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The Impact of the Fluctuations of RMB Exchange Rate on Shaanxi Export Trade under the Background of "the Belt and Road Initiative"

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***Abstract*—In contemporary export trade, the fluctuations of RMB exchange rate has a great impact on the total volume of the export trade. The formal implementation of the "the Belt and Road" strategy put forward by President Xi brought new challenges to Shaanxi export trade. Under the new economic environment, it is necessary to study the new relationship between the exchange rate fluctuation and the export trade of Shaanxi. This paper presents a detailed study on how the total volume of export trade of Shaanxi is affected by the exchange rate through a new VAR model. Besides GDP, CPI, the policy variable of "the Belt and Road Initiative" is added to the new model to explore the different effects of variables on the total volume of the export trade of Shaanxi. Meanwhile, the introduction of the new policy variable optimizes the existing trade model of the exchange rate at a certain angle. After analyzing the empirical results, a new impact relationship of the exchange rate and the export trade of Shaanxi has been obtained, and the corresponding suggestions for optimizing the export trade structure of Shaanxi are proposed.**

Keywords*— *RMB exchange rate; export trade volume; VAR model; Belt and Road Initiative

I. INTRODUCTION

In the existing refences, there are two different views about the effects of RMB exchange rate fluctuation on the export trade. The main view is that the appreciation of RMB exchange rate results in decrease in export trade. But sometimes REER acts as an non-effect factor in some industries of export trade. For example, Feng fuyu[1] investigated the asymmetric effects of REER change on export trade using threshold autoregressive model based on quarterly data from 1995 to 2003. He proved that the depreciation of the RMB exchange rate brought an increase of export trade when the change of REER is less than 1.26%. Based on the exchange rate data from 1990 to 2008, Song Jie [2] proved that REER change was the Granger's reason of the change of total volume of import and export by using VAR mode and Johansen cointegration test. Yang Guangqin[3] showed that the appreciation of RMB resulted in negative effects on the export trade of the cities along "the Belt and Road" range by utilizing the panel data of those areas from 2000 to 2013. Although most of the domestic scholars identify that the appreciation of RMB results in negative effects, some case studies gives contrary conclusions. For instant, after analyzing the trade data of China, Japan, and the United States from 1978 to 2000 in detail, Xie Jianguo[4] verified that the depreciation of RMB almost had no effects on China trade volumes because his investigation showed that the exchange rate flexibility of China trade is tiny, which is about 0.09. Based on the data from 1981 to 2011, Zou Xiaofang[5] concluded that the appreciation of exchange rate is positively related with total volumes of import and export and the effects of exchange rate change on export trade were neutralized by the import trade due to the manufactured trade with a feature of its raw and semi-finished materials imported abroad. At the same time, foreign scholars also have two views about the effect on trade. By selecting the panel data of 22 developed countries and 69 developing countries, Sauer &Bohara[6] constructed a 3-variable VAR model including exchange rate change, real income abroad, and trade condition. And his investigation proved that the exchange rate change had greater negative effects on the developing countries than the developed countries. Based on the monthly data from 1995 to 2005, Zheng[7] built univariate linear regression equation and proved that the appreciation of exchange rate in short term had negative effects on export. Marquez & Schindler [8] investigated the long-term relationship between RMB exchange rate and the general import and export trade by means of least square method based on the related data from 1997 to 2006. In his research, he added the lagged term and his empirical study showed that the appreciation of exchange rate could result in an increase of import and an decrease of export.

According to the international trade standard, Yamashita & Jayasuriya [9] studied the effect of exchange rate on the manufacture products of categories of SITC7 and SITC8. he predicted that the significance of the export effect is very small by building the VAR model. The product export of category SITC7 increased with 1.15% and that of category SITC8 increased with 0.3%. This conclusion seems to the contrary with theory possibly due to the limitation of the effects of manufacture products.

"The Belt and Road Initiative" was put forward by Xi, the General Secretary of the Communist Party of China when he visited countries of central and southeast Asia in September , 2013. And Shaanxi province as the original site of "the Belt and Road Initiative" takes an important role in the export trade and is one of the important cities along " the Belt and Road" range. Therefore, we select the export trade of Shaanxi province as the study case. At the same time, the fluctuations of RMB real effective exchange rate(REER) is a very important factor affecting export trade, especially after trade disputes between China and the United States in May, 2018. In this paper, the effects of RMB exchange rate on the export trade of Shaanxi province are investigated under "the Belt and Road Initiative" and the complicated environment of the fluctuations of REER.

II. Data And Methodology

In this study case, for considering the effects of "the Belt and Road Initiative" on the export trade of Shaanxi province, we introduce the policy variable to build a new VAR model to analyze the data of export trade in this new condition. In the new model, there are five variables. They are S the monthly data of the total export trade volume of Shaanxi province acquired from Xi'an customs, the monthly date of REER from IMF, the monthly date of GDP and CPI of Shaanxi province from State Statistical Bureau, and the monthly date of P the policy variable which is total trade volume between Russia, Singapore, Malaysia, and Indonesia and China from China customs. Since "the Belt and Road Initiative" was put forward in September, 2013, the monthly data of these five variables from January, 2012 to December, 2018 were selected for further investigations.

The first variable is S the monthly data of the total export trade volume of Shaanxi province. For disclosing the relationship between the exchange rate change and the trade change, we use (1) to attain the monthly change rate of the monthly data of the total export trade volume of Shaanxi province.

$$\ln Y_t = \ln\left(\frac{S_t}{S_{t-1}}\right) \tag{1}$$

Here, the $\ln Y_t$ is the monthly change rate of the monthly data of the total export trade volume of Shaanxi province in time t, and S_t is the current monthly data of the total export trade volume of Shaanxi province in time t .

Similarly, the second variable is the monthly change rate of REER, which is represented by (2).

$$\ln X_t = \ln\left(\frac{REER_t}{REER_{t-1}}\right) \tag{2}$$

The third variable is the monthly change rate of GDP of Shaanxi province, which is represented by (3).

$$\ln Z_t = \ln\left(\frac{GDP_t}{GDP_{t-1}}\right) \tag{3}$$

The fourth variable is the monthly change rate of CPI , which is represented by (4).

$$\ln M_t = \ln\left(\frac{CPI_t}{CPI_{t-1}}\right) \tag{4}$$

And the fifth variable is the policy variable P under "the Belt and Road Initiative", which is a new term of the VAR model proposed in this paper because the emphasis of this case is to study the effects on the export trade under "the Belt and Road". But the policy variable is just a macro variable of economy, which is not easy to represent by using a specific data. Therefore, it is necessary to construct a variable to stand for the extent of the effects of the policy "the Belt and Road". Here, we choose the monthly change rate of the total trade volume of the countries along "the Belt and Road" range which have a close trade relations with China. To reflect the different effects due to different trade volume with China, we average them using with different weights. And the monthly change rate of the policy variable is obtained in (5).

$$\ln P_t = \omega_1\% \times \ln\left(\frac{E_t^1}{E_{t-1}^1}\right) + \omega_2\% \times \ln\left(\frac{E_t^2}{E_{t-1}^2}\right) + \cdots\cdots + \omega_n\% \times \ln\left(\frac{E_t^n}{E_{t-1}^n}\right) \tag{5}$$

Here, $\ln P_t$ is the monthly change rate of policy variable at time t, E_t^n is the total trade volume of the nth nation at time t with China, and $\omega_n\%$ is the weight of the total trade volume of the nth nation with China. Since there are more than 65 countries along "the Belt and Road" range, it is a little difficult to cover all them. And here we choose four countries from them as the representatives which have the closest trade relations with China. They are Russia, Singapore, Malaysia, and Indonesia. We think that the four countries are enough to represent the all countries along "the Belt and Road" range due to their total trade volume is about 35% of that of the all countries. Moreover, the four countries belong to the developed and the developing countries respectively according to the economic standard of IMF. After considering the respective trade volumes of the four countries with China, we attain the trade weights for Malaysia, Russia, Singapore, and Indonesia with 36%, 27%, 19%, and 18%. With substitution into (5) with their weights, the (5) turns to (6).

$$\ln P_t = 36\% \times \ln\left(\frac{E_t^1}{E_{t-1}^1}\right) + 27\% \times \ln\left(\frac{E_t^2}{E_{t-1}^2}\right) +$$

$$19\% \times \ln\left(\frac{E_t^3}{E_{t-1}^3}\right) + 18\% \times \ln\left(\frac{E_t^4}{E_{t-1}^4}\right) \tag{6}$$

Combining (1),(2),(3),(4), and (6), we get the new VAR model represented in (7). And here we choose the number of lag period as 1 due to the real number of lag period is not determined. Where, C_1,C_2, C_3,C_4, and C_5 are constants.

$$\begin{bmatrix} \ln Y_t \\ \ln X_t \\ \ln Z_t \\ \ln M_t \\ \ln P_t \end{bmatrix} = \begin{bmatrix} C_1 \\ C_2 \\ C_3 \\ C_4 \\ C_5 \end{bmatrix} + \begin{bmatrix} \varphi_{11} & \varphi_{12} & \varphi_{13} & \varphi_{14} & \varphi_{15} \\ \varphi_{21} & \varphi_{22} & \varphi_{23} & \varphi_{24} & \varphi_{25} \\ \varphi_{31} & \varphi_{32} & \varphi_{33} & \varphi_{34} & \varphi_{35} \\ \varphi_{41} & \varphi_{42} & \varphi_{43} & \varphi_{44} & \varphi_{45} \\ \varphi_{51} & \varphi_{52} & \varphi_{53} & \varphi_{54} & \varphi_{55} \end{bmatrix} + \begin{bmatrix} \ln Y_{t-1} \\ \ln X_{t-1} \\ \ln Z_{t-1} \\ \ln M_{t-1} \\ \ln P_{t-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \\ \varepsilon_{4t} \\ \varepsilon_{5t} \end{bmatrix} \tag{7}$$

Before applying the VAR model to analyze the real data[10], we perform the test for stationarity of time series of ln*Yt* , ln *Xt* , ln *Zt* , ln*Mt* , and ln *Pt* by the ADF unit root tests using data processing software the Eviews 8.0. And the test results show that these five time series are all stationary. Also by this processing software with AIC and SIC information criterions, we determine the optimal number of lag period of is 3. Thus the 3-lag VAR mode is obtained in (8).

$$\begin{bmatrix} \ln Y_t \\ \ln X_t \\ \ln Z_t \\ \ln M_t \\ \ln P_t \end{bmatrix} = \begin{bmatrix} 0.0307 \\ -0.0015 \\ 0.0125 \\ -0.0003 \\ 0.0061 \end{bmatrix} + \begin{bmatrix} -0.5876 & -0.0342 & 0.3496 & 4.6396 & -0.4605 \\ 0.0156 & 0.6360 & 0.0176 & -0.4247 & -0.0128 \\ 0.0381 & 1.1154 & 0.4068 & 5.5446 & -0.0845 \\ 0.0031 & -0.0919 & -0.0171 & -0.6875 & 0.0018 \\ -0.0396 & -0.1692 & 0.3733 & 1.4186 & -0.5374 \end{bmatrix} \begin{bmatrix} \ln Y_{t-1} \\ \ln X_{t-1} \\ \ln Z_{t-1} \\ \ln M_{t-1} \\ \ln P_{t-1} \end{bmatrix}$$
$$+ \begin{bmatrix} -0.4142 & 2.4486 & 0.2813 & 9.0221 & -0.4262 \\ -0.0009 & -0.2424 & -0.0127 & -0.2617 & 0.0065 \\ 0.0250 & -1.4658 & 0.2449 & 8.5050 & -0.0262 \\ 0.0024 & -0.0689 & 0.0177 & -0.3172 & 0.0004 \\ -0.0266 & 0.4211 & -0.0384 & -2.9387 & -0.5911 \end{bmatrix} \begin{bmatrix} \ln Y_{t-2} \\ \ln X_{t-2} \\ \ln Z_{t-2} \\ \ln M_{t-2} \\ \ln P_{t-2} \end{bmatrix} \tag{8}$$
$$+ \begin{bmatrix} -0.2025 & -2.0302 & 0.1948 & 3.9730 & 0.2115 \\ 0.0119 & 0.1946 & 0.0201 & 0.0134 & -0.0023 \\ 0.0262 & 0.2461 & -0.9101 & 7.3656 & 0.1886 \\ 0.0262 & 0.1258 & 0.0157 & -0.2579 & -0.0151 \\ -0.1661 & -1.4984 & -0.0244 & 0.7373 & 0.0956 \end{bmatrix} \begin{bmatrix} \ln Y_{t-3} \\ \ln X_{t-3} \\ \ln Z_{t-3} \\ \ln M_{t-3} \\ \ln P_{t-3} \end{bmatrix} + \begin{bmatrix} e_{1t} \\ e_{2t} \\ e_{3t} \\ e_{4t} \\ e_{5t} \end{bmatrix}$$

In order to verify the model's economic significance and to avoid it spurious regression, Granger causality test is carried out to attain the relationship between the total export trade volume Y and REER, GDP, CPI, and P. The test results demonstrate that there is Granger causality between Y and REER, GDP, CPI, and P at the significance level of 5%. Therefore, it is not required to delete any of the variable in the proposed VAR model.

To test the stationarity of the VAR model, we use the function AR roots in Eviews 8.0 to attain the characteristic roots given by Fig. 1. The Fig. 1 shows that the 3-lag VAR model with 5 variables has 15 characteristic roots, which are all located in the inner of unit circle. Therefore, the new VAR model is stationary.

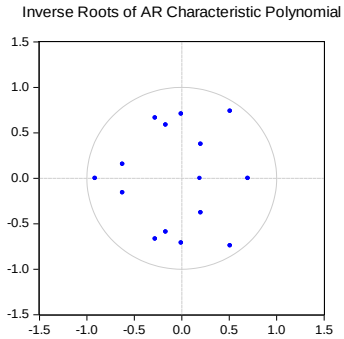

Fig. 1. Characteristic roots of VAR model.

III. EMPIRICAL ANALYSIS OF RESULT

Up to present, we built the new 3-lag stationary VAR model with five variables that are the total export trade volume Y, REER, GDP, CPI, and the policy variable P which represents the changes brought by "the Belt and Road Initiative". The data here are logarithmically processed in advance in EXCEL. Thus Y represents for ln*Yt* , REER for ln*Xt* , GDP for ln*Zt* , CPI for ln*Mt* , and P for ln*Pt*. In order to analyze the dynamic effects on the new model when it is suddenly impacted by any of the five variables, the impulse response can be achieved using Eviews 8.0. Here, we mainly analyze the impulse responses of Y to X(REER), Z(GDP), M(CPI), and P respectively. They are depicted in Fig. 2.

In Fig. 2. the impulse responses of the VAR model show that the different variables have different impacts on Y the total export trade volume of Shaanxi province at a short term. And moreover, Their impacts on Y in different term is sometimes positive or negative, but the total changing trends of the different variables with time are considerably similar. The impulse response of Y to X(REER) presents that if REER is excited by an impulse in the initial point, it impact on Y is negative at the first term and slowly change to positive at second term, then attain to a peak at third term. The impact on Y is changed from negative to positive at about 2.3 term and then continue to fluctuate. Up to 16the term its trend keep to be stable. This changing feature shows that REER impact on Y has compliance with J-curve. The results verified that one unit depreciation of REER with the other variables constant the export trade volume Y will be changed slowly to its original level in about 70 days(the 2.3th term) by the impact of this depreciation. And then the REER depreciation will produce positive effects on the export trade of Shaanxi. This analyzed results are compliance with Marshall-Lerner conditional theory. For the newly adding variable P standing for " the Belt and Road Initiative" , the results in Fig. 2. shows that P has negative impact on Y at the first two terms, and attain a peak at the end of second term. Thereafter, at the third term, it effects is changed to positive gradually and keep to be stable after the 11th term. The analytic results confirm that the impact of the change of the total trade volume of the all countries along "the Belt and Road" on the change of the total export trade volume of Shaanxi has 3 month time-lag effect.

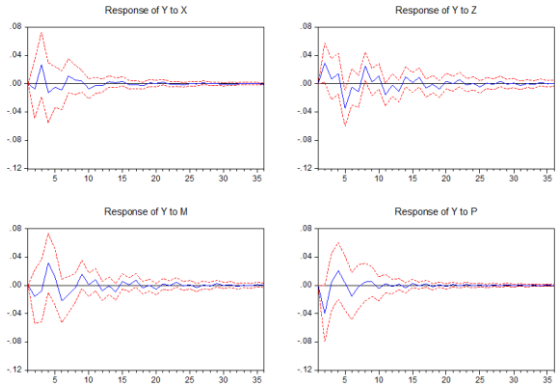

Fig. 2. The impulse responses of the VAR model.

TABLE I. THE DETIALED RESULTS OF VAIRANCE DECOMPOSITION

Period	S.E.	Y	REER	GDP	CPI	P
1	0.165029	100	0	0	0	0
2	0.201542	93.1362	2.158022	0.140514	0.621906	3.943357
3	0.204143	91.20688	2.209822	1.926911	0.759808	3.896584
4	0.210716	87.70554	2.530748	2.183272	2.961745	4.618698
5	0.215317	85.2689	5.01646	2.139161	3.129415	4.446068
6	0.218176	83.93203	4.934572	2.257332	4.054607	**4.821454**
7	0.220047	83.33093	5.099203	2.469816	4.350972	4.749076
8	0.22169	82.17645	6.288579	2.496756	4.3156	4.722618
9	0.222594	81.73272	6.25019	2.504199	4.7759	4.736986
10	0.223033	81.42265	6.456556	2.59745	4.758221	4.765121
11	0.223737	80.91397	6.889001	2.591268	4.859409	4.746357
12	0.223914	80.78958	6.886209	2.602275	4.976652	4.745286
13	0.224195	80.59274	7.088835	2.61509	4.965233	4.738099
14	0.224657	80.28888	7.248312	2.607995	5.111356	4.743457
15	0.224774	80.20759	7.245925	2.628966	5.164883	4.752633
16	0.224983	80.07123	7.39805	2.629372	5.156556	4.744796
17	0.22522	79.92211	7.457933	2.62654	5.248998	4.744418
18	0.225282	79.88079	7.454834	2.641928	5.271375	4.751071
19	0.225416	79.79009	7.556812	2.64081	5.26513	4.747159
20	0.225531	79.71744	7.576013	2.638823	5.320115	4.747608
21	0.225556	79.70063	7.574394	2.648098	5.326685	4.75019
22	0.225639	79.64267	7.639213	2.646532	5.32355	4.748031
23	0.2257	79.60506	**7.743675**	2.645131	5.356917	4.749214
24	0.225712	79.59688	7.743574	2.650682	5.35847	4.75039
25	0.225762	79.56163	7.682187	2.649524	5.357591	4.749072
26	0.225795	79.54215	7.682512	2.648776	5.376547	4.750011
27	0.225802	79.53718	7.683586	2.651857	5.376792	4.750586
28	0.225831	79.51654	7.705108	2.651173	5.377281	4.7499
29	0.225848	79.50665	7.704672	2.650887	5.387277	4.750514
30	0.225853	79.50321	7.706412	2.652423	5.387201	4.75075
31	0.225869	79.49147	7.717716	2.652049	5.388324	4.750439
32	0.225878	79.48648	7.717335	2.652025	5.393329	4.750832
33	0.225881	79.48395	7.719222	2.652722	5.393204	4.750904
34	0.225891	79.47743	7.724845	2.652521	5.394425	4.750781
35	0.225895	79.47492	7.724625	2.652612	**5.39682**	4.751023
36	0.225898	79.47305	7.726308	**2.652896**	5.396715	4.75103

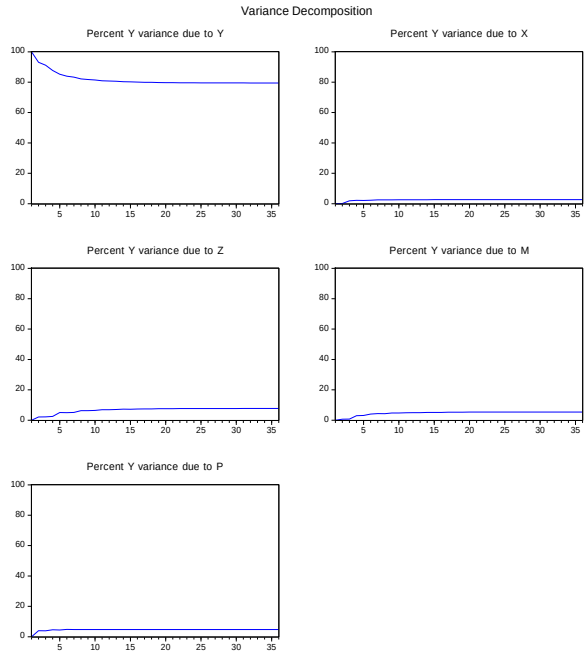

Fig. 3. The variance decomposition of the VAR model

Besides the impulse response analysis, it is necessary to perform variance decomposition of the proposed VAR model. Variance decomposition is used to analyze the respective contributions of different variables of the VAR model when an impulse impact is given and then its result is used to estimate the importance of each variable for this model. The Fig. 3. gives the results of the contribution of REER, GDP, CPI and P to the total export trade volume of Shaanxi. In Fig. 3. the changing trends of the contribution of the variables are easily observed. And with increasing term, all the contributions of the variables except for the total export trade volume Y are also increasing. These results are also obtained by data processing software Eviews 8.0. To give a detailed descriptions of all variables, the specific computed data are showed in Table I.

From Table I, without consideration of contribution of the export trade volume Y itself, the contribution of REER is up to its maximum 7.74% at the 23th term, and then it keeps to be stable from that time. The contribution of GDP is up to its maximum 2.65% at the 36th term. The fact that the maximum contribution is a relatively small value illustrated that the change of GDP has a relatively small effect on the total export trade volume Y. The contribution of CPI is up to its maximum 5.39% at the 35th term, which always keeps a relatively stable value. The contribution of the variable of "the Belt and Road" is up to its maximum 4.82% at the 6the term, and then it keeps to be stable from that time. To add up the contributions of all 36 terms of the variables, we obtain the pie chart Fig. 4. of the contributions of the different variables. In Fig. 4. we can easily observe that the REER has largest contribution on the total export trade volume, the contributions of the policy variable P of "the Belt and Road and CPI take the second place, and the contribution of GDP is minimum. These statistical results are compliance with the empirical analysis above mentioned.

IV. CONCLUSIONS AND SUGGESTIONS

By means of data processing and empirical analysis, the conclusions are given as follows.

At first, the regressive results of the proposed VAR model show that the change rate of 1-lag REER has negative effect on the total export trade volume of Shaanxi province, that is to say, the increase of REER results in the decrease of the total export trade volume. And the change rate of 2-lag REER has positive effect on the total export trade volume while the change rate of 3-lag REER has also positive effect. That means the effects of change of RERR on the export trade volume of Shaanxi province has the feature of positive and negative fluctuations. GDP and CPI always has positive effect on the total export trade volume regardless of their terms. The newly added policy variable of "the Belt and Road Initiative" at the first and second terms has a little negative effect on the export trade volume and after the 3rd term, it has the positive effect on the total export trade volume. This results illustrate that the effect of the policy variable on the total export trade volume has a large term-lag.

Secondly, the analyzed results show that the appreciation of REER will bring the decrease of the export trade volume, which complies with Marshall-Lerner conditional theory. At the same time, the impact result on the total export trade volume is that the total export trade will decrease at first and slowly recover its original level at 2.3 term. This process comply with J-curve.

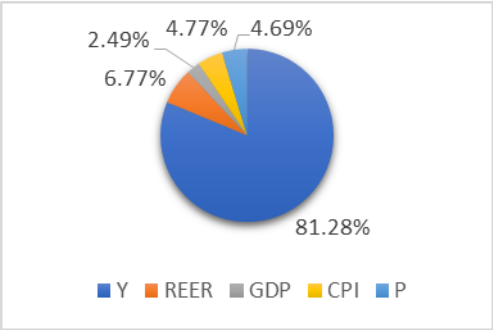

Fig. 4. Contributions of five variables.

And thirdly, the analyzed results of the VAR model present that the total export trade volume changes with multivariate changes including REER,GDP, CPI, and the policy variable P. Of which REER and the policy variable P have greater effects on it. The empirical analysis in this paper give us an inspiration that the export trade of Shaanxi province still has a close connection with REER and it also has relationship with the level of productive forces and the level of the consumptions of Shaanxi province. And "the Belt and Road Initiative" also affects the export trade at some extent. Therefore, to do export trade of Shaanxi province better, it is necessary to make out the effective policy to improve the trade level.

There are several effective suggestions proposed for improving the export trade of Shaanxi province in this paper[11]. The first is how to avoid the risk of the fluctuations of REER. The research result of the new VAR model presents that the appreciation of REER has negative effect on the export trade of Shaanxi province. And even if the increasing rate of the export trade volume is considerable, the potential effect of the appreciation of REER cannot be neglected, especially at the condition of the appreciation of REER after the ease of Sino-American trade relations. At the same time, with considering "the Belt and Road" policy, we should pay a more attention to the exchange rate in export trade when REER has more fluctuations. Therefore, in the future of the export trade, the government of Shaanxi province should seriously study the complicated environment and make the corresponding plan to avoid the risk of the fluctuations of REER.

The second step is to enhance financial innovation and to build new mode for the export trade[12]. The export trade volume depends not only the government but also the financial institutes and the export trade enterprises. Therefore, the three parties should enhance communications each other and co-founded the new mode of the export trade according to the new export trade environment under the policy of "the Belt and Road". Meanwhile, the utilization of the financial derivates to avoid the risk of REER has becoming mainstream in the export trade. And the government should develop the new mode for the export trade by utilizing the related regulations, enhancing business operation and management, and improving the capacity and value of production.

The final step is to find the new chance for the development of the export trade of Shaanxi province under "the Belt and Road Initiative". According to the trade states of Shaanxi, the government of Shaanxi province should cherish the chance of the policy of "the Belt and Road", Sino-US provincial-state cooperation, China-Africa local government cooperation, and the development strategy of China's free trade zone to accelerate the development of the export trade of Shaanxi province[13]. Although in recent years, the export trade of Shaanxi has a great progress, it is not enough to offset the difference of the economically developed coastal areas due to the geographical disadvantages and the later development of the export trade. As a result, the government of Shaanxi province should clench the good chance brought by "the Belt and Road Initiative" to develop rapidly the export trade so that the export trade business reaches a new stage.

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