RMB Exchange Rate Pass-through with Exchange Rate Attention Factor

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Abstract

For an open economy, exchange rate is an important economic indicator, and price is directly related to the quality of life of the people. Thus, the study on exchange rate pass-through is important to the society development. With the widespread of Internet, individuals and producers would have their expectations on exchange rate by searching the Internet. Therefore, public attention can have an influence on exchange rate pass-through. This paper first summarized the exchange rate pass-through mechanism theory, and analyzed the impact of exchange rate change and public attention to China's consumer price. The Vector Error Correction model was established selecting monthly data from 2011 to 2017, to investigate the short-term volatility and long-term equilibrium among the variables. To figure out the dynamic impact of China's exchange rate fluctuations and exchange rate attention on China's consumer price, impulse and response function was used to test the transmission effect of RMB. The empirical results show that there is a long-term co-integration relationship among the four variables. RMB appreciation has a restraining effect on domestic inflation, but the effect is small. And exchange rate attention factor indeed affects exchange rate pass-through, thus authorities need to strengthen communication with public to correctly guide public expectation. Enterprises and individuals should also enhance risk prevention to face exchange rate fluctuation.

Introduction

Consumer price and exchange rate are two core economic variables in an open economy. The domestic value of a currency is reflected by the price, and the external value of the currency is reflected by the exchange rate. After the collapse of Bretton Woods system, many developed countries replaced with floating exchange rate system, the fluctuation of exchange rate has been widening. How the exchange rate fluctuation affects the domestic price has been an important topic for many scholars. The purchasing power parity theory believes that the internal and external value of currency changes in the same direction and ratio. But in China, sometimes RMB depreciates and domestic price appreciates at the same time, purchasing power parity seems failed. In recent years, with the rapid growth of China's economic openness, the impact of exchange rate on domestic prices has also gradually increased. Exchange rate movements become one of the important factors that determine China's balance of payments and inflation or deflation. Monetary authority needs consider the influence of exchange rate on domestic price in order to stabilize the price level. Therefore, the exchange rate pass-through effect has such an important influence on country's trade balance and monetary policy, so the empirical analysis on exchange rate to the consumer price transmission is of great reference significance for policy making.

In terms of micro psychology, the public concern about exchange rate fluctuation can affect the exchange rate pass-through to some extent. When public attentions focus on the exchange rate or related policy, their consuming behavior might change. Thus, we intend to contain exchange rate attention rate in our model. As attention is a subjective behavior of human, it is difficult to quantify accurately. The Internet is a very important source of information in the contemporary society, and searching engine offers a way to measure attention. Individuals can learn more about exchange rate information through web search. Generally, the amount of relevant information search on exchange rate related information reflects the extent of the individual's attention to the exchange rate. The quality

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and quantity of the information obtained will also affect the individual's economic behavior, and then affect consumer price fluctuation. Baidu occupies a large share in China's searching market, so the Baidu index can effectively reflect the extent of individuals' concern about exchange rate. Therefore, this paper also uses Baidu Index as a parameter to measure exchange rate attention.

To figure out the transmission effect of RMB exchange rate on domestic consumer price, we will analyze the impact of exchange rate fluctuation and public attention to exchange rate. We will establish a macro-economic model and do co-integration test. To investigate the short-term volatility and long-term equilibrium among the variables, VEC model will be used. In order to figure out the impact of China' s exchange rate fluctuations on RMB exchange rate pass-through, we will use impulse and response function. Finally, conclusion based on the empirical analysis and policy suggestions will be provided in the last section.

This paper's innovation is reflected in two aspects: First, we incorporate exchange rate attention factor using Baidu Index into the model, which broadens the scope of the exchange rate pass-through research. Second, the data is relatively newer than previous studies.

Literature Review

In this section, we will review and summarize the studies on the impact of exchange rate movements and exchange rate attention on price levels.

The exchange rate pass-through related literature

The law of one price is a classical and earliest exchange rate pass-through theory. Cassel (1922) first proposed 'purchasing power parity'. He systematically explained the relationship between exchange rate and price, and made an empirical study on the theory of purchasing power parity. In a free competitive market, without transport fees and official trade barriers, the price using the same currency for a homogeneous commodity sold in different countries is equal. The function is presented as follows:

$$P=EP^{*[5]}$$

If absolute purchasing power parity is tenable, exchange rate movements will affect the domestic price change in the same proportion, that is, and transmission effect of exchange rate to price is 1. But these presumptions is very difficult to satisfied in reality: No transport costs, no official trade barriers and equal price index. Subsequently, economists put forward the relative purchasing power parity, that is, the main factor determining the fluctuation of exchange rate is the difference of inflation between two countries. Formulation is as follows:

$$e=p-p^{*[6]}$$

Compared to the purchasing power parity, the relative purchasing power parity does not require the commodity arbitrage without cost, but the arbitrage cost should remain unchanged. Considering various constraints and the adjustment of countries' trade policies in reality, this hypothesis is still difficult to satisfy. And more importantly, when collecting inflation data, the proportion of tradable commodities and non-tradable commodities between countries are different, which may cause the failure of purchasing power parity.

Based on purchasing power parity, Einzig(1935) believed depreciation can boost import price, and decrease export price. Therefore, domestic price level rises by currency's depreciation, and the rising competitiveness of export enterprises can lower other trading countries' price. If workers have real wage targets, price changes will lead to wage changes, which will further affect price level.

Thereafter, economists mainly used the macro open economic monetary model to research the exchange rate pass-through with the assumption of absolute or relative purchasing power parity. But the empirical tests to different countries showed that this assumption is not supported. Therefore, researchers tried using different models to explain the defect of purchasing power parity, like Giovannini(1988) used various data and empirical methods to test the applicability of the law of price, but the results all deviated from the law of one price due to exchange rate surprises, price staggering

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[5] P and P^* are general price level of domestic and foreign country, E is the exchange rate of two countries in direct foreign exchange quotation.

[6] e, p and p^* refer to logarithmic form of exchange rate, domestic price level and foreign price level.

and price discrimination. Factors that lead to the incomplete pass-through of the exchange rate were also analyzed, the main conclusions are as follows: the deviation of purchasing power parity from reality can be divided into two types: structural deviation and temporary deviation. The structural deviation is mainly from differences in labor productivity or differences in labor productivity change between the two countries(Balassa and Samuelson, 1964), supply shock, permanent terms of trade shock, preferences change of trade goods and non-tradable goods, trade policy change, etc. The factors that cause temporary deviation are trade cost, money shock, price and wage stickiness (Dornbusch, 1980). There are also lots of studies on exchange rate pass-through based on industry level data, focusing on industrial organization, market segmentation and price differentiation in different markets. Among them, the representative research is Pricing to Market (PTM) proposed by Krugman (1985). He thought the export enterprises would adjust product price markup according to the exchange rate, and restrained exchange rate's influence on price.

Later researchers focused on the incompleteness of exchange rate pass-through from a micro perspective, such as incomplete competition theory (Dornbusch, 1987), market segmentation theory(Dornbusch, 1987), Precipitation theory(Baldwin, 1988), theory of currency settlement selection, etc. Betts and Devereux (1996, 2000) established Local Currency Pricing (LCP) model, and concluded that the short-term exchange rate transmission effect is 0 under the short-term price stickiness. They assumed the import products are priced in local currency. Campa and Goldberg (2005) did the empirical research with quarterly data from 25 OECD countries. And confirmed that in short-term there was no complete exchange rate transmission among 22 countries, in the long run, only 9 countries had obviously incomplete exchange rate transmission, due to the price stickiness.

Through the above research, the microeconomic factors including the market structure and the manufacturer pricing strategy, and the macroeconomic factors including the domestic inflation environment and the stability of the monetary policy all have an impact on the exchange rate transmission.

Monetary policy and exchange rate pass-through

Many scholars focus on the exchange rate pass-through with the effectiveness of monetary policy. Parsley and Popper (1998) believe that monetary policy is an important factor to exchange rate pass-through. The results would be biased if the exchange rate pass-through model excluded monetary policy factor. Taylor (2000) established a theoretical model based on firm behavior, to study the relationship between exchange rate pass-through effect and inflation. He believed the decline of exchange rate transmission to CPI in many countries is due to the successful monetary policy.

Some research shows that exchange rate transmission is highly related with monetary policy and currency stability. The more stable a country's monetary policy is, the lower inflation rate and exchange rate transmission level. Under an unstable monetary policy, there is no nominal anchor for CPI, thus exchange rate change is more related with price level (Devereux & Engel, 2003).

Chinese Scholars' Research on exchange rate pass-through

Piao (2001) is the earliest scholar to research China's exchange rate pass-through and used a semi open economic model. Feng (2006) used recursive estimation in VAR model to analyzed RMB real effective exchange rate transmission effect to domestic consumer price and producer price. Chen and Liu (2007) analyzed exchange rate shock on import price and consumer price based on VAR and impulse response function. These researches mostly verified incomplete exchange rate pass-through in China, and the impact on import price is larger than domestic general price. There are also some researches on exchange rate pass-through influence factors. Ni and Cao (2009) found the exchange rate pass-through effect tended to decline, inflation rate, exchange rate fluctuation and real GDP can have remarkable impact on China's exchange rate pass-through. Cao (2010) introduced dummy variable and threshold model to test RMB exchange rate pass-through asymmetry in an early stage. They found the transmission effect had a downtrend. The depreciation had a higher transmission effect to import price, while the appreciation had a lower effect. Li and Peng (2014) constructed two phases dynamic models under incomplete competitive conditions, and concluded that exchange rate expectation could affect export demand and price by price effect and substitution effect. Hu and Wu (2015) used two-stage model to analyze the transmission of exchange rate on import price index with 2000-2013 monthly data, and found the transmission rate is around 0.3.

All in all, a large number of previous studies focused on the developed countries due to data availability, but less in developing countries, especially in China. Before 1990s, the fixed exchange rate system was adopted in China, and the enterprises were insensitive to the change in RMB exchange

rate. Therefore, the domestic scholars did not pay enough attention to the study of exchange rate transmission.

Exchange rate attention and exchange rate pass-through

All economic behaviors have their special subjective meaning. Therefore, in terms of exchange rate transmission, it is more effective to incorporate individual exchange rate attention into the analytical framework. But previous studies are relatively scarce.

Kahneman and Tversky(1973) inferred that attention is defined as the subjective acquisition of information input. The ability of individual attention can reflect the degree of information input and satisfy the people's need for information. Guo and Zhang (2009) used RMB NDF exchange rate as substitution variable to estimate exchange rate expectation. But NDF can not measure public's exchange rate attention. Zhang, Liao and Zhang (2014) measured investment attention using Baidu Index.

From the existing studies, although there are some literatures on the use of the Baidu index to measure the degree of attention, but the exchange rate attention analysis is relatively scarce. Therefore, this paper will use the data provided by the Baidu index to analyze the exchange rate attention factor. And we use Bandura's Reciprocal determinism theory as exchange rate attention factors' study framework. Reciprocal determinism is proposed by A.Bandura(1963). He believes that human behavior, individual factors, and environment are independent, interacting and mutually determining theoretical entities. Among them, individual factors include physiological response ability and cognitive ability of behavior subjects.

Exchange rate pass-though mechanism

According to Goldberg and Knetter(1997) and Rahimov(2017), the exchange rate can affect the price level directly and indirectly.
Direct transmission mechanism:
First, for the reason that the imported products are part of the price index, the price changes directly affect the price level. Ceteris paribus, when RMB exchange rate appreciates, the domestic price of imported commodities will decrease, which can lead to the decline of the consumer price index. On the contrary, the devaluation of the RMB can increases the domestic price of imported good. Then the consumer price index will rise.
Indirect transmission mechanism:
The indirect transmission mechanism of the exchange rate on consumer prices is more complex. It can affect the price by replacing imported products, impact on the cost of the import dependent enterprises, the psychological expectation of the consumers and nominal wage.
1) The imported substitutes mechanism
The exchange rate can affect consumer price indirectly by influencing the price of domestic import substitutes. When exchange rate appreciates, the price of import products will decline. Some consumers might replace similar domestic products to import products, which can reduce the demand of domestic products and decrease domestic consumer price.
2) Production cost mechanism
Exchange rate changes will have an impact on import intermediate inputs, like imported raw materials and equipment, which will affect producer costs. The appreciation of RMB can reduce the intermediate product price and consumer price. The degree of impact depends on the proportion of intermediate inputs in costs. If the proportion is relatively large, the impact of exchange rate changes will be relatively strong.
3) Psychological expectation mechanism
The exchange rate expectation can influence the exchange rate, when residents' expectation of currency trend changes, domestic price levels will be affected through current account and capital account. In current account, the exchange rate expectation includes consumer expectations and producer expectations. Consumers who expect RMB exchange rate will appreciate, will reduce their current consumption and price level; in terms of producers, when the domestic currency is expected to appreciate, which means that local currency value is undervalued, the export commodity will have the price advantage and competitiveness. Thus, the net demand of domestic products and the domestic price level will increase. In capital account, the undervaluation of exchange rate will form appreciation expectation in the market. If the appreciation expectation is strong, the short term capital will flow into domestic market. In order to maintain the stability of exchange rate, the central bank will intervene and increase the supply of base money, which will lead to an increase in the money supply in the market

and push up the price level.

4)   Money supply mechanism

The money supply mechanism mainly affects the domestic price level through money supply and foreign exchange revenue and expenditure. On the one hand, exchange rate changes have an impact on international trade. With the appreciation of exchange rate, the prices of export commodities will rise, the external demand will fall relatively, which will reduce the trade surplus. And the money supply of bank settlement will decline. On the other hand, exchange rate changes will affect the prices of assets, thereby affecting capital flows and foreign exchange balance of payments. When the exchange rate appreciates, the value of assets measured by the local currency is rising, which leads to the inflow of external capital. The central bank will carry out 'sterilization' and increase the money supply, which leads to the increase of the price level. This two mechanisms work in opposite directions, so the result is uncertain. More concretely, we need to see the relative impact of the two mechanisms.

5)   Nominal wage mechanism

When exchange rate appreciates, the nominal wage maintains unchanged. On the one hand, the real wage rises, in order to guarantee the profit, the manufacturers tend to reduce the nominal wage of the labor force. Further, the lower wage level will lead to a decline in the consumption level and price level. On the other hand, the rise in real wages will increase the purchasing power and increase the commodity demand, especially the demand for imported consumer goods. The inflow of imported commodities will reduce domestic prices.

Methodology

Model

VECM is a vector auto-regressive model applying co-integration constraints to all variables. Kim(1998) used co-integration and VECM to estimate exchange rate pass-through in the U.S.
In this paper, we assume that the economy is a system of four equations: a consumer price equation, a money supply equation, an exchange rate attention equation and an exchange rate equation, and we mainly focus on these equation using VECM:

$$Zt=(CPIt, M1t, EXt, BIt)$$

Where $CPIt$ refers to consumer price, $M1t$ refers to money supply, EXt refers to exchange rate and BIt refers to exchange rate attention.

Data

All the series was seasonally adjusted by EViews 8.0 Census X12.

Consumer Price Index: The CPI index published by National Bureau of Statistics of China. (2010=100).

Exchange rate: Since China's exchange rate reform in 2005, China started to have managed floating exchange rate system based on market supply and demand, referring to basket of currency. Therefore, bilateral exchange rate of China and U.S which has been widely used in previous studies is not able to represent China's exchange rate. Real effective exchange rate (REER) is trade-weighted, and it can reflect the fluctuation of China's exchange rate more efficiently. We choose monthly real effective exchange rate as the proxy variable (2010=100). And the data are given by the Bank for International Settlements.

Money Supply: Previous studies show that when there is an external shock interfere price stability by affecting exchange rate, the central bank can take corresponding measures to counteract adverse effects of exchange rate, thereby reduce the exchange rate pass-through effect. Therefore, our model also incorporate monetary related factor. In order to put monetary policy factor in the model, 'Money supply (M1)' is used as proxy variable. The data are given by National Bureau of Statistics of China.

Exchange rate attention: In this paper, we also included exchange rate attention into the model. The quality and quantity of information obtained from searching engine will affect consumers and producers' expectation and behavior. And exchange rate pass-through effect would be impacted. Moreover, the exchange rate market preform would attract more attention. Therefore, the exchange rate attention is highly related with exchange rate market. Baidu occupies an absolute position in the Chinese searching engine market and is very popular among individuals operators in China. Therefore, Baidu index can effectively depicts the degree of attention to the exchange rate by the domestic consumers and producers. It is based on the data of netizens in Baidu's search, and the weighted sum of the keywords search frequency in Baidu web search is analyzed and calculated.

These variables' graphical analyses are presented as follows:
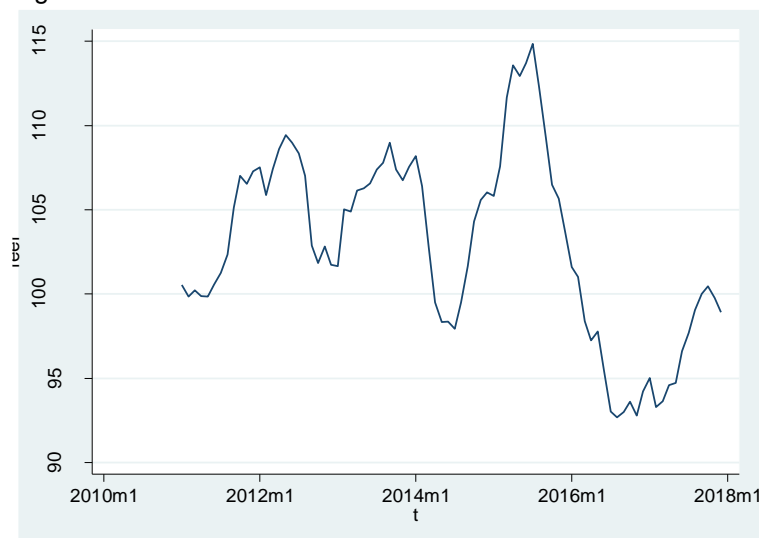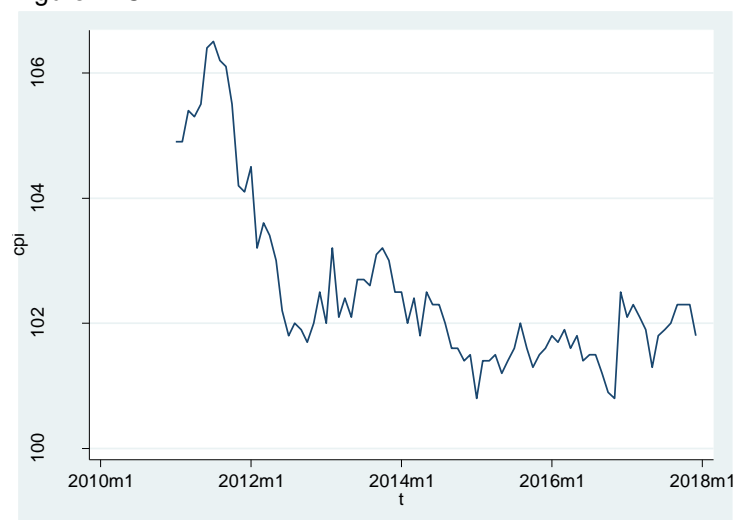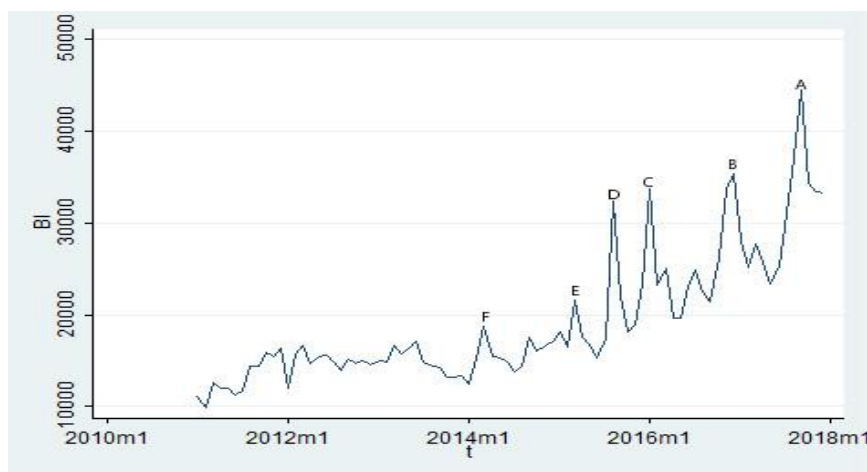
Figure 1 : REER

Figure 2: CPI

From Figure 1 and Figure 2 we can see, CPI increase peaked at 6.5 percent in 2011 then decreased a lot, while the real effective exchange rate also rose since RMB kept appreciating against US dollar. In 2012, RMB appreciation trend was weakened, at the same year, CPI had a mild rise. In 2013, although the new normal of China's economic development had formed, compared to the international zero interest rate and the slow recovery of the US economy, RMB began to appreciate, while CPI raised gently. Due to the exchange rate reform in 2014 and 2015, the exchange rate had two large inflection points, appreciation increased after March 2014, and began to decrease after August 2015. While CPI kept in a low level in 2014 and 2015. In 2016, the inflation rate is moderate, far below the 3% inflation goal set by the government, while RMB effective exchange rate kept depreciating, and the drop range is the largest. In 2017, RMB exchange rate appreciated, and CPI had a slight increase. From trend of the two variables, the correlation exists. Generally speaking, RMB exchange rate has a negative relationship with CPI. However, in a certain period of time, RMB exchange rate and CPI changed in the same direction, this phenomenon reflects the complexity and diversity of the interaction mechanism between exchange rate and CPI under the background of special macroeconomic operation in recent years.

Figure 3: Baidu Index for Exchange Rate:

As can be seen from the Figure 4, public attention to the exchange rate has being increasing rapidly. Several representative points are marked.

The point A is around August and September in 2017, the represented events are: RMB exchange rate has reached highest in one year; The rate of foreign exchange risk reserve was adjusted from 20% to 0. The reason for RMB appreciation is that the people's bank of China announced to use the anti-cyclical factor adjustment in May 2017. In order to keep down the appreciation, foreign exchange risk reserve is reduced.

The point B is around the end of 2016. The represented event is: The central bank: RMB exchange rate can keep stable at a reasonable and balanced level.

The point C is at the beginning of 2016. The represented events are: the central bank said: The RMB exchange rate formation mechanism will refer to a basket of currencies;

The point D is around in August 2015. At that time, the People's Bank of China announced that they would complete the intermediate price quotation for RMB exchange rate. Before the opening of foreign exchange market, the market makers refer to the closing exchange rate of yesterday's inter-bank foreign exchange market, considering the supply and demand of foreign exchange rate to offer the intermediate price quotations to the China foreign exchange trading center. This kind of policy change can increase the transparency of RMB intermediate price exchange rate quotation. At the same time, we can see the real effective exchange rate rapidly decreased in graph.

The point E is around in March 2015. The represented event is: The spot exchange rate of RMB against the US dollar is hovering near the "limit down" for three consecutive days; State Administration of foreign exchange announced to reform foreign exchange capital management for foreign invested enterprises, and implement willingness exchange settlement system.

The central bank announced to expand RMB exchange floating rate against U.S dollar around the point F. In that year, the RMB exchange rate began to appreciate from January to April.

From the line chart of exchange rate Baidu Index, we can infer that the exchange rate attention is highly related with exchange rate change. According to Bandura's Reciprocal determinism theory, human behavior interacts with individual factors and environment. As for this paper, we can consider exchange rate attention as a human behavior. The other two factors that influenced the exchange rate attention rate are as follows: First, policy introduction and time node are environment factors. When People's Bank of China changes the exchange rate policy or monetary policy, domestic producers and citizens search exchange rate related news to make their future decisions. Because a new policy can reveal the trend of exchange rate, and might also cause a sudden appreciation or depreciation of the currency. In addition, time node also plays a part, at the beginning and end of a year, companies usually need to make financial arrangements. At this time, they should forecast the trend of RMB exchange rate, especially import and export companies. Thus, the exchange rate attention usually tends to increase at the beginning and the end of a year. Second, consumers and producers' psychological factors are the individual factors. Specifically, consumers and producers' degree of risk aversion would affect exchange rate attention rate. In order to reduce or avoid exchange rate risk and maximize the interest, consumers and domestic producers would search the exchange rate news and decentralize exchange rate risks. When there is a sudden appreciation or depreciation, the concern on exchange rate could be increased.

In general, when there are some unexpected changes or uncertainty about exchange rate, people tend to concern about the currency value, which might influence the producer's behavior. Therefore, the exchange rate attention could be an intermediate factor in the exchange rate pass-through

mechanism.

Unit Root Test

First, the unit root test is performed to test the stationary of all variables. This part, we use augmented Dicky-Fuller(ADF) test and Phillip Perron(PP) test. The result shows that all the series are I(1).

Table 1

	Level		First Difference		
	ADF Test Statistic	PP Test Statistic	ADF Test Statistic	PP Test Statistic	
lnCPIsa	-1.631	-1.974	-11.258*	-11.422*	
lnm1sa	0.960	1.422	-11.947*	-11.859*	
lnreersa	-2.200	-1.966	-5.795*	-5.836*	
lnBIsa	-2.007	-1.499	-10.754*	-12.189*	

Note: * indicates significance at 1 percent level.

Co-integration Test

Then, to check the co-integration relationship, Johansen's cointegration test is employed. The eigenvalue trace tells null hypothesis is rejected, which means that the series has one co-integrated relationship. Therefore, VEC model can be used.

Table 2

Johansen tests for cointegration						
Trend: constant						
Sample: 2011m3 - 2017m12						
Maximum Rank	parms	LL	eigenvalue	Trace statistic	5% critical value	
0	20	921.10249	.	64.4028	47.21	
1	27	939.43703	0.36057	27.7337*	29.68	
2	32	947.38231	0.17617	11.8432	15.41	
3	35	953.05461	0.12921	0.4986	3.76	

Notes: the variables included in the regressions are: consumer price index, money supply, exchange rate attention and exchange rate. Significance level:*=1%.

And the vectors have one co-integration function:

$Incpisa=-0.328Inm1sa+0.141InBIsa-0.16Inreersa-1.165$
$\quad\quad\quad(-9.76)\quad\quad(-3.45)\quad\quad(6.53)$

As the co-integration function shows, CPI (Lncpisa) has negative correlations with real effective exchange rate(Lnreersa) and money supply(lnm1sa), while exchange rate attention(lnBIsa) is positive with CPI. The quantitative relations among variables can be seen from variable's coefficients. When real effective exchange rate rises by one percentage, CPI will increase 0.16 percentage point. And exchange rate attention's increase can lead CPI to rise by 0.14. But when M1 goes up by one percentage, CPI will decrease 0.328. As is known to all, M1 is a leading indicator of the price level, and it usually takes one quarter to one year ahead of the price level. Thus, the elasticity of M1 to CPI is likely to be negative during 2011 to 2017.
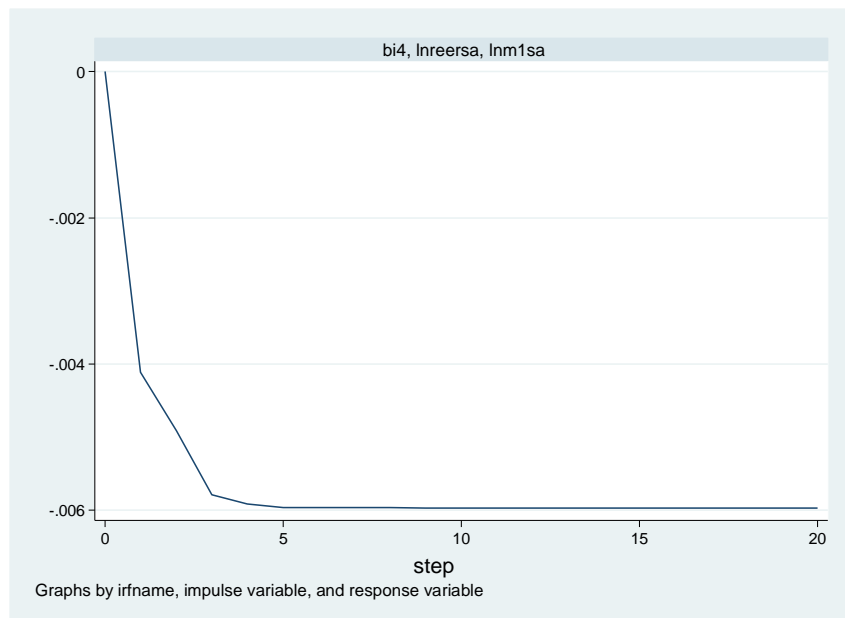
Impulse Response Function Analysis

Co-integration test only reflects the long-term relationship information among variables, but it cannot reflect the dynamic effect of one variable on another variable. The impulse response function reflects the impact on the current and future values of the endogenous variable after the positive impact of a standard difference size is applied to the random error term. The impulse responses

function graphs are reported below. The simulation contains 20 months, the horizontal axis represents the time periods after the impulse of a standard deviation. The vertical axis demonstrates the response range.

In order to figure out the short-term dynamic relations among the variables, positive impulses of exchange rate, exchange rate attention and M1 on variables are examined respectively, and the corresponding figures are as follows:

Figure 4: The impulse of real effective exchange rate to money supply（M1）

The impulse of M1 to CPI figure shows that the response of money supply to exchange rate shock is negative. And it decreased until the 5th period, then it remains around the level 0.006.

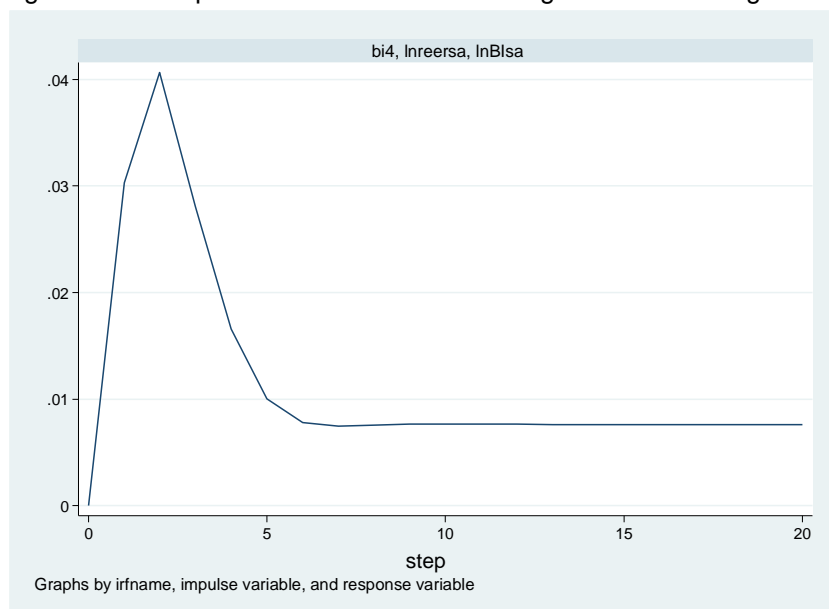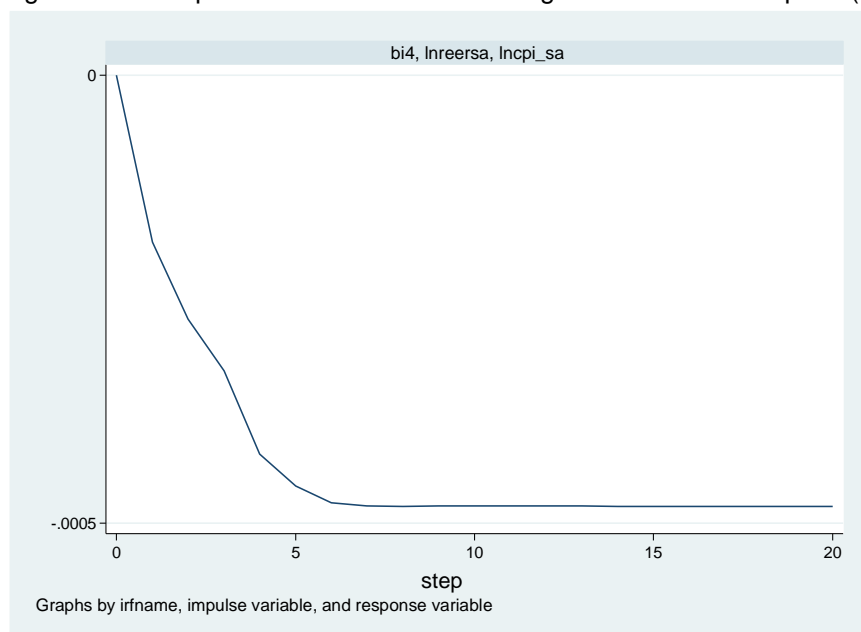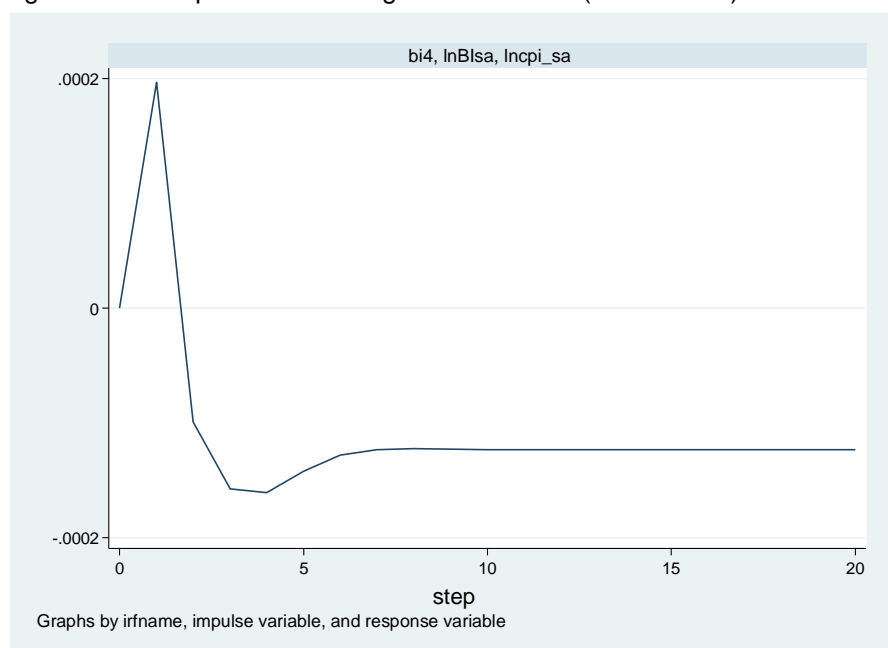Figure 5: The impulse of real effective exchange rate to exchange rate attention

Figure 5 presents that exchange rate attention is significantly positive affected by the impulse of the exchange rate, and reaches its maximum in 3rd period.

Figure 6: The impulse of real effective exchange rate to consumer price (CPI)

Graphs by irfname, impulse variable, and response variable

From Figure 6, the consumer price (lnCPIsa)response to the impact of exchange rate (lnreer) change is negative, which is consistent with the presupposition. When there is a exchange rate shock, the response of CPI is around zero at beginning, and decreases until the around sixth time period, then it levels off at approximate 0.0005.

Figure 7: The impulse of exchange rate attention (Baidu index) to consumer prices(CPI)：

Graphs by irfname, impulse variable, and response variable

From Figure 7, the exchange rate attention shock can have a positive impact in first two periods. And then decreases to -0.00017. The value is relatively low, which indicates the exchange rate attention's influence on CPI is slight in short-term.

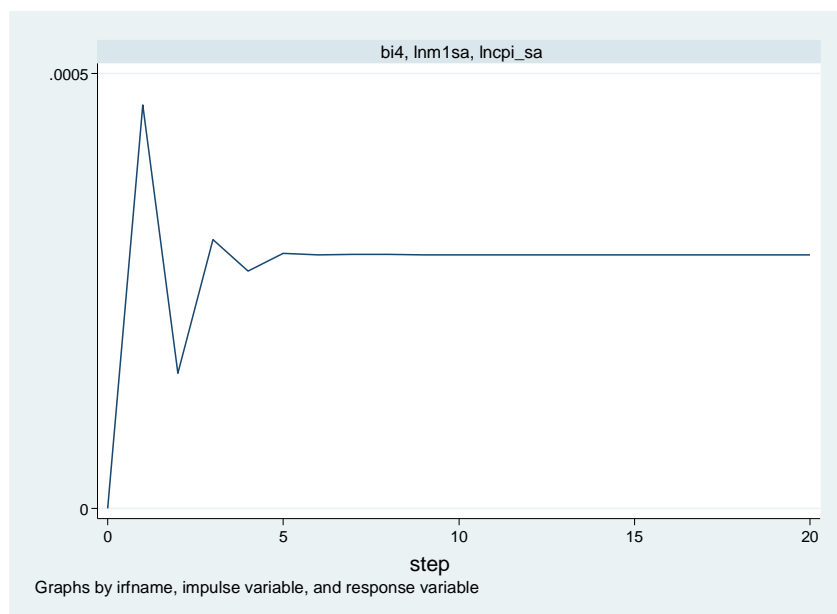Figure 8: The impulse of money supply(M1) to CPI:

bi4, lnm1sa, lncpi_sa

Graphs by irfname, impulse variable, and response variable

Figure 8 shows CPI increases after a standard deviation impact on M1. That is to say, in short-term, M1 has a positive effect on CPI.

Variance Decomposition:

While the impulse-response function demonstrates the response of an endogenous variable to other shocks, forecast error vector decomposition shows each shocks' importance by analyzing each variables' contribution to the other variables. Table 3 reports the results of CPI's vector decomposition.

Table 3

step	Impulse: lncpi_sa	Impulse: lnm1sa	Impulse: lnBlsa	Impulse: lnreersa
0	0	0	0	0
1	1	0	0	0
2	.982675	.012917	.002328	.002081
3	.983022	.010249	.002078	.00465
4	.979209	.011129	.002436	.007226
5	.975458	.01111	.002689	.010742
6	.972069	.011338	.002729	.013864
7	.969357	.01148	.002682	.016481
8	.967256	.011591	.002626	.018527
9	.965602	.011679	.002577	.020142
10	.964271	.011747	.00254	.021441
11	.963173	.011805	.002511	.022511
12	.962252	.011853	.002486	.02341
13	.961467	.011893	.002465	.024174

14	.960791	.011929	.002447	.024833
15	.960203	.011959	.002432	.025406
16	.959686	.011986	.002418	.02591
17	.95923	.01201	.002406	.026355
18	.958823	.012031	.002395	.026751
19	.958458	.01205	.002385	.027107
20	.958129	.012067	.002376	.027428

The forecast error of CPI mainly comes from its own variation. At the first period, the value for CPI is 100%, which means the variation of CPI all from its newly generated standard error, then its own contribution begins to fall slightly. M1's contribution raises gradually to 0.012 at 20th forecast period. Other factors, exchange rate has a relatively lower rate of contribution at beginning, and increased to 0.027in the 20th period. Exchange rate attention explains CPI least, and it reaches maximum in 9th period, then tends to decrease as forecast periods prolongs.

Summary

This section estimated a VEC model of exchange rate pass-through process, using from Jan 2011 to Dec 2017 monthly data. The following conclusions are obtained through empirical analyses:
1. The correlation between CPI and exchange rate is negative in both long-term and in short-term, but its impact on CPI is relatively weak. That is to say, RMB appreciation has a restraining effect on domestic inflation, and its effect can also be realized by affecting money supply and exchange rate attention.
2. In terms of exchange rate attention, its positive influence on CPI has short duration, and reduces from second period. In long-term, the exchange rate attention factor could raise the consumer price. The external information stimulation and individual psychological factors can increase attention rate, which might change the behavior of production and consumption. When exchange rate attention increases, it means exchange rate related environmental factors such as policy change and exchange rate fluctuations appear. From psychological perspective, the import and export enterprises might suffer more exchange rate risk due to exchange rate uncertainty. Dumas(1978) proposed that although the transaction risk of a firm is known, the overall risk of future exchange rate changes, macroeconomic effects and the corporate response function is uncertain. For instance, the enterprise has reached a foreign currency transaction, but the accounts have not been settled. Thus the exchange rate changes will affect the change in the cash flow calculated in the local currency. In order to minimize risks, the enterprises should take actions such as using financial instruments. In addition, false expectations to exchange rate fluctuation direction can also bring financial loss. Like in 2017, many enterprises judged RMB would continue to depreciate at the end of last year. According to this expectation, many companies made financial arrangements contrary to the real value trend of RMB in2017, which leads to profit loss. Therefore, at present, when the exchange rate attention rises, usually exchange rate change loss and financial instrument charges will increase some enterprises' cost. And CPI will accordingly increase by 0.1 percentage.
3. Monetary policy change has a greater impact on consumer price than exchange rate and exchange rate attention.

Policy Suggestions

1. With the expansion of RMB exchange rate fluctuation and the continuous development of financial market, the impact of factors on exchange rate pass-through effect will be more and more obvious. At the present stage, the exchange rate pass-through effect on consumer price is relatively small, which provides more space for the reform of the exchange rate system. People's Bank of China can choose a more flexible exchange rate system, and further improve the RMB exchange rate formation mechanism under the guidance of the principle of initiative, controllability and gradualism. In order to achieve the transformation of foreign exchange management from direct management to indirect regulation, the authorities also should speed up the process of RMB capital account convertibility, and gradually eliminate the control of direct investment and capital exchange under capital account. In addition, the exchange settlement system should be abolished and implement the willingness exchange settlement system, so as to make foreign exchange transactions more reflect the wishes of economic subjects.

2. Expectation management can improve the transparency and predictability of policies, and avoid excessive speculation. Since China's financial market is still not completely developed, the openness and accuracy of exchange rate related information need to be improved. Cognitive bias might bring economic loss. Like in 2017, many enterprises judged RMB would continue to depreciate at the end of last year, thus many companies made financial arrangements contrary to the real value trend of RMB this year. Such misjudgment can lead to considerable profit loss to enterprises. At present, the functions and objectives of People's Bank of China in maintaining financial stability are not clear enough, the communication frequency of financial stability is relatively low, and the attitude of communication is more conservative and prudent. Therefore, China's finance reform and exchange rate reform need to consider public expectation. The central bank should enhance communication with the public with the assessment of exchange rate market, and raise public confidence of preventing the financial risk.

3. As the increase of exchange rate fluctuation has become an inevitable trend, the import and export enterprises need to understand the status of foreign exchange transactions risks in real time and take measures to deal with them. For example, adding fluctuation-adjusted currency value in the contract. Enterprises should realize the importance of exchange rate risk management. For the small and medium import and export enterprises that do not have their own control departments, they should establish long-term cooperative relationships with the banks and use the specialized financial instruments such as deliverable forwards and non-deliverable forwards to control exchange rate risk and create conditions for the long-term and stable sustainable development of the enterprises.

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Asymmetric Effect of Monetary Policy Based on the Empirical Research of China's Strategic Emerging Industries

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Abstract

For getting rid of the international financial crisis, every country wants to seek the new growth points that will support the economic growth. At present, they have proposed to develop some emerging industries like new energy industries and low-carbon economy as an important means of coping with economic crisis and adjusting development strategies. In order to accelerate the strategic adjustment of the economic structure and enhance the coordination and competitiveness of economic development, China has introduced a series of policies and measures to promote the development of strategic emerging industries, which in turn to become a strong support for industrial growth. In the future, the strategic emerging industries will represent the direction of economic development and become an important driver of economic growth. This paper establishes the VAR models to analyze three issues: the effectiveness of monetary policy in strategic emerging industries, asymmetric effect between strategic emerging industries and traditional industries, asymmetric effect within strategic emerging industries. We find the crowding out effect of monetary policy and screening function of fiscal policy in strategic emerging industries. In addition, there is a significant asymmetric effect between strategic emerging industries and traditional ones. And priced monetary policy is more effective than quantitative policy inside the strategic emerging industries. This article fills the gaps in the research of strategic emerging industries. It also creatively analyzes the impact of monetary policy on strategic emerging industries and the asymmetry effect of this impact in all directions. The research results can provide a strong theoretical support for the central bank to formulate relevant monetary policies for supporting strategic emerging industries.

1. Introduction

According to the economic data released by National Bureau of Statistics of China in Jan 2018, China's national GDP in 2017 exceeded 80 trillion Yuan for the first time, reaching 82.7122 trillion Yuan. In terms of economic growth, China's GDP grew by 6.9% year-on-year in 2017, which was 0.2 percentage points higher than the one in 2016. Moreover, the growth rate for the first time picked up since 2011. Among them, we should note that the industrial added value of strategic emerging industries accounts for the proportion of GDP has steadily risen. Fei Zhirong, deputy secretary general of the National Development and Reform Commission, pointed out in the "2017 Strategic Emerging Industry Development Summit Forum" that China's strategic emerging industries were an important support for the comprehensive transformation and upgrading of traditional industries. During the "12th Five-Year Plan" period, strategic emerging industries have achieved Rapid growth and their industrial added value are expected to account for 15% of GDP by 2020. Strategic emerging industries will become a breakthrough point in China's economic restructuring. It will not only play a stimulating role in economic investment, but also will become a significant engine for China's economic growth in the future with the development of scale. How to support the development of strategic emerging industries better so that it will gradually become the leading force in China's economic and social development is the key issue need to be solved nowadays.

Currently there is no unified academic definition of strategic emerging industries. Mike Porter (1980) defines emerging industries as newly established or reshaped industries. These industries have the opportunities to start because of technological innovations, changes in relative cost structures or new customer needs, etc. From " the Decision of the State Council on Accelerating the Cultivation and Development of Strategic Emerging Industries", Chinese strategic emerging industries are mainly divided into seven major industries: energy saving and environmental protection(ESEP), new generation of information technology(NIT), bio-industry(BIO), high-end equipment manufacturing(HEM), new energy sources(NE), new materials(NM) and new energy vehicles(NEV).

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On this basis, Zhou Jing and He Jinyi (2011), Lv Yanwei and Sun Hui (2013) conduct a more systematic and scientific statistical classification of strategic emerging industries from a statistical perspective, which enabling us to collect detailed data from various industries and analyze it. Scholars pay more attention to study strategic emerging industries from the perspective of fiscal policy. Li Miaomiao et al. (2014) conduct empirical analysis of strategic emerging industries from three aspects of fiscal policy, R&D expenditure and technological innovation capabilities. And draw a conclusion that the government should Set a proper threshold of fiscal policy, which can make it has a positive effect. Liu Jiaqing (2011) and Wang Yuxi et al. (2013) verified the importance and positive role of the fiscal policy to strategic emerging industries based on the data of Gansu and Inner Mongolia. However, there are few studies focusing on the effect of monetary policy in strategic emerging industries. This paper can make up for this vacancy in this respect.

With regard to the effectiveness of monetary policy, that is to say, the impact on the industry, many scholars have conducted some researches. Friedman and Meiselman (1963) first use measurement methods of time series to examine the effects of monetary and fiscal policies on nominal output. Sims (1972) studies the effect of monetary policy from the output dimension. Liu Bin (2001) reveals the different effect of China's monetary policy impact on the real economy in different time dimensions. Feng Sixian(2006) prove that the actual interest rate gradually becomes an effective medium in China. Yan Li et al. (2009) use the VAR model to analyze the effectiveness of China's monetary policy and empirically demonstrate that the price effect of money supply is more significant than the output effect. Qi Yingfei (2013) collects China's 30 industrial double-digit industry data to establish a SVAR model analyzing the micro-conduction mechanism of monetary policy.

The micro-subjects of industries in real word cannot have homogeneity, and there are obvious heterogeneities among some industries. Therefore, the impact of monetary policy will not only affect the adjustment of demand in different industries, but also affect the supply capacity of each industry. Improving the efficiency of monetary policy and formulating more targeted policies by the monetary authorities require us to study the various effect of monetary policy between different industries. Bernanke and Gertler (1995) study the industrial effect of the monetary policy from credit transmission channels and prove the impact of monetary policy on durable consumer goods and non-durable consumer goods is significantly different. Ganley and Salmon (1997) use error correction model to compare 9 Industries response to the impact of monetary policy in the UK and find out that the construction industry responded most, followed by manufacturing, services, and agriculture. Hayo and Uhlenbrock (2000) collect monthly data from 1978 to 1994 in Germany to build the VAR model. Then they study the response of 28 sub-sectors in the German manufacturing industries to monetary policy and find that heavy industries response to interest rates much greater than clothing and food industries. Dedola and Lippi (2005) conduct empirical research based on 21 manufacturing sectors in Germany, Italy, France, the United Kingdom, and the United States. And they find that different industries have different responses to monetary policies. Among these industries, the automotive industry reacts most to interest rate shocks while the reaction of food manufacturing industry is minimal. Lucio and Izquierdo (1999), Arno ld and Vrugt (2002), Ibrahim (2005), Alam and Waheed (2006) conduct studies in Spain, the Netherlands, Malaysia, and Pakistan, respectively, and also find the evidence of asymmetric effects in the monetary policy industry.

In this paper, we establish a VAR model with quarterly data of the supply of money (M2), gross value of industrial output (GDP_i), benchmark loan interest rate (R), public finance expenditure (FP) and the output of strategic emerging industries (SEI) to verify the effectiveness of monetary policy in China's strategic emerging industries first. Besides, analyze the asymmetric effect between traditional industries and strategic emerging industries. Last but not the least, we study the asymmetric effect among the seven industries of strategic emerging industries from different perspectives. It is the first time that has study of the monetary policy on the strategic emerging industries. It provides theoretical basis for formulating effective monetary policy to support the development of strategic emerging industries. The result of this research can not only play a guiding role in the future development of China's strategic emerging industries, but also provide some references to other countries that are in economic transition around the world.

2. Vector Autoregressive Model

The Vector Autoregressive Model (VAR) was first put forward by CA. Sims in 1980. The autoregressive model uses multivariate simultaneous equations to make regression on the lag items of endogenous variables, which is not based on economic theory. And it can reflect the dynamic relationship of endogenous variables. There is no need to specify which variables are endogenous or exogenous. All variables are endogenous. The VAR model allows the value of a variable to depend on

its own lags and the lags of other variables. Model offers a rich structure, which may be able to capture more characteristics of the data. Besides, forecasts generated by VAR are often better than conventional structural models.

However, in practical application, the model can completely reflects all the dynamic relationship information if the lag phase is large enough. But it has a serious drawback in that if the lag phase is larger, the parameters to be estimated will become more and then the degree of freedom will decrease. Therefore, it is necessary to find equilibrium between the degree of freedom and the lag phase.

This paper builds a VAR model to analyze the relationship between money supply, interest rate, public finance expenditure, gross value of industrial output and the output of various industries. The specific expressions are shown below:

$$Y_{i,t} = \alpha_i + \sum_{p=1}^{k} A_i Y_{t-p} + \varepsilon_{i,t} \quad （1）$$

Where $Y_{i,t}$ is a vector of endogenous variables, α_i is constants in the model, A_i is a coefficient

vector, $\varepsilon_{i,t}$ is white noise.

3. Empirical studies

3.1 Variable Selection and Data Source

The sample interval selected for this paper is quarterly data from January 2004 to September 2015. All the original data are from the website of China National Bureau of Statistics, "China Statistics Yearbook on High technology Industry" and Wind database.

According to the previous literature, they believe the fiscal policy has great impact on the output of strategic emerging industries. Therefore, we choose the public finance expenditure to represent the fiscal policy in the model. In order to further analyze whether the monetary policy can influence the output of strategic emerging industries. This paper choose the money supply M2 represents the quantitative monetary policy, and the benchmark interest rate for RMB loan represents the priced monetary policy to comprehensively reflect the impact of monetary policy on strategic emerging industries. As for total output, we choose Gross value of industrial output to represent.

For verifying the asymmetric effect of monetary policy between traditional industries and strategic emerging industries, we select ten different traditional industries according to the ease of data acquisition and industrial characteristics. The chosen traditional industries are shown as followed: food manufacturing, liquor, beverage and tea manufacturing (LBT), tobacco industry, textiles, clothing industry, petroleum and natural gas extraction (PNGE), chemical materials, paper industry, furniture manufacturing, general equipment manufacturing (GEM).

The strategic emerging industries classified statistically by Zhou Jing and He Jinyi (2011) and "Guidance Catalog of Key Products and Services for Strategic Emerging Industries"(2016) published by the National Development and Reform Commission as seven main industries. They are energy saving and environmental protection(ESEP), new generation of information technology(NIT), bio-industry(BIO), high-end equipment manufacturing(HEM), new energy sources(NE), new materials(NM) and new energy vehicles(NEV). The data of output is collected by the main business income of every detailed industry.

Then the whole data mentioned above make seasonal adjustment by X-11 method. Besides, we apply natural logarithm to all data for better eliminating the problem of heteroscedasticity. All of the econometric work in this paper is using Eviews 8.0 software.
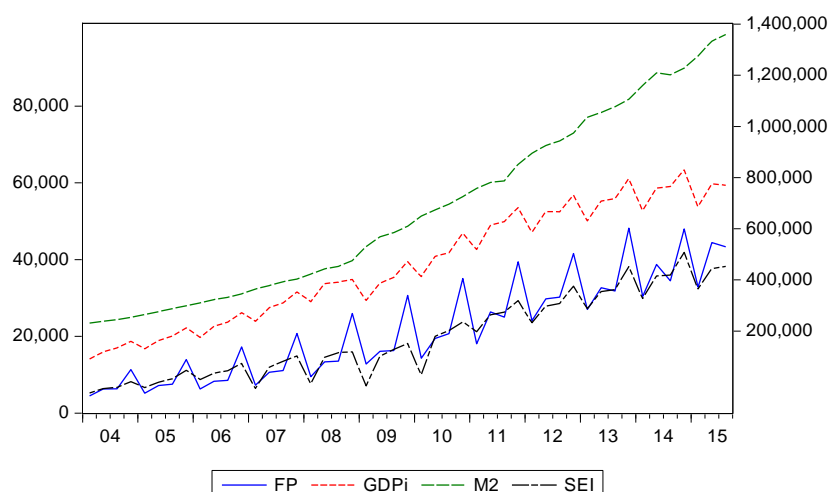
Figure 1. Increasing Trend of Variables

Source: the Wind database

Figure 1 shows that the amount of money supply, public finance expenditure, Gross value of industrial output and output of strategic emerging industries grows steady from 2004 to 2010. After the government formally proposed the concept of strategic emerging industries and gave them strong support in 2010. The four variables show a same rapid growth trend afterwards.

Since the financial crisis in 2008, China's broad money supply M2 has risen sharply to 127.5 trillion Yuan at the end of 2015, Average year-on-year growth of 9.87%. At the same time, the public finance expenditure has also increased from 8.96 trillion in 2010 to 17.6 trillion in 2015. Gross value of industrial output reaches 68.9 trillion Yuan in 2015 while the output of strategic emerging industries is 14.4 trillion Yuan in 2014.

3.2 The Effectiveness of Monetary Policy

In order to study the asymmetric effect of monetary policy in China's strategic emerging industries, we must study the effectiveness of monetary policy in strategic emerging industries first. Only if we understand whether monetary policy has a significant impact on strategic emerging industries, how it affects, and how the emerging strategic industry reacts, then we can better study their asymmetric effects. We build a VAR model to verify its effectiveness as below:

Unit Root Test

Before estimating the VAR model, it is necessary to test the stability of the time series to prevent spurious regression. There are some methods to test it such as the Dickey-Fuller test (DF test), the extended Dickey-Fuller test (ADF test) and the Phillips-Perron test (PP test). The DF test is applicable to test time series of first-order autoregression without time trend, while the ADF test is applied to the test of higher-order regression time series. Moreover, the PP test does not introduce lag items in the test model. This paper uses the ADF test method to test the stationarity characteristics of each time series variable. All data has been made seasonal adjustment and natural logarithm processing. Then we correct the non-stationary series by the first-order difference so that they can become stationary series. The result is shown in Table 1.

Table 1. ADF Test Results

Variables	ADF statistic	P-value	Stationarity result
GDP_i	-4.426	0.0052	Stationary
FP	-9.209	0.0000	Stationary
M2	-5.507	0.0002	Stationary
R	-4.856	0.0015	Stationary
SEI	-8.886	0.0000	Stationary

Note: the ADF statistic is at the 1% significance level

No original time series are stable. But after the first-order difference they become stable at the 1% significance level shown in Table 1. Therefore, the differential sequence of variables satisfies the stationarity assumption. We can establish a VAR model based on these data.

Johansen Cointegration Test

In the time series analysis, the time series traditionally required to be stable. However, the time series in the real economy are usually non-stationary. We can differentiate them to make them stable. Meanwhile, it will lose the long-term information, which is necessary to analyze the problem. The cointegration test can solve this problem well. In order to test whether there is a long-term and stable equilibrium relationship between non-stationary sequences, we choose the Johansen cointegration test to test the time series in this paper. The results of the test are shown in Table 2.

Table 2. Johansen Cointegration Test Results

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	P-value **
None *	0.816	203.107	69.819	0.0000
At most 1 *	0.709	126.906	47.856	0.0000
At most 2 *	0.571	71.359	29.797	0.0000
At most 3 *	0.418	33.269	15.495	0.0000
At most 4 *	0.180	8.940	3.841	0.0028

Note: *denote rejection of the hypothesis at the 5% level **Mac Kinnon-Haug-Micheils (1999) p-values

It can be seen from Table 2 that GDP_i、M2、FP、SEI and R have at least 5 cointegration relationships, which means these time series have long-term equilibrium.

The Stationarity Test of VAR System

Before establishing a VAR model, it is significant to estimate the lag order. We can easily tell by the Eviews that the optimal lag order of sequential modified LR test statistic, Akaike information criterion and Schwarz information criterion is 2, while Hannan-Quinn information criterion is 1. On the basis of the majority principle, this paper builds the vector autoregressive model with a lag order 2.

In addition, whether the eigenvalues are in the unit circle can determine the impulse response analysis is valid or not. All the eigenvalues of a stationary VAR system should be less than one. And the result is shown below:
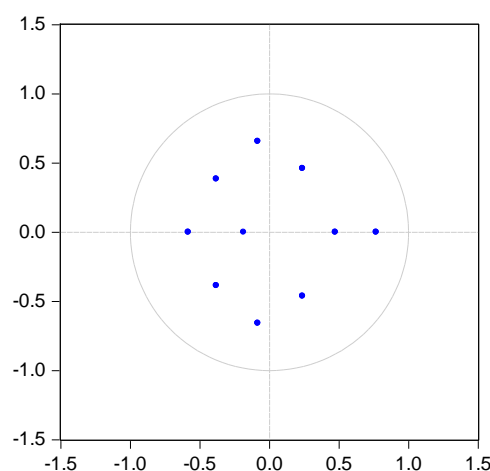
Inverse Roots of AR Characteristic Polynomial

Figure 2.Result of VAR System Stationarity Test

According to Figure 2, all the eigenvalues are in the unit circle, which means the VAR system we established is stationary. Then we can analyze the response of variables to the impact by impulse response.

Granger Causality Test

It is necessary to analyze the impact of past monetary policy on the output of strategic emerging industries when we build the VAR model. For studying the dynamic effects among various variables, we need to conduct Granger causality test on each variable of the VAR model. The test results are as follows:

Table 3. Granger Causality Test Results

Null hypothesis	F-Statistic	P-value

SEI does not Granger Cause FP	1.474	0.2315
FP does not Granger Cause SEI	4.821	0.0337
SEI does not Granger Cause M2	0.715	0.4027
M2 does not Granger Cause SEI	3.471	0.0695
SEI does not Granger Cause R	0.027	0.8713
R does not Granger Cause SEI	11.673	0.0014
SEI does not Granger Cause GDP_i	1.239	0.2721
GDP_i does not Granger Cause SEI	4.197	0.0468

The results of granger causality test in Table 3 illustrate that FP, M2, R and GDP_i granger cause SEI at a significance level of 10%. It can explain that past monetary policy, fiscal policy and Gross value of industrial output have a long-term effect on the output of strategic emerging industries.

Impulse Response Analysis

We can see the analysis of granger causality test that money supply, interest rate, public finance expenditure and Gross value of industrial output are the factors that affect the output of strategic emerging industries. The impulse response graph can reflect the dynamic relationship between them directly. In this paper, we give a positive impact of a Cholesky standard deviation on money supply, interest rate, public finance expenditure and Gross value of industrial output, respectively. Then observing how the output of strategic emerging industries responds to them within 10 quarters. The results are shown in Figure 3:

(1)The first graph in Figure 3 shows that the output of strategic emerging industries responses to the positive changes in public finance expenditure. As many studies have shown, fiscal policy will stimulate strategic emerging industries in the short term. After a positive impact on public finance expenditure, the output of strategic emerging industries will have a slight increase immediately. Because fiscal policy has no clear target at the beginning, so the support is for the entire industry. However, there is a substantial reduction of 4% with it, and it is not restored the positive impact until the third period. Through market screening, some products with high-energy consumption or without great market competitiveness will be eliminated by the market discipline, which causes this reduction in output. In the next period, the enterprises left behind by market screening have stronger competitiveness than before. At this time, the fiscal policy will have a clearer target to support and this will cause the increase of output. After that, this process will be repeated until the entire market has stabilized. We consider this phenomenon as a screening function of Fiscal policy in supporting strategic emerging industries. The cumulative response of the strategic emerging industry to the impact of fiscal policy is 1.1%.
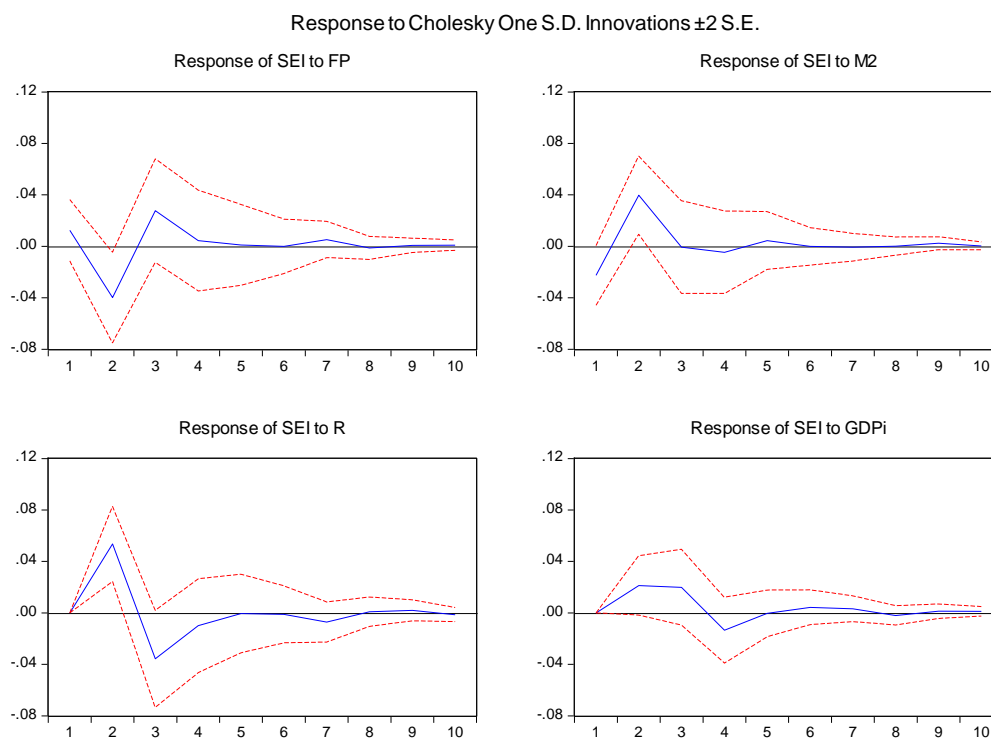
Response to Cholesky One S.D. Innovations ±2 S.E.

Figure 3. Impulse Response Analysis Results

(2)From the impulse response of strategic emerging industries responses to the money supply, we can see that the output of strategic emerging industries shows a significant negative growth when giving a positive impact on the money supply at the beginning. Monetary policy will cause 'Crowding out Effect' while money supply has a positive impact. When the money supply increases, it becomes easier for traditional industries to obtain funds, which will stimulate investment in traditional industries and increase their output. Relatively speaking, strategic emerging industries receive little investment, which will shortly cause the traditional industries to have ' Crowding out Effect ' on strategic emerging industries. However, we assume that the demand of domestic market is constant then the increase of output will cause the market to oversupply. Emerging strategic industries manufacture mostly high-tech products with subsidies from fiscal policies so that the price of them is relatively stable. Compared with traditional industry, the output of strategic emerging industries will greatly improve. Just like in the second graph, it reaches a peak at 4% in the second period and stabilizes afterwards. The total cumulative response is about 1.8%.

(3)As can be seen from the third graph, the impulse response of strategic emerging industries output to the impact of interest rate. There is no response at the first place, but it peaks a high point at 5.4% in the second period. As we all know, there is a lag in the regulation of the macro-economy by the central bank through interest rates, which is not as quick as the fiscal policy. Therefore, the first quarter will have no impact on the output of strategic emerging industries when interest rate increases. As time passes, the effects of priced monetary policies will begin to work. As the increase in interest rate leads to a credit crunch with decreasing loans, followed by reduction of investment and consumption, and then prices will fall. As mentioned above, strategic emerging industries mostly manufacture high-tech products, so investment and consumption are stable. Compared to traditional industries, the output of strategic emerging industries will increase. Then it quickly drops to the bottom at -3.6% and reaches a plateau to the end with the total cumulative response of 0.5%. Because the price declines, imports are restrained to a certain extent, exports are promoted, which will attract international capital inflows, thereby increasing the demand for local currency and the supply of foreign exchange. This will lead to the development of traditional industries, which will cause the crowding out effect similar to the one in the second graph. And then the output will be stabilized.

(4)The last graph represents the gross value of industrial output has impact on the output of strategic emerging industries. It does not response until the second period and increase during the second and third period. It is well understood that the increase in the gross value of industrial output indicates that the economic environment is relatively good, which can stimulate the development of various industrial sectors including strategic emerging industries. Then it declines at -1.3% and levels off to the end. The reasons of this situation are manifold. The impulse response is used for analyzing the dynamic reflection of the strategic emerging industries' output under the impact of a single factor.

Therefore, the disorderly development of the industry will not be regulated by monetary policy and fiscal policy. Ultimately, it leads to a decline in the output of the entire industry. The total cumulative response is approximately 3.5%.

Variance Decomposition of Strategic Emerging Industries

It is clear from the granger causality test and impulse response analysis that money supply, interest rate, public finance expenditure and gross value of industrial output have a positive effect on the output of strategic emerging industries. In other words, the increase in the output of strategic emerging industries is the result of the four factors mentioned above. We can explain which variable is most effective by variance decomposition method to analyze the contribution of each variable to changes in output.
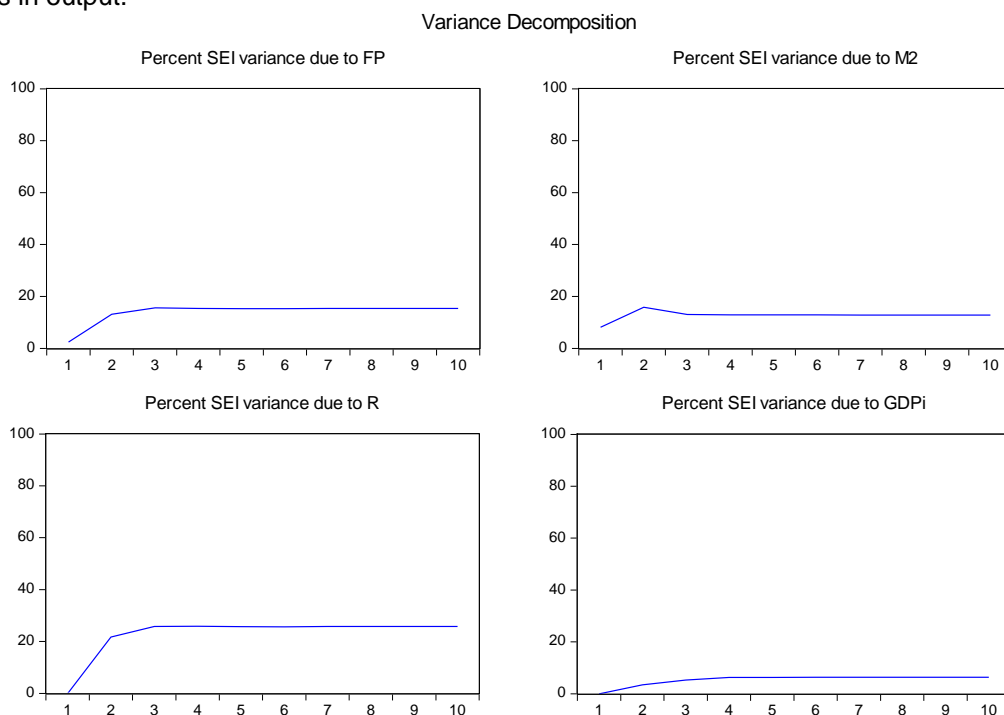

Figure 4. Variance Decomposition of SEI

The above graphs in Figure 4 illustrate that the impact on the output is phased. At the first period, only money supply and public finance expenditure can affect the output. M2 has the largest impact on the output (8.10%) while FP accounts for 2.46%. It can be seen that money supply can affect the output of strategic emerging industries quick but its effect is widespread. In the initial period, the fiscal policy responds as fast and great as money supply to strategic emerging industries but it is more precise than monetary policy. What is more, fiscal policy is the key for supporting the industry to develop from zero. After the second period, interest rate R provides the greatest contribution of 25.79% to the increase of output. Other variables M2, FP and GDPi occupies 12.83%, 15.33% and 6.40%, respectively. After the initial period of starting a business, if fiscal policy still strongly supports the industry by financial subsidies, there will be a series of problems, such as reducing the enthusiasm of enterprises for production and damaging the competitiveness of products, etc. Therefore, supported industries should be exposed to the market at an appropriate time and grew under the discipline of the market so that they could finally survive in this harsh market environment.

3.3 Asymmetric Effect between Traditional Industries and Strategic Emerging Industries

This paper selects ten different traditional industries by their industrial characteristics to analyze the different impact of monetary policy from the strategic emerging industries. They are food manufacturing, liquor, beverage and tea manufacturing (LBT), tobacco industry, Textiles, clothing industry, Petroleum and Natural Gas Extraction (PNGE), chemical materials, paper industry, furniture manufacturing, general equipment manufacturing (GEM).

Every traditional industry will do the same process in section 3.2. We figure out all series variables are stationary by the first-order difference. Then we can tell the relationship among the output of these traditional industries and money supply, interest rate, public finance expenditure, Gross value of industrial output by the Granger Causality Test, which results are shown below:

Table 4. Granger Causality Test Results

Variables	FP	M2	R	GDPi
Food	Strong	Strong	Strong	Strong
LBT	Strong	Strong	Strong	Weak
Tobacco	Weak	Strong	Strong	Weak
Textile	Strong	Weak	Strong	Strong
Clothing	Strong	Strong	Weak	Weak
PNGE	Weak	Weak	Strong	Strong
Chemicals	Strong	Strong	Strong	Strong
Paper	Strong	Weak	Strong	Strong
Furniture	Strong	Strong	Strong	Strong
GEM	Strong	Weak	Strong	Strong
SEI	Strong	Strong	Strong	Strong

Note: strong denote rejection of the hypothesis at the 10% level

As we can see from the Table 4, public finance expenditure can hardly affect the tobacco industry, Petroleum and Natural Gas Extraction. It makes sense in the real world, Tobacco and Petroleum and Natural Gas Extraction industry are the important source of public finance. Thus, they will not only receive no subsidies from fiscal policy, but also need to pay a higher tax burden to subsidize other industries. This just coincided with recent Chinese policy of accelerating industrial marketization to eliminate a group of high-energy and high-pollution enterprises through market competition rules.

The money supply has little impact on the textile, petroleum and natural gas extraction, paper industry and general equipment manufacturing while the interest rate can influence most of traditional industries except clothing industry. The textile industry is an industry with high labor-intensive and great dependence on foreign countries in China. China is the world's largest producer and exporter. In 2017, the export value of Chinese textile industry reached 268.6 billion dollars. The sustained and stable growth of textile exports guaranteed China's foreign exchange reserves, balance of international payments, stability of the exchange rate and social employment. Due to the close relationship between interest rates and exchange rates, the textile industry is more affected by interest rates than money supply. In 2017, the foreign natural gas occupied 39% in China while the oil import was even higher as 72.3% of Chinese market. Therefore, the impact of interest rates can be imagined. With the rapid development of the Internet economy, express delivery industry develops at an unimaginable rate that causes the increasing demand for paper products at the same time. Because of the heavy dependence on imports of raw materials and equipment, China's paper industry is affected significantly by interest rates. For the general equipment manufacturing industry, the global market is mainly dominated by Germany, the United States, and Japan. In addition to some individual sub-sectors, China's general equipment manufacturing industry has a low degree of industry concentration and relies highly on Imports. Products differ little in the industry. Thu, the impact of interest rates is even greater than money supply. In general, interest rates have a broader influence than money supply in traditional industries. We will discuss the detailed impact of monetary policy later.

Gross value of industrial output has no influence on the liquor, beverage and tea manufacturing, tobacco industry and clothing industry.

Then we give a positive impact of a Cholesky standard deviation on interest rate. After that, we can see the contribution and intension of interest rate to the changes in the output of industries throng the variance decomposition and impact cumulative value in Figure 5. Impact cumulative value is calculated the changes in output by the impulse response with 10 periods.

Variance Decomposition
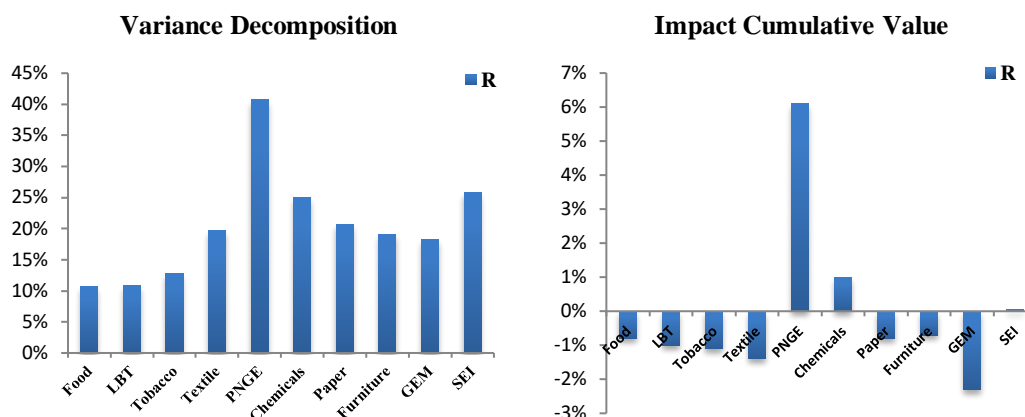
Impact Cumulative Value

Figure 5. Interest Rate Results

It is clear in variance decomposition results of Figure 5 that interest rate has the greatest impact contribution on Petroleum and Natural Gas Extraction industry (40.73%) followed by strategic emerging industry (25.79%). The smallest industry (Food) accounts for at least 10%. As for impact cumulative value, only PNGE, chemicals and SEI can increases the output when the interest rate rose. Though the impact cumulative value of strategic emerging industries is quite small, the impact is positive after all. For other industries, the increase of interest rate reduces their investment, which will lead to a drop in output. The rise in interest rates to some extent suppresses imports, while most of the petroleum and Natural Gas, chemical materials products rely on imports. Because when imports reduced, it will provide more room for domestic products and increase the output of this industry. When this stimulation effect is greater than the one of investment reduction, it will show an increase in overall output. It is the same for strategic emerging industries.

Moreover, we can analyze the impact contribution and intension of money supply on the industrial output by the variance decomposition and impact cumulative value. The results can be seen in Figure 6.

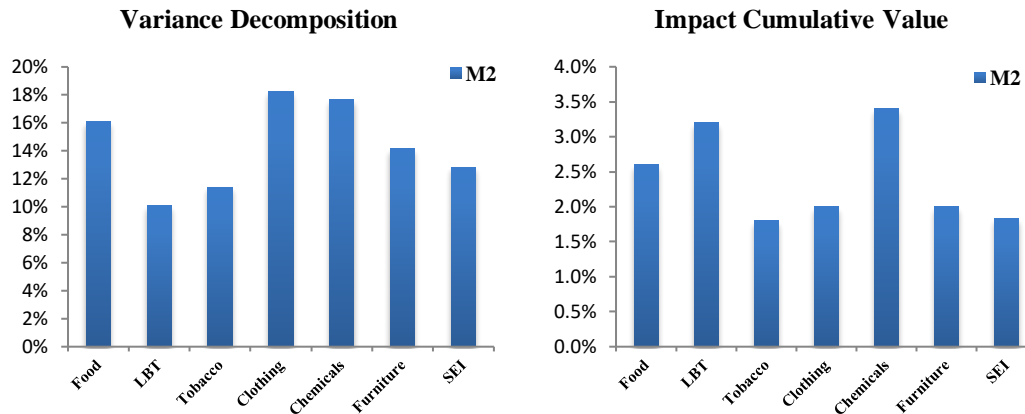**Variance Decomposition**

Impact Cumulative Value

Figure 6. Money Supply Results

As we can see from Figure 6, the variance decomposition of money supply is almost the same from 10% to 18% while impact cumulative value in liquor, beverage and tea manufacturing and chemical materials industry are larger than other industries. An increase in the money supply will bring more investment to the market, which raises the output of industries. There is crowding out effect of money supply in strategic emerging industries, though it has a positive effect overall.

By collating and analyzing the sensitivity coefficients in each industrial equation, we can intuitively find out the amount of change in the total output varies with one unit change of money supply or interest rate. Based on this, we can conclude that the sensitive level of industry to the priced and quantitative monetary policies.

Table 5. Sensitivity Coefficient

Variables	M2	R
Food	1.692	0.308

LBT	1.584	0.513
Tobacco	1.184	0.240
Textile	Null	0.419
Clothing	2.369	Null
PNGE	Null	1.581
Chemicals	1.966	0.798
Paper	Null	0.542
Furniture	1.781	0.564
GEM	Null	0.299
SEI	1.341	0.699

The sensitivity coefficients in Table 5 illustrates that the coefficient of money supply in strategic emerging industries is less than the overall average (1.702). However, the coefficient of interest rate in strategic emerging industries is greater than the overall average (0.596). The remaining coefficients can also be a good proof for the explanation above again.

3.4 Asymmetric Effect within Strategic Emerging Industries

We collect the data of seven industries of strategic emerging industries. They are energy saving and environmental protection(ESEP), new generation of information technology(NIT), bio-industry(BIO), high-end equipment manufacturing(HEM), new energy sources(NE), new materials(NM) and new energy vehicles(NEV).

Every industry will do the same process in section 3.2. We figure out all series variables are stationary by the first-order difference. Then we can easily tell the granger causality from Table 6.

Table 6. Granger Causality Test Results

Variables	FP	M2	R	GDPi
HEM	Strong	Strong	Strong	Strong
ESEP	Strong	Strong	Strong	Strong
BIO	Strong	Strong	Strong	Weak
NM	Strong	Weak	Strong	Strong
NE	Strong	Weak	Strong	Weak
NEV	Strong	Weak	Weak	Strong
NIT	Strong	Strong	Strong	Strong

Note: strong denote rejection of the hypothesis at the 10% level

From Table 6 we can see that only fiscal policy and gross value of industrial output can influence the new energy vehicles industry. New energy vehicles have become the general trend for the development of the global automotive industry. The United States, Europe and Japan are strongly promoting the development of new energy vehicles. China's new energy vehicle industry is leading the world in capital investment and market volume. After reviewing by China's Ministry of Industry and Information Technology, it was finally confirmed that the subsidy funds for new energy vehicle companies is about 18.892 billion Yuan in total from 2016 to 2017. As an emerging industry, all countries have provided huge subsidies for the new energy vehicle industry, hoping that they can occupy more in the future market competition. Therefore, this industry is currently dominated by fiscal policy, and the impact of monetary policy is relatively small on it. Besides, interest rate is more effective than money supply in new energy and new material industry. New energy generally refers to energy that has not yet been used on a large scale and is being actively researched and developed, including solar energy, wind energy, modern biomass energy, geothermal energy, ocean energy, and hydrogen energy, etc. For example, in the solar photovoltaic industry, more than 95% of solar cell manufacturers' production in China is used for export, and they rely heavily on the European market, which reflecting in another aspect that the industry is more affected by interest rates. As for new materials industry, they are widely used in various fields such as information, energy, transportation, and medical care, etc. They are the basis and precursor for the development of other high-tech and emerging industries. Although the government supports strongly and the industries develop rapidly, there are still many deficiencies and many high-end materials need imports. For example, the output of iron and steel in China ranks in the forefront of the world. However, high-quality standards steel is less than 20%, and we still need to import more than 10 million tons of high-quality steel every year. The output of cement

production of China ranks first in the world, but high-grade cement only accounts for 17% of total production. Furthermore, high performance general polymer materials and engineering plastics have a large gap with foreign countries and currently need to be imported in large quantities. So the interest rate also has great impact on this industry. Finally, bio-industry and new energy cannot be affected by Gross value of industrial output.

Combine the granger causality test results with variance decomposition results, we can see which monetary policy will have more impact within the strategic emerging industries.
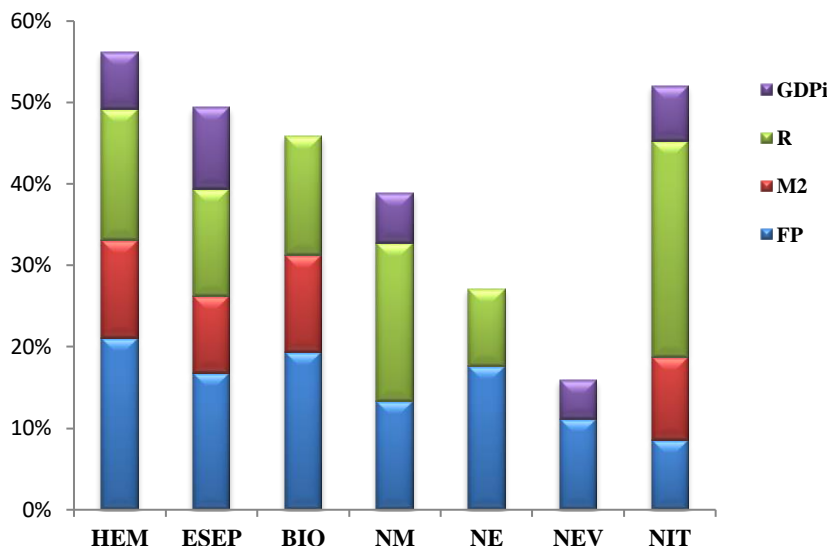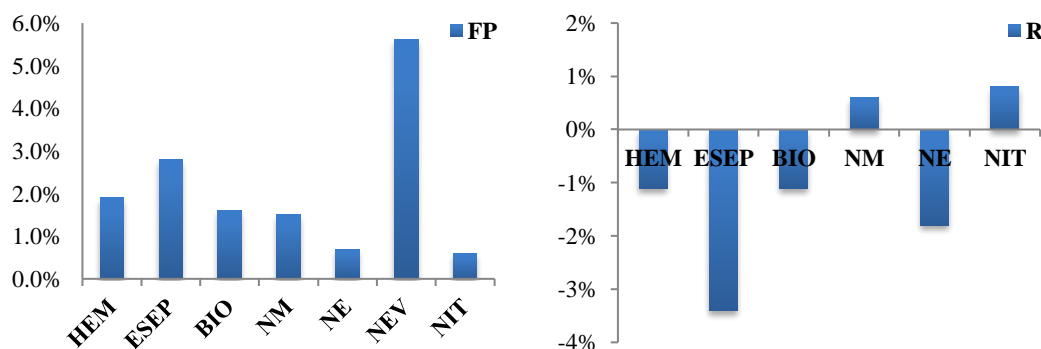

Figure 7. Variance Decomposition Results

As can be seen from Figure 7, fiscal policy has general impact on the whole strategic emerging industries from 8% to 21%. And interest rate makes the largest contribution to the change in new generation of information technology industry (26.54%) while money supply plays a significant role in high-end equipment manufacturing industry (12.01%). To some extent, priced monetary policy is more effective than quantitative monetary policy within the strategic emerging industries.

We can study the total influence of a positive shock from the money supply, interest rate, public finance expenditure, Gross value of industrial output on the strategic emerging industries within 10 periods through impact cumulative value. The results show in Figure 8.

The Figure 8 illustrates that fiscal policy affects the new energy vehicle most without any doubt. Besides, money supply and fiscal policy can significantly affect the output of energy saving and environmental protection industry. It can be seen that energy saving and environmental protection industry mainly affect by the domestic market. Meanwhile interest rate has negative impact on most of industry except new material and new generation of information technology industry. The increase in interest rates will bring about two kinds of shocks. On the one hand, it will reduce investment, which will cause decline in the output of enterprises. On the other hand, it will restrain imports meanwhile stimulate exports, providing domestic companies with greater room for survival and increasing output at the same time. For Gross value of industrial output, the new energy vehicles industry takes the first place.
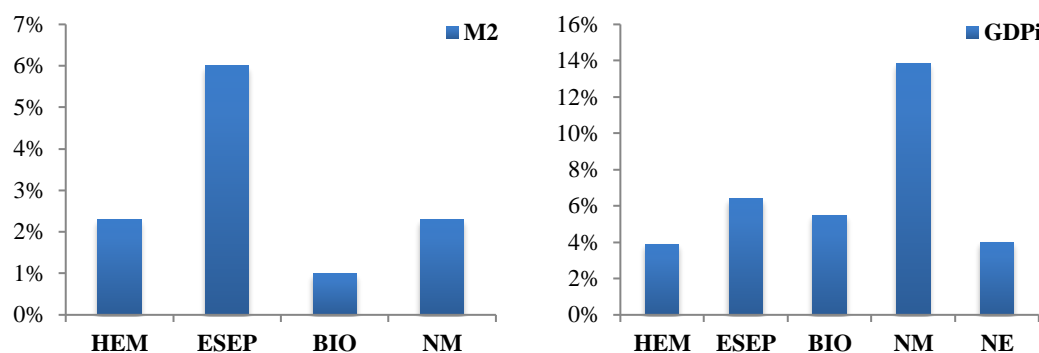
Figure 8. Impact Cumulative Value

In addition, sensitivity coefficient is another important indicator to reflect the impact of monetary policy, fiscal policy and gross value of industrial output within the strategic emerging industries.

Table 7. Sensitivity Coefficient

Variables	FP	M2	R	GDPi
HEM	-0.895	1.439	0.432	1.798
ESEP	-0.985	2.346	0.196	3.392
BIO	-0.743	1.187	0.382	Null
NM	-1.368	Null	1.041	3.104
NE	-0.973	Null	0.343	Null
NEV	0.233	Null	Null	5.003
NIT	-0.601	1.086	0.713	2.171

As is shown in the Table 7, the sensitivity coefficients of money supply is much larger than the ones of interest rate. The largest coefficient of money supply is in energy saving and environmental protection industry (2.346) while the one of interest rate is 1.041 from new material industry. And the sensitivity coefficients of fiscal policy is mostly negative except new energy vehicle. This just proves that the fiscal policy has a positive effect on the nascent development of the industry, but the long-term support will reduce the enthusiasm of the enterprise and the competitiveness of the products, which will adversely affect the development of the enterprise.

Conclusion

In this paper, we conduct the VAR model to analyze three significant aspects: the effectiveness of monetary policy in strategic emerging industries, asymmetric effect between traditional industries and strategic emerging industries, asymmetric effect within strategic emerging industries. In the strategic emerging industries, money supply, interest rate, public finance expenditure and Gross value of industrial output all have impact on them. However, their influence and contribution to the changes are quite different. We can draw conclusions as follow:

(1) Fiscal policy has a screening function for the strategic emerging industries. It will help the whole industries to eliminate high-energy-consuming enterprises and leave enterprises and products that are truly competitive in the market. At the same time, it can provide effective targets for financial subsidies.

(2) There is a crowding out effect of monetary policy for strategic emerging industries. No matter money supply or interest rate, it will affect the domestic market and traditional industries, which will cause some reaction to the output of strategic emerging industries. Taking advantage of this feature can effectively help the development of strategic emerging industries

(3) Among traditional industries, the interest rate is becoming a more effective medium than money supply in China. There are nine traditional industries can be affected by interest rate while only six industries can from money supply aspects. Moreover, from contribution to the changes of output, interest rate mostly occupies 20% and money supply normally takes 10%.

(4) Within the strategic emerging industries, industries are more responsive to interest rate instead of money supply. It is quite different from the traditional industries, the impact cumulative value and variance decomposition of money supply and interest rate are nearly same within the strategic

emerging industries. But they differ significantly in the sensitivity coefficients.

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Whether the Hong Kong RMB Offshore Market Has Brought Cross-border Speculative Funds?

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Abstract

Since the RMB settlement in cross-border trade was allowed in July 2009, Hong Kong offshore RMB market has formed the foundation of cross-border arbitrage of speculative funds, which leads to threats to China. This paper firstly accurately estimates the amount of speculative funds from Hong Kong RMB offshore market and then expands Interest Rate Parity(IRP). By using ARDL-ECM model to test the data from 2009-2015,we find that RMB interest rate differences, RMB spot price differences, the return rate of stock market and the amount of cross-border RMB trade settlement are the significant factors affecting foreign speculative funds.Accordingly,from the perspective of Hong Kong RMB offshore market, the paper specifically   suggests related recommendations.

Introduction

Since the cross-border RMB trade settlement pilot in July 2009, cross-border RMB transactions tend to be more convenient and cross-border speculative funds flow into China through various channels. It is noticeable that there is large-scale arbitrage between the offshore market in Hong Kong and the Chinese mainland onshore market. The frequent transactions of cross-border funds bring huge cross-border capital flows, which have a great impact on the operation of the real economy and the stability of the macro economy. Therefore, it is of great theoretical and practical significance to explore the impact of offshore RMB market on Chinese cross-border speculative funds in Hong Kong from the qualitative and quantitative respectively. In addition, this has an important guiding role for public consumers and investors to make cross-border investment decisions.

The Model

Domestic and foreign scholars basically agree that the basic theory that influences cross-border speculative capital flows is Interest Rate Parity and arbitrage models are based on this basis. The theory of Interest Rate Parity believes that the difference in interest rates determines the exchange rate. In order to achieve higher returns, cross-border speculative funds flow from countries with lower interest rates to countries with higher interest rates, resulting in depreciation expectations of the latter's exchange rate. However, IRP requires that there is no obstacle to capital flow and the unlimited margin capital scale does not hold true in real economic life. Therefore, a large number of scholars expand the model on this basis. The Mundell-Fleming model considers that the flow of funds is incomplete, the supply of arbitrage funds is limited , the exchange rate is expected to be static and the interest rate at home and abroad can only lead to limited cross-border financial flows. It is assumed that the arbitrage is a risk aversion, and the precondition for holding the risk assets is to obtain a certain extra risk compensation P. The equation of the free rate parity can be expressed as Equation (1):

$$r_d = r_f + \triangle E^e + P \qquad\qquad (1)$$

Among them, r_d is the domestic interest rate, r_f is the foreign interest rate, and $\triangle E^e$ represents static exchange rate expectations. It can be seen that the flow of cross-border speculative funds is mainly affected by the difference of interest rate between different countries, the change of expected exchange rate, and the linkage between interest rate and exchange rate.From Equation (1),it can be seen that the cross-border flow of the speculative funds is mainly affected by interest rate differences between different countries, the change of expected exchange rate, and the linkage between interest rate and exchange rate.For example, in countries with capital controls, cross-border speculative capital

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inflows are only likely to occur when assets denominated in the currency of the importing country provide a risk reward sufficient to compensate for possible transaction costs.

However, the above model does not explain China's cross-border speculative capital inflow and its motivation very well. There are three main reasons. First, China's financial market is not perfect enough, the free interest rate has not yet been fully realized, spot and forward foreign exchange market is not perfect. Second, considering the institutional costs (such as foreign exchange controls, capital controls and differential tax rates), the transaction costs in China are not small enough to be negligible. Third, the economic transition period of some form of trade, such as false trade, the use of capital controls a loophole in the implementation of the domestic and foreign exchange, etc.) also provides a special arbitrage mechanism for cross-border speculative inflows. It can be seen that cross-border speculation is not only due to the large-scale inflow of arbitrage, which is expected from both domestic and foreign interests and the expectation of RMB appreciation, but also the additional benefits of stock market investment income, real estate price difference and so on. In order to better illustrate the impact of Hong KONG RMB offshore market on cross-border speculative capital, we must take fully into account the particularity of China's economic transition period and combine the development of Hong KONG RMB offshore market, expand the expansion model of interest rate parity. A multi-arbitrage model based on interest rate, exchange rate, stock market, cross-border trade settlement and balance of RMB deposits in Hong Kong is constructed. In this paper, the cross-border speculative fund function C=f (DIR, NIR, EE, SR, T, SA) is expressed as a multiple arbitrage model shown in Equation (2):

$$C_t=\alpha_0+\alpha_1 DIR_t+\alpha_2 NIR_t+\alpha_3 EE_t+\alpha_4 SR_t+\alpha_5 T_t+\alpha_6 SA_t+\varepsilon_t \qquad （2）$$
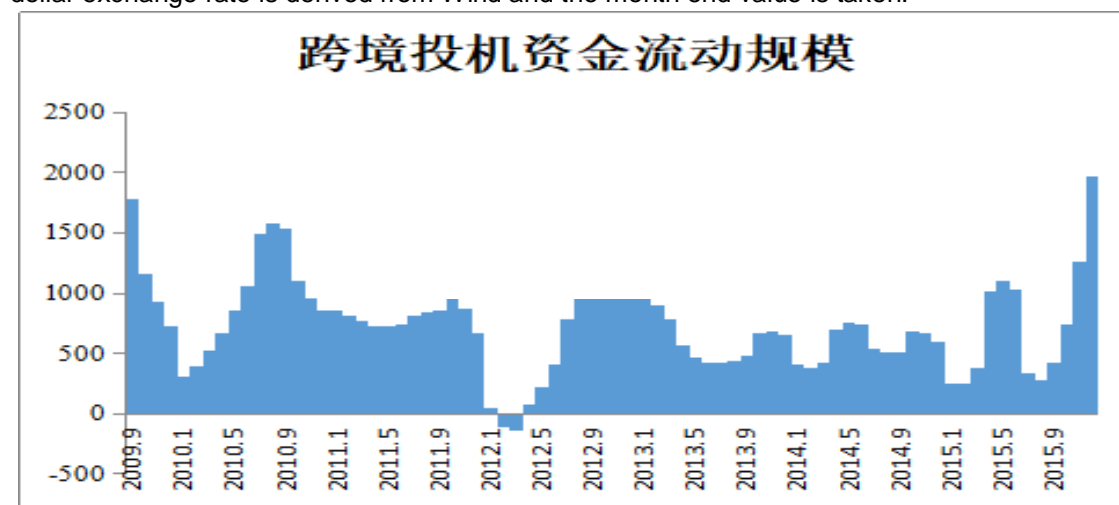
Considering the availability and adequacy of sample data, the sample interval of this empirical study is from September 2009 to December 2015. The data sources and descriptions are as follows.

Cross-border speculative capital flows (C). Referred to Liu Liya (2008) research, we calculate the size of cross-border speculative funds as follows. Cross-border speculative funds = excess trade surplus +excess frequent transfer +errors and omissions. To estimate the scale of cross-border speculative funds in trade surplus and current transfer, we take the moving average of the two indicators as the standard[3]. The deviation from the moving average of the two indexes is considered as speculative capital. The calculation results are shown in Figure 1.

The interest rate difference(DIR). One-year SHIBOR and HIBOR present the domestic and Hong Kong interest rates, respectively. Interest rate difference can be expressed as: DIR=SHIBOR/HIBOR. SHIBOR data come from the Shanghai interbank offered rate official website. The HIBOR data come from the financial data monthly report published on the official website of the Hong Kong Monetary Authority(HKMA).

RMB spot price difference(NIR). CNY divided by CNH indicates the difference in the spot price of RMB, namely NIR=CNY/CNH.CNY data are obtained from the official website of the State Administration of Foreign Exchange (SAFE) and CNH comes from the HKMA website.

The change in expected RMB exchange rate(EE). Dollar/RMB NDF (one-year) implies the change of the expected value of RMB exchange rate. It is converted into RMB against the dollar exchange rate, namely, the ratio of RMB NDF to the nominal exchange rate of RMB in the same period. One-year dollar exchange rate is derived from Wind and the month end value is taken.

跨境投机资金流动规模

3 In this paper, December 2004 and 2002 are taken as the dividing points of trade surplus and current transfer item respectively.

Figure 1. The monthly scale of cross-border speculative funds in China (Unit: billion yuan)
Data source: the author calculates according to the balance of payments.

Stock market return on investment(SR). The return rate of Shanghai Composite Index is chosen as the representative, and the calculation formula is $SR_t=SP_t/SP_{t-1}$, in which SP is the stock price index. The original data of Shanghai Composite Index come from CSRC's official website. Take the monthly value at the end of the month.

RMB cross-border trade settlement (T) and Hong Kong's RMB deposit balance (SA). Take the monthly data from the HKMA website.

Empirical Test

In order to analyze the impact of Hong Kong RMB offshore market on China's cross-border speculative flows, the multiple arbitrage model is established. Using the data between September 2009 and December 2015, ARDL-ECM model and boundary test, we prove the existence of the influence.

First, ADF unit root test is carried out and the results are shown in table 1.

Table 1　Unit root test table of ADF

Variable	ADF	Test form	Prob.	Variable	ADF	Test form	Prob.
S	-2.4132	(C,0,4)	0.1418	△S	-5.7189*	(C,0,2)	0.0000
DIR	-2.8883***	(C,0,3)	0.0517	△DIR			
NIR	-0.9993	(0,0,0)	0.2824	△NIR	-7.5519*	(C,0,0)	0.0000
EE	-3.9878**	(C,T,0)	0.0131	△EE			
SR	-6.6403*	(C,0,0)	0.0000	△SR			
LN	-6.8138*	(C,T,0)	0.0000	△LN			
SA	-3.9473*	(C,0,0)	0.0028	△SA			

Note: *** **, *** reject the original hypothesis at the significance level of 1%, 5% and 10% respectively.

There are both stationary series and first-order variables in a sequence of single whole sequence, and the long-term co-integration relationship between variables require Pesaran margin cointegration test and error of autoregressive distributed lag ARDL model - the ECM. According to equation (2), the corresponding conditional error correction model ECM is Equation (3) :

$$\triangle S_t=\alpha_0+\alpha_1 T+a_k\sum_{k=1}^{p-1}\triangle S_{t-k}+b_k\sum_{k=0}^{p-1}\triangle DIR_{t-k}+d_k\sum_{k=0}^{p-1}\triangle NIR_{t-k}+e_k\sum_{k=0}^{p-1}\triangle EE_{t-k}+f_k\sum_{k=0}^{p-1}\triangle SR_{t-k}+$$

$$g_k\sum_{k=0}^{p-1}\triangle LN_{t-k}+h_k\sum_{k=0}^{p-1}\triangle SA_{t-k}+\lambda_1 S_{t-1}+\lambda_2 DIR_{t-1}+\lambda_3 NIR_{t-1}+\lambda_4 EE_{t-1}+\lambda_5 SR_{t-1}+\lambda_6 LN_{t-1}+\lambda_7 SA_{t-1}+\mu_t \qquad （3）$$

According to the values of AIC and SBC, first order and fourth-order sequences, the results are shown in table 2.According to AIC criterion and SBC criterion, the optimal lag order is 2. The trend term and no trend of margin in both cases test F statistics are 5.65 and 6.264. They rejected the level meaning that there is no long-term co-integration relationship between variables of the original hypothesis 4.This suggests that there are long-term relationships between cross-border speculative funds (S), interest rate difference (DIR), yuan spot price difference (NIR), the expected rate of RMB exchange rate (EE), stock market investment yields (SR), cross-border yuan trade settlement amount (LN) and the Hong Kong RMB deposit balance (SA).

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[4] see margin test F statistic threshold Pesaran etc. (2001)

Table 2　lagged order number selection and sequence correlation LM statistics

Lag order	Non-trend term				Trend term			
P	AIC	SBC	$\chi^2(1)$	$\chi^2(4)$	AIC	SBC	$\chi^2(1)$	$\chi^2(4)$
1	-490.5143	-514.7070	3.3313	12.7789**	-489.5470	-514.8917	3.0769**	12.2418**
2	-478.9848	-511.0512	0.0138	18.4278*	-479.2217	-512.4333	0.0206	20.4162*
3	-475.4509	-515.2925	7.6852*	14.8935*	-476.1205	-517.1005	10.3419*	18.2400*
4	-458.3693	-505.8855	1.5067	27.3444*	-459.1260	-507.7736	2.0565	31.7824*
5	-450.1928	-505.2810	6.1314**	32.4345*	-449.2459	-505.4583	8.1436*	36.6923*
6	-397.8435	-460.3984	5.6733**	37.2717*	-398.6539	-462.3259	5.9826**	36.4298*

Note: $\chi2(1)$、$\chi2(4)$ are the statistics related to first order sequence and fourth-order sequence;"*, **, *** respectively represents the original hypothesis that the sequence is not relevant at the significance level of 1%, 5% and 10%.

According to the AIC,SBC information criterion and the relevant diagnostic criteria, the estimation equation was simplified to eliminate the unsignificant order. The final ARDL model (2,0,0,0,0,2,0) was selected, as shown in Table 3.

Table 3　Long-term co-integration equation estimation of ARDL model

Information criterion	AIC	AIC	SBC	SBC
Order	(2,0,0,0,0,0,1)	(2,0,0,0,0,2,0)	(2,0,0,0,0,0,0)	(2,0,0,0,0,0,0)
T		42.5637** (1.9412)		31.6767 (1.1713)
α_0	−21543.0* (−3.1469)	−28826.9* (−3.8383)	−23010.8* (−2.8875)	−20730.7** (-2.5036)
DIR	7.7874 (0.1082)	17.9675 (0.1594)	5.2466 (0.0634)	144.0078 (0.9553)
NIR	24071.9* (3.1946)	31062.1* (3.7899)	25204.2* (2.8862)	22230.4** (2.4331)
EE	20898.6** (2.3543)	9917.4 (1.4200)	16192.1** (1.7822)	13304.0 (1.4148)
SR	1765.9*** (1.8543)	2192.2** (2.4243)	2211.6** (2.0127)	1896.2 (1.6478)
LN	−0.11301 (−0.8937)	−0. 64398* (−2.9899)	−0. 1456 (−1.0076)	−0.15772 (−1. 0365)
SA	0.1468 (1.0923)	0.30891 (1.4513)	0.19344 (1.2681)	−0.040753 (−0.1623)

Note :(1) the ARDL order is determined according to AIC and SBC information criterion;(2) the T statistic of the corresponding coefficient is in brackets."*, **, ***" stands at 1%, 5% and 10% respectively.

Based on this, the long-term co-integration equation of the cross-border speculative capital model is Equation (4):
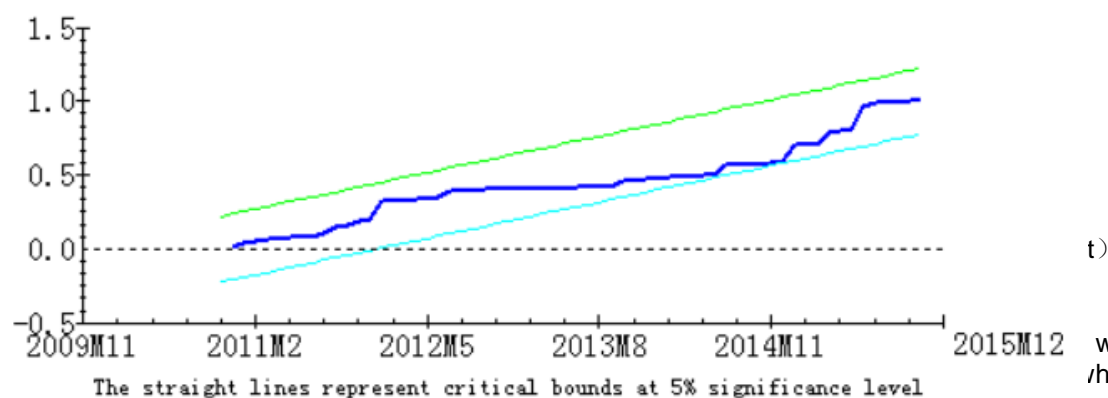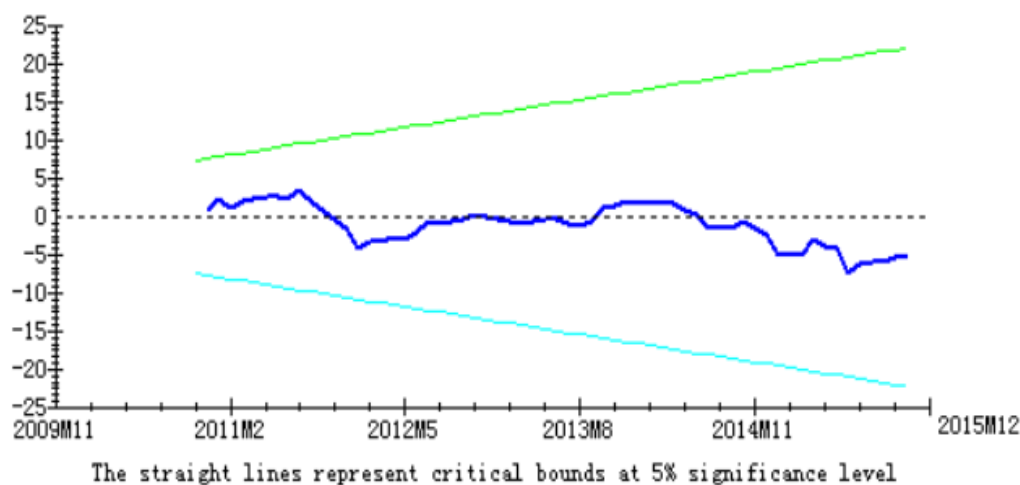
$$S=-28826.90+42.56T+17.97DIR+31062.10NIR+9917.40EE+2192.20SR-0.64LN+0.31SA \quad (4)$$

The Error correction model is shown in Equation (5). ECM represents the Error correction term and the T statistic are in brackets.

$$\triangle S=-9759.70+14.41T-0.34ECM(-1)+0.53\triangle S(-1) +6.08\triangle DIR+10516.40\triangle NIR+$$
$$(-3.90^*) \quad (2.13) \quad (-5.01^*) \quad (5.83) \quad (0.16) \quad (3.76)$$
$$3357.60\triangle EE+742.18\triangle SR-0.08\triangle LN+0.09\triangle LN(-1)+0.10\triangle SA$$
$$(1.58) \quad (2.50) \quad (-1.94) \quad (2.83) \quad (2.22) \quad （5）$$

In the Error correction model, ECM (1) = 0.33856, which indicates that the valuation is reasonable. At the level of 1% significance, there is no sequence correlation of order 1 and order 4 of the model. In general, the model setting is basically appropriate. To verify the ultimate reliability of the model setting, we use CUSUM test and CUSUMSQ test on the stability of the parameters of the model structure. The

results show that the model parameter estimation is stable and reliable at the 5% significant level as shown in Figure 2,3.

The straight lines represent critical bounds at 5% significance level

The straight lines represent critical bounds at 5% significance level

estimates of DIR are not significant.LN is negatively correlated with cross-border speculative capital flows, and its coefficient is very significant. SA is negatively correlated with cross-border speculative capital flows, but its coefficient estimate is significant at 15% level. From the estimation results of ECM, the cross-border speculative capital flows and the RMB cross-border trade settlement series have a significant lag effect on the cross-border speculative capital flows. Among them, the cross-border speculative capital flows have a weak positive hysteresis effect and the RMB cross-border trade settlement has both negative hysteresis effect and positive hysteresis effects, but both effects are very small.

The empirical results show that in the long run, the interest rate difference is positively correlated with the cross-border speculative funds, but the effect is not significant enough due to capital control. In the long and short term, the RMB spot price difference is a significant factor affecting China's cross-border speculative flows, and the widening of the RMB spot price difference will attract more cross-border speculative funds. The expected strengthening of RMB will bring increasing cross-border speculative inflows, although the effect is not significant enough currently. Both the long-term and short-term investment returns in the stock market are the significant factors affecting the cross-border speculative funds which is the same as the theoretical expectation. In the long run, the increase in Hong Kong's cross-border RMB trade settlement has led to the decline in cross-border speculative capital flows, but the direction is uncertain in the short term. This is because with the development of Hong Kong cross-border RMB trade settlement, speculative capital inflows have more convenient way. That is to say, the original cross-border speculative funds have been transferred to cross-border trade settlement for a long time. In the long and short term, the changes in the balance of RMB deposits in Hong Kong have a positive direction with the flow of cross-border speculative funds, but the impact is not significant enough. That is, the balance of RMB deposits in Hong Kong has not significantly affected the flow of cross-border speculative funds. The empirical results also show that there is a demonstration effect on China's cross-border speculative capital flow, and the early capital flow will

affect the latter.

Conclusion

This paper discusses the phenomenon that cross-border speculative funds have carried out large-scale arbitrage activities with the help of the Hong Kong RMB offshore market since the implementation of the pilot project of RMB cross-border trade settlement.It is confirmed that the Hong Kong RMB offshore market has a significant impact on cross - border speculative capital flows , among which the main influencing factors include RMB interest rate, RMB current exchange price difference,stock market investment return rate and Hong Kong cross - border RMB trade settlement amount

Based on the above analysis,we can conclude that the public consumers and investors should consider the significant factors that influence the scale of cross-border speculative capital when making cross-border decisions. First of all, we should pay close attention to the reform process of onshore RMB exchange rate formation mechanism and the range of two-way floating RMB exchange rate. Secondly, we should focus on the difference of interest rates between the onshore market and the offshore market and pay attention to the changes of HIBOR and SHIBOR. Finally, investors should also pay attention to the process of opening up the mainland capital account, such as the Qualified Domestic Individual Investor system launched by China(QDII2), which is conducive to enterprises in China using RMB for outward direct investment.

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