Effects of Exchange Rate Change on Domestic Price Level: an Empirical Analysis

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ABSTRACT: The two core variables - exchange rate and inflation in the open economy environment are closely related to the stable development of China's economy. In the new era, the rise of both RMB exchange rate and price level has aroused our interest in the relationship between them. This paper firstly analyzed the internal relationship between exchange rate and inflation from the perspective of theoretical analysis, and then made an empirical analysis with VAR model. The empirical results showed that the exchange rate will have a negative impact on inflation, and there is a certain delay because of the incomplete pass-through effect.

I. INTRODUCTION

In recent years, the rise of both RMB exchange rate and prices has occurred in China, which has a great impact on the people's production and life. Generally speaking, the exchange rate and the price level change in an opposite direction. When the RMB appreciates, the exchange rate falls, the purchasing power of the RMB rises, and the price level falls. The exchange rate can affect the price level in both channels: (1) affecting the domestic currency market: when RMB appreciates, the foreign exchange held by the Central Bank will decrease. If more base currencies in circulate in the market, the pressure on the Central Bank to put money on the market will be reduced. Generally speaking, there is a positive correlation between inflation and the velocity of money. When the velocity of money slows down, the inflation will be restrained effectively. (2) affecting the international market price: when RMB appreciates, the price of domestic purchases of foreign goods will fall relatively, which will make the domestic price level fall. In economics, this phenomenon is called "the theory of appreciation and suppression of inflation", but the reality of our country is just opposite. When the RMB appreciates, the price level is rising at the same time. The conduction mechanism of the influence of exchange rate on price is very complicated. Different conduction modes will have different influence on price level.

Comparing the current situation of economic development in China with that of foreign countries, it's worth thinking about the influence of RMB exchange rate change on price level. Under the open economic environment, the level of exchange rate and inflation is related to people's quality of life and has a profound influence on the money market and product market of every country. China needs to pay more attention to the changing trend of these two factors and the relationship between the two factors, which is conducive to a more accurate grasp and prediction of the price level in the future and to formulating a more rigorous and scientific monetary policy in order to achieve price stability. At the same time, it can also provide reference value on the change of RMB exchange rate.

II. CONDUCTION MECHANISMOF RMB APPRECIATION TO INFLATIONIN CHINA

The influence of exchange rate on prices is mainly manifested in the fact that, without excluding inflation, the change of RMB nominal exchange rate affects the domestic price level as well as the price level of import and export commodities. China's market economic system has not yet been mature, and is maintaining a semi-open state to the outside world. Therefore, according to the actual situation of our country, the influence of exchange rate change on price has the following two conduction mechanisms.

1) Direct conduction mechanism

The exchange rate change directly causes the change of price, and the effect of price pass-through is directly reflected in the change of price of imported commodity. Taking the RMB exchange rate change as an example, if the RMB appreciates relatively, the purchasing power of RMB increases, and the prices of foreign commodities fall relatively compared with the past, and China will import more foreign goods. This exchange rate change is directly reflected in the commodity price level.

2) Indirect conduction mechanism

Exchange rate change also indirectly affects the prices of imported commodities by influencing the macro and micro economic environment, and through market mechanisms. The conduction process will be relatively long. There is conduction delay from exchange rate to general price level. In general, the effect of exchange rates on domestic price levels is based on the following conduction mechanisms:

First, monetary supply mechanism. The monetary supply mechanism refers to changing price level through changing the supply of money, mainly including adjusting the international balance of payments, changing the supply channels of money and regulating the level of foreign exchange. When the RMB appreciates, the actual demand for currency in the money market and the product market will decrease and the supply will exceed the demand. To balance supply and demand, the Central Bank will adjust the supply of money. At the same time, in the foreign exchange market, the appreciation of the RMB will increase the price of our country relative to foreign commodities. Our exports will be reduced, while our imports will increase. The level of our foreign exchange reserves will fall, and the RMB will flow out. These two ways can reduce the price level of our country at the same time.

Second, monetary wage mechanism. After the appreciation of RMB, the nominal wage of our country remains unchanged, and the price of imported goods declines relatively. Lower import prices mean higher real incomes for residents and more demand for lower-priced imports. Because of the survival pressure, the manufacturers of imported substitutes will reduce the price of the goods; At the same time, the wage increases. Domestic labor units will lower the level of workers' wages, and the production cost of enterprises will decrease, which will lead to the reduction of the ex-factory price of goods, thus lowering the domestic price level.

Third, substitution mechanism. After the appreciation of the RMB, the relative prices of imported commodities fall, while the prices of similar commodities produced in China rise relatively. These two commodities are substitutes for each other. Consumers will reduce their consumption of domestic goods and consume imported goods. That is, the import products can substitute the domestic similar products. In turn, the overall price will fall back to the price of imported products, which will lead to the decline of the domestic general price level.

III.   EXCHANGE RATE PASS-THROUGH EFFECT

Exchange rate pass-through effect refers to the study concerning the impact of nominal effective exchange rate change of RMB on China's domestic price level (mainly consumer price) index. Exchange rate pass-through effects include complete exchange rate pass-through and incomplete exchange rate pass-through.

1) Complete exchange rate pass-through

Complete exchange rate pass-through means that the exchange rate changes of one country can timely impact the domestic and foreign prices. The effect of the exchange rate changes on expenditure conversion is very obvious, and then it can effectively adjust a country's trade balance. However, the complete exchange rate pass-through is based on the theory of purchasing power parity, which means that it is also based on the strict free competitive market and the assumption that there are no transaction costs, trade barriers and non-tradable goods. It is actually difficult to achieve. Therefore, there is no complete exchange rate pass-through in the real economic environment.

2) Incomplete exchange rate pass-through

The main function of exchange rate in open economy lies in its expenditure conversion effect. The expenditure conversion effect means that the change of exchange rate first affects the price of import and export commodities, then the domestic price, and has an impact on the consumer's consumption choice. The incompleteness of exchange rate pass-through will weaken the effect of exchange rate expenditure conversion and result in exchange rate interruption. Assuming the exporters in a country can "price by the market", when the currency of the importing country depreciates, the exporter can reduce the export price expressed in its own currency to maintain its market share in the importing country. However, the incompleteness of exchange rate pass-through also weakens its function of adjusting trade balance to a certain extent, which will directly affect the choice of optimal monetary policy and the formulation of exchange rate policy in a country.

IV. AN EMPIRICAL ANALYSISOFTHE CONDUCTION EFFECTOF RMB EXCHANGE RATEON INFLATIONIN CHINA

A. Selection of variables and sources of data

In order to ensure the simplicity and accuracy of the empirical research process, this paper constructs four variables: Dependent variable: consumer price index (CPI) and three independent variables: Nominal effective exchange rate of RMB (NEER); supply of broad money (M2); VAR model of producer price index (PPI). The time range for the above data is from January 2016 to September 2018. CPI, M2 and PPI are selected from the National Bureau of Statistics and NEER from BIS (Bank for International Settlements) database.

B. Data stationarity test

First of all, the stability of the data is checked by ADF. The value of ADF statistics of the variable NEER, M2 is greater than the critical value by inputting the data into Eviews7.2 system. The data are not stationary, so there is a need to make a first difference on the variable and rename the variable after the first-difference to DNEER, DM2. The processed data are re-entered into the system to show that the variable data are stable, as shown in Table1:

Table 1

statistics of variable	ADF statistics		critical value		smoothness
	T statistical value	P value	5%	10%	
cpi	-5.154256	0.0002	-2.95711	-2.617434	steady
neer	-2.471284	0.1319	-2.960411	-2.61916	non-stationary
m2	-0.697323	0.8316	-2.971853	-2.625121	non-stationary
ppi	-3.784234	0.0074	-2.960411	-2.61916	steady
Dneer	-3.398067	0.0188	-2.960411	-2.61916	steady
Dm2	-5.269751	0.0002	-2.971853	-2.625121	steady

At the 5% or 10% significant level, NEER, M2 cannot refuse the original hypothesis of the existence of unit root; After the first difference, all variables can reject the original hypothesis at the significant level of 5% or 10%, and the data is stationary.

C. Test of VAR Model

1) Determination of optimal lag order
In order to ensure that the constructed VAR model is optimal, it is necessary to determine the optimal lag order. The results in Table 2 show that the VAR model is optimal when the lag order is 4 according to the FPE, AIC and HQ criteria. Therefore, the optimal lag order is determined to be 4 orders, and the model is established by using the four periods of lag.

Table2 Test of Optimal Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	152.8156	NA	2.84e-10	-10.62969	-10.43937	-10.57151
1	182.6462	49.00739	1.07e-10	-11.61759	-10.66601*	-11.32668
2	192.2040	12.97126	1.84e-10	-11.15743	-9.444592	-10.63380
3	217.7419	27.36208*	1.15e-10	-11.83871	-9.364614	-11.08235
4	241.8509	18.94281	1.03e-10*	-12.41792*	-9.182570	-11.42884*

2)   Characteristic root test

It can be seen from Fig. 1 that the model has characteristic roots and all the characteristic roots are in the unit circle, which indicates that there is no one or more characteristic roots in the model, namely that the model is stable.

Fig. 1Characteristic root test value
Inverse Roots of AR Characteristic Polynomial
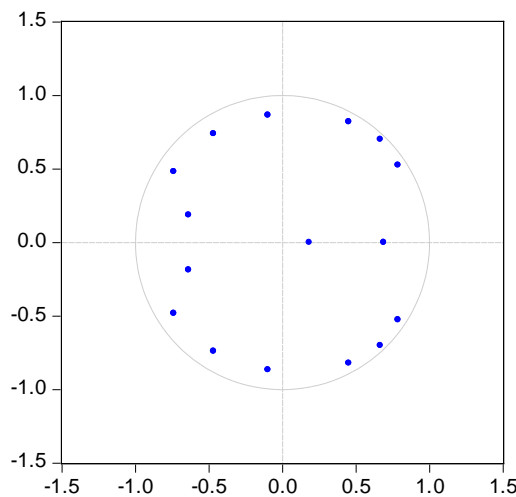
After the establishment of the basic model, the application of VAR model can be further carried out, namely to explore the impact of each influence factor on corresponding variables and impact degree.

D.   Application of VAR Model

1)   Granger causality test

Granger causality test is applied to determine whether independent variables and dependent variables areinterdependent. The results are shown in Table3:

Table 3 Granger Causality Test Results

Dependent variable: CPI			
Excluded	Chi-sq	df	Prob.
DM2	7.633597	4	0.0359
DNEER	17.33601	4	0.0017
PPI	22.92509	4	0.0001
All	54.67010	12	0.0000

The data in Table 3 indicates the probability of accepting hypotheses. If the number becomes smaller, the stronger the causal relationship between the independent variable and the dependent variable will be stronger. Thus, M2, NEER and PPI are Granger causes of CPI.

Figure2 Pulse Response Function Diagram
Response to Cholesky One S.D. Innovations ?2 S.E.

Response of CPI to DM2

Response of CPI to DNEER

Response of CPI to PPI
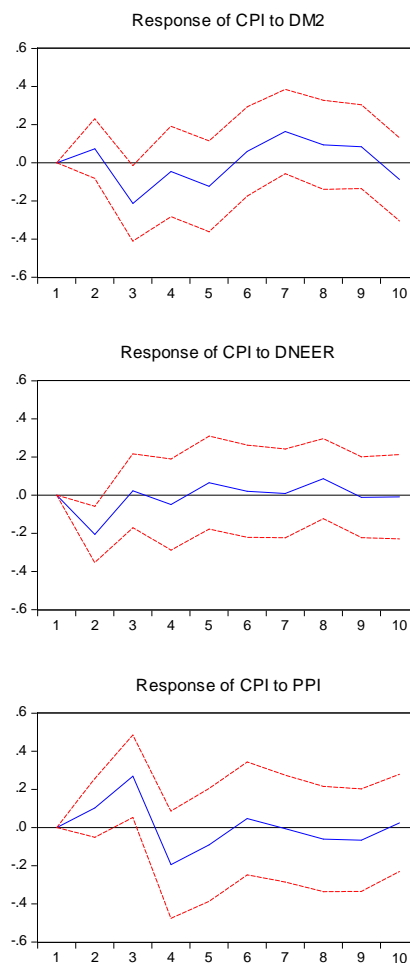
As shown from the above figure, PPI has the greatest influence on CPI among the three influencing factors. When PPI gives a positive impact, CPI immediately responds and reaches the peak in the third phase, and then disappears gradually in the sixth phase. When NEER produces a positive impact, it will bring a reverse impact to CPI. There is a

long-term equilibrium relationship between CPI and NEER, M2, in which CPI is positively correlated with PPI, M2 and negatively correlated with NEER.

2)   Analysis of variance decomposition

Variance decomposition is based on the analysis of the impact strength of different variables to the total change, so as to determine the impact of each factor on the results of the study. Therefore, the relative importance of any variable shock to dependent variables in VAR model can be analyzed.

Table 4 CPI Variance Decomposition

Period	S.E.	CPI	DM2	DNEER	PPI
1	0.282147	100.0000	0.000000	0.000000	0.000000
2	0.378668	59.33738	3.797626	29.52601	7.338980
3	0.528427	36.72849	18.16968	15.35006	29.75177
4	0.575414	33.81492	15.95954	13.67535	36.55019
5	0.599296	31.22268	18.97359	13.80382	35.99991
6	0.604865	30.78011	19.58887	13.66913	35.96190
7	0.626810	28.66259	25.09183	12.74911	33.49648
8	0.648892	28.69059	25.51037	13.67373	32.12530
9	0.659986	28.41095	26.28520	13.24694	32.05691
10	0.666718	27.96985	27.48684	12.99748	31.54583

Cholesky Ordering: CPI DM2 DNEER PPI

It can be seen from Table 4 that the main cause of price change is CPI itself and the contribution of PPI to 27.96% and 31.54%, respectively. The contribution of PPI to CPI decreases gradually after reaching the peak of 36.55% in the fourth phase. The contribution of NEER to CPI is the largest in the first phase to the second phase, and begins to decline after reaching 29.52% in the second phase, and keeps stable at 13% in the third phase. Like pulse analysis, NEER's contribution to CPI remains a negative growth. The contribution of M2 to CPI has been increasing gradually, up to 27%. Therefore, in the long run, the effect intensity of variables on CPI ranges from large to small in order: PPI, M2, NEER.

In a word, the results of pulse response analysis and variance decomposition show that: Although the change of the nominal effective exchange rate of RMB (NEER) has a negative effect on the domestic price level to some extent, the appreciation of the RMB will only cause a small decline in CPI. The pass-through effect coefficient is incomplete and there is a certain delay, RMB appreciation cannot restrain inflation effectively.

E.   Conclusions and Suggestions

Firstly, in the short term, it is weak of the conduction effect of effective exchange rate changes of RMB to CPI. Clearly, RMB appreciation is not an effective way to control inflation.

Secondly, in the long run, CPI is positively correlated with RMB supply and PPI and negatively correlated with RMB nominal effective exchange rate. The conduction of RMB nominal effective exchange rate to CPI is incomplete. We should reasonably adjust the level of monetary policy and strengthen the control of inflation.

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