March 20, 2015 to March 31, 2020 are selected as the research samples. Considering that the CICC stipulates that customers participating in the delivery of treasury bond futures must declare and obtain the approval of the custody account before the delivery month to enter the delivery month, otherwise the Treasury bond futures contract in the delivery month will be forcibly closed. Therefore, it is difficult for the current arbitrage of treasury bond futures in the delivery month to build a position and obtain IRR immediately. In view of this, the IRR interest rate series of 5-year and 10-year Treasury bond futures contracts in this quarter excluding the delivery month are constructed, including 1048 data series of 5-year treasury bond futures and 799 data series of 10-year Treasury bond futures; At the same time, the 7-day inter-bank pledged repo interest rate R007 of the same time series is selected to represent the position building financing cost of arbitragers.



*Fig.4 Trend of Current Arbitrage Yield of 5-Year Treasury Bond Futures after Excluding Financing Cost |Irr | - R007 (2013-2020)*



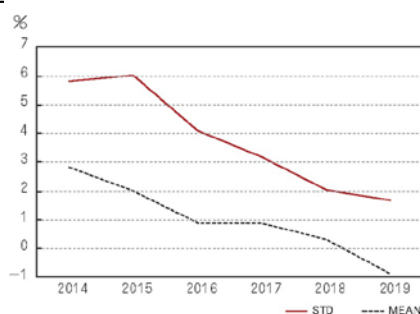
*Fig.5 Trend of Current Arbitrage Yield of 10-Year Treasury Bond Futures after Excluding Financing Cost |Irr | - R007 (2015-2020)*

As can be seen from Figure 4 and figure 5, since CICC launched 5-year treasury bond futures in 2013 and 10-year Treasury bond futures in 2015, the implied repo interest rate IRR of treasury bond futures arbitragers excluding the position building financing cost ro07 gradually converges to 0. This means that the price trend of 5-year and 10-year Treasury bond futures gradually converges to its corresponding CTD bonds (since the seller of the Treasury bond futures contract has the option to participate in the delivery of the bonds, the seller of the futures contract usually selects the bonds with the lowest delivery cost from a basket of deliverable bonds for delivery, and the bonds with the lowest position building cost are usually called the cheapest deliverable bonds.) Real time convergence, the linkage between 5-year and 10-year Treasury bond futures and corresponding CTD bonds is increasing, and the opportunity of future cash arbitrage across treasury bond futures and cash bond markets is decreasing. When the basis exceeds the arbitrage cost, the existence of future

cash arbitragers makes the basis return to the non arbitrage range quickly, and the pricing efficiency of China's 5-year and 10-year Treasury bond futures markets is increasing.

*Table 1 Mean and Standard Deviation of 5-Year Treasury Bond Futures |Irr| - R007 (2014-2019)*

year	Number of samples	IIRRI-R007mean value	IIRRI-R007standard deviation
2014	160	2.82	5.81
2015	158	1.99	6.03
2016	159	0.87	4.09
2017	157	0.86	3.17
2018	162	0.29	2.02
2019	162	-0.92	1.66

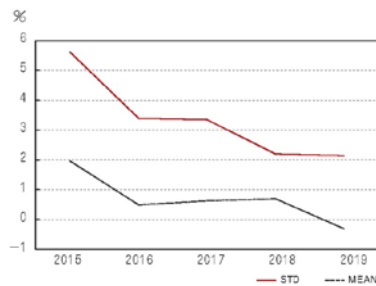


*Fig.6 The Mean and Standard Deviation of 5-Year Treasury Bond Futures |Irr| - R007 Show a Downward Trend (2014-2019)*

Table 1 and Figure 6 show the mean value, standard deviation and trend chart of IRR of 5-year treasury bond futures excluding financing cost r007 from 2014 to 2019. Firstly, from the mean value, the mean value of  $|irr| - r007$  arbitrage income shows a downward trend year by year, which shows that the linkage between the price of 5-year treasury bond futures and CTD bonds is increasing, especially the mean value of  $|irr| - R007$  in 2019 is negative -0.92, considering “Bears raise their hands “ Due to the restriction of the system on the reverse spot arbitrage, the reverse arbitrage income is difficult to realize, so the pricing efficiency of the 5-year treasury bond futures market is improved year by year; secondly, from the perspective of standard deviation, except that the standard deviation in 2015 is slightly higher than that in 2014, the standard deviation of  $|irr| - R007$  in other years shows a downward trend year by year, indicating that the volatility of the spot arbitrage income in the 5-year treasury bond futures market is increasing The pricing efficiency of China's five-year treasury bond futures market is improving day by day.

*Table 2 Mean and Standard Deviation of 10-Year Treasury Bond Futures |Irr|-R007 (2015-2019)*

year	Number of samples	IIRRI-R007mean value	IIRRI-R007standard deviation
2015	123	1.92	5.63
2016	159	0.43	3.38
2017	157	0.57	3.33
2018	162	0.64	2.17
2019	162	-0.38	2.11



*Fig.7 The Mean and Standard Deviation of 10-Year Treasury Bond Futures |Irr|- R007 Decreased (2015-2019)*

Table 2 and Figure 7 show the mean value, standard deviation and trend chart of IRR of 10-year Treasury bond futures excluding financing cost  $r_{007}$  from 2015 to 2019. Firstly, from the mean value, the mean value of  $|IRR| - R_{007}$  arbitrage income from 2016 to 2019 is significantly lower than that in 2015, and although the mean value of  $|IRR| - R_{007}$  from 2016 to 2018 fluctuates slightly, the amplitude is small, especially the mean value of  $|IRR| - R_{007}$  in 2019 is negative Count -0.38, consider “short hands up” Due to the restriction of the system on the reverse spot arbitrage, the reverse arbitrage income is difficult to realize. Therefore, since the launch of 10-year Treasury bond futures, its pricing efficiency has been improved on the whole; secondly, from the perspective of standard deviation, since the launch of 10-year Treasury bond futures in 2015, the standard deviation of  $|IRR| - R_{007}$  has decreased year by year, indicating the fluctuation of spot arbitrage income in the 10-year Treasury bond futures market Liquidity is declining, and the pricing efficiency of China's 10-year Treasury bond futures market is improving year by year.

#### 4. Countermeasures and Suggestions

The continuous improvement of the pricing efficiency of China's treasury bond futures market is related to the increasing liquidity and market depth of the market, the increasingly rich trader structure and trading strategies, the increasingly improved trading and delivery mechanism and other infrastructure construction, as well as the increasingly perfect product maturity system. In order to further improve the pricing efficiency of treasury bond futures market, we suggest the following aspects:

First, minimize the friction generated in the transaction of treasury bond futures and treasury bond spot market, and create a more standardized trading mechanism and more convenient trading environment to attract more investors, so that the futures trading price can fully reflect the supply-demand relationship between treasury bond futures and treasury bond spot market. For example, formulate standardized treasury bond futures law, treasury bond futures trading system and treasury bond spot delivery system, so as to create a more standardized and transparent market environment, fully reflect the “openness, fairness and fairness” of the market, and improve the pricing ability and efficiency of the futures market.

Second, increase the varieties of deliverable treasury bonds to attract more traders and enhance market liquidity.) Enrich the varieties, interest rates and maturities of treasury bonds to meet the preferences of investors. The Ministry of finance should enrich the varieties of treasury bonds, make full use of big data to count the number of investors in various varieties of treasury bonds, draw the structure chart and trend line of holders of various varieties of treasury bonds, analyze investors' preferences, and design products of various varieties, terms and interest rates, so as to meet the liquidity needs of short-term investors and the willingness of prudent investors to maintain principal and increase value, Through the mismatch of term and interest rate, we should make good use of this

fiscal and monetary policy tool on the basis of supporting the needs of national economic construction.

To increase the trading volume of treasury bond futures and treasury bond spot market, we need to first increase the trading volume of deliverable treasury bond spot. At present, the deliverable treasury bonds are mainly 4-7-year bookkeeping interest bearing treasury bonds. For other types of treasury bonds, futures trading hedging with limited delivery will inevitably lead to the lack of liquidity and the low efficiency of treasury bond futures pricing. Therefore, it is suggested that the exchange gradually liberalize the deliverable varieties of treasury bonds. With the increase of deliverable treasury bonds, the number of participants will also increase, which will inevitably increase the trading volume of the futures market. This can not only meet the needs of all kinds of traders, but also enhance liquidity and effectively improve the pricing efficiency of the futures market.

Third, improve the custody transfer efficiency of inter-bank and exchange bonds and realize the interconnection between inter-bank and exchange markets. Treasury bond futures is an interest rate derivative across the inter-bank bond market and the exchange bond market. The segmentation of the cash bond market makes arbitrageurs unable to realize real-time arbitrage due to the complexity of cash bond custody transfer procedures, even if they find arbitrage opportunities across the three markets of China Securities Exchange, inter-bank and exchange, which hinders the price linkage and information exchange of the three markets, It hinders the improvement of pricing efficiency of treasury bond futures market. Therefore, China should realize the efficient electronic connection of inter-bank and exchange custody systems, effectively shorten the time lag of re custody and transaction settlement, and establish a national centralized and unified cash bond custody and settlement system if conditions permit, so as to improve the pricing efficiency of treasury bond futures market.

Fourth, enrich and improve the investor structure of China's treasury bond futures market, realize the complementary trading needs of arbitrage investor groups with different capital cost, term characteristics and risk characteristics in China's treasury bond futures market, and enhance the depth and breadth of China's treasury bond futures market. At present, the participation qualification of China's treasury bond futures market has been opened to large commercial banks, but joint-stock banks and urban commercial banks holding a large number of bond assets are still unable to participate directly. On the premise of controllable risk, we can gradually liberalize the participation qualification of joint-stock banks and urban commercial banks, improve the heterogeneity of arbitrage investors in the Treasury bond futures market, provide more counter parties for the expression of trading opinions in the Treasury bond futures market, and enable the transaction price of treasury bond futures to more comprehensively and objectively reflect the market long and short information, Then improve the pricing efficiency of China's treasury bond futures market.

Fifth, improve marketing methods and enrich marketing means. On the mobile phone bank, mobile banking, App, Alipay, We Chat payment and other Internet Financial platforms, the mode of distribution by proxy or authorized agency is adopted to facilitate investors to buy treasury bonds whenever and wherever possible through the traditional sales mode of commercial banks and their outlets. Secondly, by referring to the practice of the U.S. Treasury Department, the government bonds to be issued can be auctioned by bidding, and the marketing of government bonds can be independently organized by the contracted marketers or commercial banks; Thirdly, we should deeply penetrate the national debt marketing into the vast rural areas, make up for the blank area of national debt issuance, give full play to the advantages of wide distribution and many outlets of rural commercial banks in rural areas, authorize them to act as agents for national debt marketing, go deep into villages and residential settlements through the establishment of national debt marketing mobile service points, and regularly carry out national debt consulting, distribution and cashing services.



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