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Exchange rate fluctuations and the trade balance between China and Australia: An empirical study

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Abstract. This paper uses Johansen cointegration test and a vector error correction model (VEC) to analyze the relationship between the trade balance and real bilateral exchange rate among Australia and China during 1990 to 2016. This paper suggest that the fluctuations of the real exchange rate will have impacts for China and Australia in the short run, but will have little or no impacts in the long run. This is inconsistent with the findings of previous studies suggesting that there has a J-Curve effect in the long run. As to what factors in the long run have cushioned the impacts of exchange rate fluctuations on the trade relations between Australia and China, we still need to continue exploring in the future.
Keywords. Bilateral real exchange rate, Trade balance, Imports, Exports, China, Australia, VEC, J-Curve, Free trade agreement, Price level, Fluctuations.
JEL. F10, F14, F15.

1. Introduction

Australia and China have continuously cooperated as trading partners for more than 40 years. The trade relationships between Australia and China have enjoyed considerable development. Australia is the largest developed economy among China's free trade partners (Petrovic & Grunberg, 2017). In terms of industrial structure, the trade relations between China and Australia are highly complementary. Australia is relatively mature in agriculture and service industries, while China's manufacturing industry is developed with some obvious advantages and complementary advantages. After China and Australia implemented the free trade agreement in 2015, the bilateral trade volume has been growing rapidly (Petrovic & Grunberg, 2017).

According the data provided by Australian Bureau of Statistics, the bilateral trade between China and Australia from January to September 2017 was 92.07 billion U.S. dollars. Among them, Australia exported 57.36 billion U.S. dollars to China, an increase of 38.2%, accounting for 33.3% of Australia's total exports. Australia imported 34.71 billion U.S. dollars from China, accounting for 21.0% of Australia's total imports. Australia imported the most from China for the mechanical and electrical products, textiles and furniture toys miscellaneous products, from January to September 2017 total imports of 21.1 billion US dollars, accounting for 60.8% of total imports from China from China. Overall, Australia also achieved growth in imports from China, but the growth rate was lower than its overall import growth even further lower than its growth in exports to China. As a result, Australia's trade surplus with China continued to grow and China maintained its largest foreign trade

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surplus Country of origin. The development of the trade relation between China and Australia is affected by many factors. However, the most important one is the commodity prices between these two countries, while the changes of commodity prices are affected by the real exchange rate fluctuations.

In the research of the development of the trade relations between China and Australia, the fluctuations of exchange rates between the two countries will exert some influence on their bilateral imports and exports. Studying the impact of the fluctuations in the bilateral exchange rates between the two countries on trade is conducive to the better development of the cooperation between Australia and China. However, previous studies cannot identify the effects of the fluctuations of the bilateral exchange rate on the trade relations between Australia and China. Most of them mainly focus on finding out the J-Curve effects due to the currency devaluation. Some studies focus on finding the factors that affects the trades between countries. Some focus on the relationship between the exchange rate fluctuations and the trade balance. However, these studies ignored one of the most important points that they did not separate the impacts of the real exchange rate fluctuations on a country's imports, exports and its trade balance. More importantly, some studies neglected the research area on the trade relationships between China and Australia which have the potential to have a great influence on the global economy. This paper provides a deeper research on the relationship between exchange rate fluctuations and trades between Australia and China, which is helpful for us to further analyze the path of economic cooperation between these two countries. Only after the effects of exchange rate fluctuations on the trade relations are clearly identified, can the impact of exchange rate fluctuations on economic development of countries be more precise, can we find out the more correct methods for the economic development of Australia and China and the managements of exchange rate fluctuations.

The purpose of this paper is to examine the relationship between the bilateral exchange rate of AUD-CNY and the trade balance between China and Australia from the period of 1990 to 2016. This paper uses Granger test, Johansen cointegration test and vector error correction model (VEC) to show different impacts of the fluctuation of real exchange rate on Australia's imports, exports from China and the trade balance.

The structure of this paper is as follows: Part 1 is the introduction of this paper. Part 2 is the literature review on the research about exchange rate fluctuation and its impacts on import, export and trade balance. Part 3 analyze the economic growth status, the real exchange rate fluctuations status and the trade balance status of China and Australia. Part 4 is the empirical analysis, including the explanations of data source and variables, the models and the methods. Part 5 explains the empirical conclusions and some suggestions for the development of the trade relationships between China and Australia and some further research suggestions.

2. Literature review

2.1. Determinants of the trade relations between China and Australia

China's investment activities in Australia are influenced by the investment policies of and market demands of the two countries (Zhou, 2017). China as a capital exporter and Australia as a capital importer will be intervened by various factors in the process of trade. The two countries can minimize political influences and trade barriers after signing the China-Australia Free Trade Agreement in 2015 (Zhou, 2017). Therefore, the main factors affecting the trade activities of the two countries will make the bilateral exchange rate fluctuations between the two countries.

Previous researches have different opinions on the determinants of the imports of China and Australia. Most of the scholars believe that product prices, exchange rates

and national income levels are the decisive factors for the two countries' imports. Tcha & Wright (1999) examine the determinants of China's imports of iron ore from Australia and suggest that the previous trade volume, China's domestic income growth rate and the steel production are the main factors that push China to import iron ore from Australia. Zhao & Wu (2007) use cointegration test and VEC method to analyze the determinants of China's imports. Their results show that due to the scarce domestic oil reserve and high exploration costs, China's industrial production growth rate and transport sectors are the key determinants that affect her imports of oil. Zhang *et al.,* (2013) use a multilevel approach to analyze China's imports from 1996 to 2008 and suggest that product quality is the main determinants for China's imports from other countries. They also suggest that the exchange rate, tariffs and domestic product price also have some influence on imports. Ludema & Mayda (2013) suggest that international trade agreement is one of determinants for country's imports and exports due to different level of the importer's tariff and the negotiation power. This also indicates that since China and Australia signed the free trade agreement, the import and export relationships between these two countries might be affected.

With regard to the determinants of exports, scholars generally agree that the real effective exchange rate is the most important factor in determining a country's exports. Valos & Baker (1996) suggest that tangible, technology, attitudinal, skill and knowledge are the four main determinants in Australia's exports to other countries. Moreover, prior export experience is also an important factor in affecting Australia's exports. Liu & Shu (2003) investigates the key determinants of China's exports and find that labour costs, the level of FDI and the size of firm are the most important factors that affect China's exports. Different from the above, scholars have also explored the impact on exports from the angle of R&D expenditures and suggest that R&D related Capabilities are the main determinants of country's export performance (Lefebvre, Lefebvre & Bourgault, 1998).

Several researches have focused on testing the determinants of a country's trade balance. Backus, Kehoe & Kydland (1994) suggest a S-Curve relationship between the trade balance and the terms of trade, that a country's trade balance is negatively affected by its current and future trade movements, but positively affected by its past movements. Fung & Lau (1998) examine the bilateral trade balance between China and United States and suggest that there are huge discrepancies between the official bilateral trade balances which might be caused by different treatments of trade. Cheong Tang (2008) suggests that real exchange rate fluctuations, country income and money supply are the important factors that affect the short-run and long-run trade balance.

2.2. Trade balance and the J-Curve

Previous studies have focused on testing the relationship between trade balance and the changes of exchange rate. But most of them find no supports for the J-Curve effects.

Brada, Kutan & Zhou (1993) proved that is no relationships between China's trade balance and the fluctuation of Chinese Yuan over the period of 1980 to 1989 by using an ECM model. Marwah & Klein (1996) construct a model to test the J-Curve between the US and Canada. They find that when currency depreciated, the trade balance will first to worsen, then to improve, after a period of time, the trade balance will worsen again. Ahmad & Yang (2004) use a cointegration and causality test to examine the short-run and long-run J-Curve effects by using a time series data of China's bilateral trade with G-7 countries. Their research results show no indication for the short-run J-Curve effect. On the contrary, Weixian (1999) suggest

the short-run and long-run J-Curve effects for China by taking into account the Chinese domestic and foreign income, domestic and foreign currency and the exchange rate of Chinese Yuan. Wilson (2001) found the J-Curve phenomenon between the trade balance and the real exchange rate among Singapore, Korea, Malaysia, the USA and Japan during the period of 1970-1996. Some studies provided evidence that there are no relationships between the fluctuations of real exchange rate and trade balance. Wilson & Tat (2001) examine the relationships between the trade balance and real exchange rate between two developed countries, Singapore and the USA, and found that the fluctuations of the real exchange rate do not have impacts on the trade balance between Singapore and the USA. Wu (2018) found that the trade balance between China and Australia would not have a significant impact when the exchange rate between China and Australia fluctuated abnormally by examining the trade curve effect between China and Australia. Short-term J-curve effects exist in most industries, while the long-term J-curve effects cannot be confirmed.

Most of the previous find long-run J-Curve effects are favorable, but the short-run effects do not exit. Rose & Yellen (1989) employed disaggregated data in analyzing the J-Curve effects. Their results show no any evidence supporting the long-run J-Curve effects between the US and her trading partners. Bahmani-Oskooee (1991) use the cointergration analysis to test the relationship between the trade balance and the real exchange rate among least developed countries (LDCs) during the period of 1973-1988, their results shows that these two factors are cointegrated in the long-run but not in the short-run. Onafowora (2003) use a cointegrating vector error correction model to analyze the short-run and long-run effects of the real exchange rate fluctuations on the trade balance of three East Asia countries, their research find that there is a long-run cointegrating relationship among real trade balance and the real exchange rate. Previous studies mainly estimate the relationship between balance of trade and real exchange rate by using OLS and 2SLS methods. However, these estimation methods are only suitable in a fixed exchange rate environment. When a flexible exchange rate regime applied, the real relationships cannot be capture by these regression models (Demirden, & Pastine, 1995).

3. Economic status and foreign trade status of China and Australia

One of the problems that currently facing by the world economy is that there is no new economic growth points have been found. After the liberal economic policies that are implemented in many countries of the world, the positive effects of the economic stimulus policies of various countries begin to gradually decline, and the negative effects begin to emerge. At a time when the global economy is slowing down, the differences in the economic conditions among various countries continue to grow. One of the sources of such differences is the changes in commodity prices in various countries and changes in the inflows and outflows of capital, which will cause some changes in their foreign trade activities. There are many ways to measure the level of economic development in a country. One of the most common methods is the expenditure method. In the calculation of the law of expenditure, the level of economic development in a country can be measured by its consumption, investment, government expenditure, imports and exports. An analysis of the economic development in Australia and China helps us to further analyze the impact of its foreign trade on its economic development.

3.1. The foreign trade in China's economic growth

In the study of China's foreign trade, some studies suggest that the foreign trade and the foreign direct investment (FDI) will cause China's regional inequality because those industries dependent on foreign trade are more likely to locate in several specific regions (Ge, 2006). Some studies suggest that China has a revealed advantages in some range of products so that it will more likely to experience a higher degree of foreign trade change in the future (Yeats, 2010). Since 1990 to 2016, China's GDP has been on a rising trend, and the consumer spending index has also been increasing year by year. Government purchases also showed a slight rise. As for foreign trade, since China's development of the country's opening up started relatively slowly, during 1990-2002, we can see that China's net exports to foreign trade were almost zero. According to statistics from the World Trade Organization, trade restrictions have been introduced in many countries since the financial crisis of 2008, while China has been the biggest victim of trade protectionism due to low commodity prices and cheap labor costs. China's steel, new energy and other pillar products have become the focus of foreign trade frictions, and the impact on exports has deepened. As China's external development continues to increase, its net export share has gradually been positive and shows slight fluctuations between 2004 and 2016. As can be seen from Figure 1, the rapid growth of China's economy mainly depends on the consumption and investment of residents, while there is still much more opportunities for development in its foreign trade.

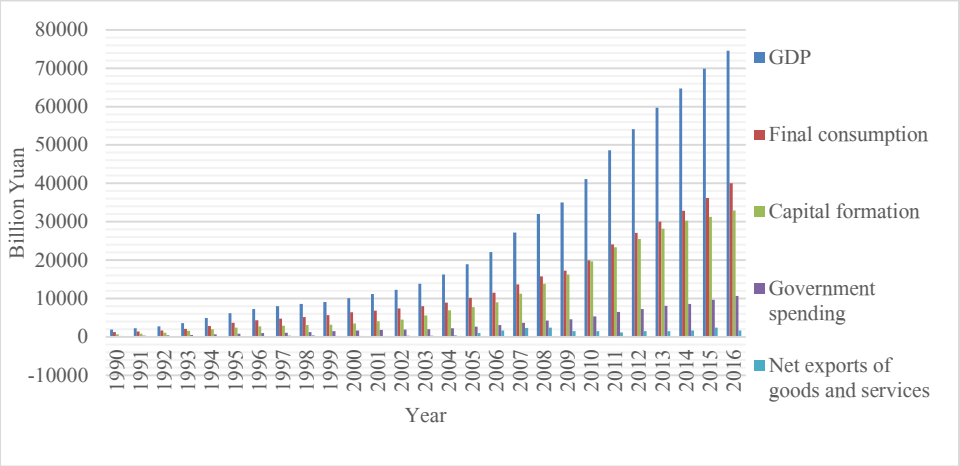

Figure 1. *The economic growth in China*
Source: China Statistics Bureau

3.2. The foreign trade in Australia's economic growth

According to the Australian Bureau of Statistics, since 1990 to 2007, Australia's economy has been on the rise. After the financial crisis in 2008, the pace of economic development declined but still showed an upward trend. It can be seen that the rise of Australia's economy mainly benefits from the rising level of national consumption and the increase of investment. Government spending accounts for a smaller portion of the Australian economy. Australia's foreign trade economy had a positive net exports between 1990 and 2002, but its net exports turned negative after 2006 (See Fig.2). Due to the sluggish investment activities in developed countries, the sluggish demand for energy resources, intermediate products and machinery and equipment dragged down the growth of international trade in investment goods. From 2012 to 2014, investment by developed countries, including Australia, increased on average

by 1.3%, 8 percentage points lower than the average growth rate from 2009 to 2011[1]. In a low-growth economy, Australia's foreign trade economy has been affected, but the level of economic growth is still showing an upward trend, indicating that there are certain research opportunities for its foreign economy.

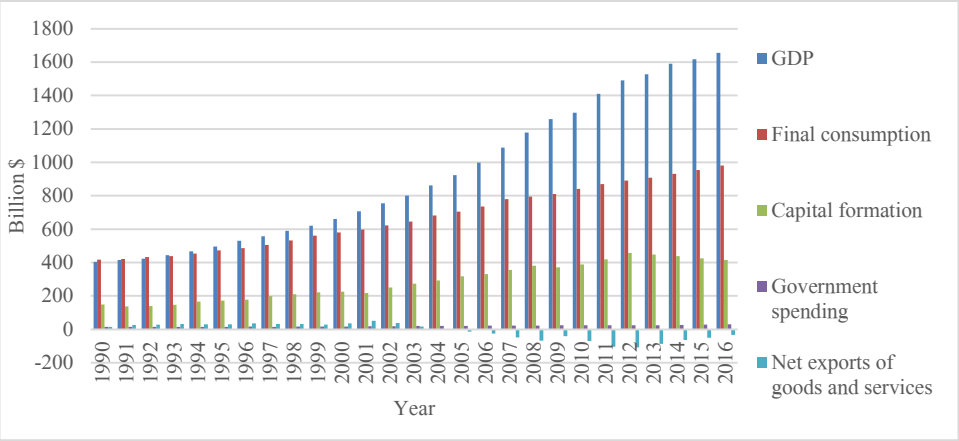

Figure 2. *The economic growth in Australia*
Source: Australia Statistics Bureau; The World Bank

4. Empirical analysis

4.1. Dependent variables and Independent variables

In this paper, we use three variables as the dependent variables, including Australia's imports from China (Import), Australia's exports to China (Export) and the trade balance between Australia and China. Independent variables include the bilateral real exchange rate, income levels and price levels in the two countries.

4.1.1. The bilateral real exchange rate

Exchange rate is an important factor affecting the trade of countries. According to the Price-specie flow mechanism theory (David, 1952), the changes of exchange rate depends on the fluctuations in the balance of payments. When a country's international balance of payments deficit, its currency exchange rate will fall down. After a period of time, when the rate of decline exceeds a certain limit, the exchange rate decline will lead to a decline of a country's good price, which will stimulate its imports. From the interaction between exchange rate and the balance of payments, exchange rate fluctuations and trade fluctuations should be mutually influential and mutually deterministic. The current devaluation of Chinese Yuan has resulted in a great volatility in the financial market of the world. The Bilateral Real Exchange Rate is the bilateral nominal exchange rate multiplied by a ratio of price indices of Australia dollar and Chinese Yuan, which can reflect their real effects on the trade balance. Thus, we collected the official exchange rate from the World Bank and divided by the purchasing power parity conversion factor of China and Australia to come out with the bilateral real exchange rate.

4.1.2. Income level

Over the long run, China would almost certainly be better off with a floating currency that can help absorb the kinds of shocks that are driving its reserve levels sharply up or down. Capital controls would have to address the dollar demand from three groups. First, with China's current account surplus growing again, there are the exporters who receive dollars in payment and prefer not to convert them to domestic currency when they fear devaluation. Second, there are the Chinese firms seeking to

[1]Data source: WTO

repay more than US$1 trillion in dollar-denominated debt. And, finally, there are the households that still legally shift substantial funds abroad.

China's current exchange rate regime is too awkward to operate for much longer without some modification. If foreign exchange reserves continue to plunge, the most likely path is a further tightening of controls, well before any large-scale devaluation or a currency float. Australia's GDP decreased form 1,505 USD billion in 2011 to 1,205 USD billion in 2016[2], which reflects a downward trend in its economy development path. Weak household income growth had a negative effect on investing in Australia. The real GDP rebounded in the December quarter 2016, increased by a stronger than expected 1.1% (See Fig.3).

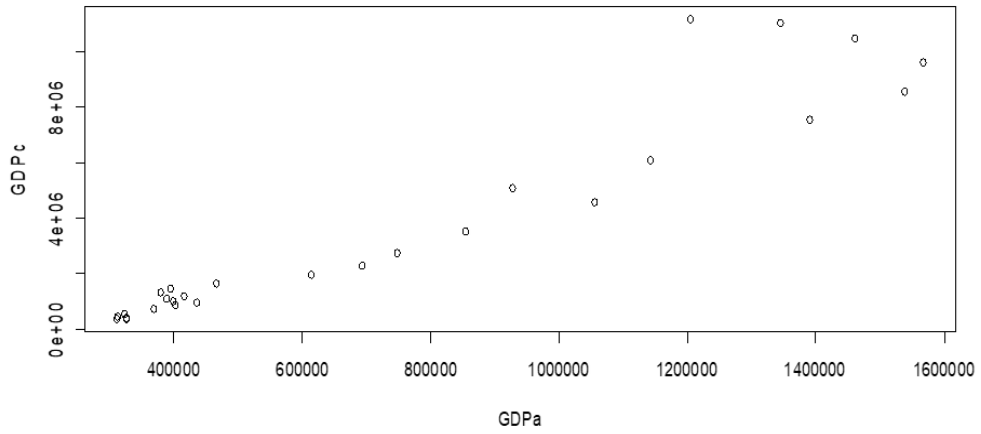

Figure 3. *Income level in Australia and China*

The bounce back was relatively broad-based across expenditure components. Corporate profits benefited from a surge in the terms of trade. However, labor income was particularly weak. Solid economic momentum near-term will likely keep the RBA on the sidelines for much of 2017. While there is clearly spare capacity in labor and product markets, the RBA aims to balance its inflation and employment objectives against financial stability considerations, particularly given the surge in house prices in key markets in late 2016 at already high household debt levels.

4.1.3. Price level

The average price level in China is lower than that in Australia from 1990 to 2016 (See Fig.4). The lowest price difference between the two countries was in 2002 and the largest price gap was in 2012 among the observation period. The impact of product price fluctuations on the demand for import and export of the two countries is very large. The price level in Australia fluctuates greatly during 1990 to 2016, while China's product has a price competitive advantage. When the good price of a country decreases, the demand of good from other countries will increase, thus affecting the status of imports and exports of the two countries. Therefore, the price level in the two countries should also be taken into account in affecting the trade relations.

[2]Data source: WDI

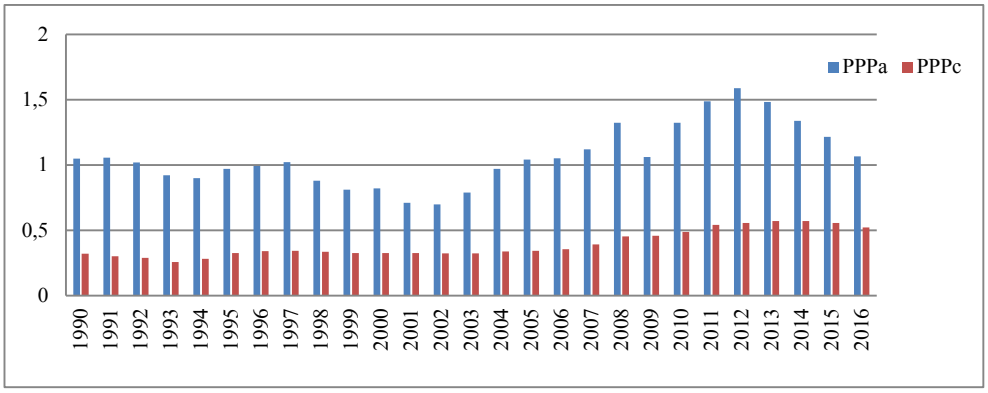

Figure 4. *Price level in Australia and China*

4.2. Data sources and models

4.2.1. Data source

In order to analysis how the changes of bilateral exchange rate affects the imports, exports and the trade balance between Australia and China. We use the historical imports, exports and trade balance records between China and Australia from 1990 to 2016 as the dependent variables. The trade balance is calculated by the Australia's export of commodity to China and the Australia's imports of commodity from China. Australia's imports, exports from China and the trade balance data are collected from the Australia Bureau of Statistics. Annual GDP data (A$000) of China and Australia comes from the World Bank and the bilateral real Exchange Rate is calculated through the official exchange rate and price level which comes from the World Bank. The data over the period 1990 to 2016 are used to carry out the empirical results.

4.2.2. The models

According to the method used by Bahmani-Oskooee & Wang (2008) which investigated the J-Curve effect using commodity level data between China and the US. There are three variables in determining the trade balance, i.e., domestic income, foreign income and the real exchange rate. In this paper, we expand the determinants by adding domestic price and foreign price index into account. We use three models to analyzing the effects of the fluctuations of real AUD-CNY bilateral exchange rate on Australia's import and export from China, and the trade balance between Australia and China.

Model 1

Model 1 is used to analyze the effect of the changes of the bilateral real exchange rate on Australia's imports from China. For model 1, Australia's imports from China are affected by the price of Chinese goods Pc to a large extent. China's commodity prices in the global trade have a big price advantage which might have a certain impact on Australia's imports from China. This can be explained by the demand function that we all known[3]. Moreover, Australia's imports from China will also depend on the Australia's domestic income, as Australian income is the basis for imports of Chinese goods. When Australia's economy grows better, their domestic income will increase and the demand for foreign goods including China's commodities will also increase. Import function also depends on the previous period of domestic income, exchange rate and the level of imports from the previous period. Therefore, the structure of model 1 is as follows:

IM=f (GDPa, REX, Pc, Pa)

[3]The demand function indicates that there is a one-to-one correspondence between the demand of a commodity and the price of the commodity. The functional relationship can be expressed separately by the product demand table and the demand curve: D = (a-P) / b.

$$\ln \mathrm{IM}_t = \beta_0 + \beta_1 \ln GDP_{au} + \beta_2 \ln GDP_{cn} + \beta_3 \ln REX_t + \beta_4 \mathrm{P}_{\mathrm{au}} + \beta_5 P_{cn} + \zeta_t \quad (1)$$

$$\Delta \mathrm{Ln}(\mathrm{IM}) = a + \sum_{k=1}^{\mathrm{n}} \beta_{t-k} \Delta LnGDP_{t-k}^{AU} + \sum_{k=0}^{n} \pi_{t-k} \Delta LnREX_{\mathrm{t\text{-}k}} + \lambda_1 Ln(IM)_{t-1} + \lambda_2 LnGDP_{t-1}^{AU} + \lambda_3 LnREX_{t-1} + \sigma_t \quad (2)$$

Model 2

In Model 2, the dependent variable is the Australia's exports to China. Australia's exports to China depend on the prices of Australian goods, China's income level and the bilateral exchange rate fluctuations, as well as the impact from the previous period. Therefore, Model 2 is structured as follows:

EX=f (GDPc, REX, Pc, Pa)

$$\ln EX_t = \alpha_0 + \alpha_1 \ln GDP_{au} + \alpha_2 \ln GDP_{cn} + \alpha_3 \ln REX_t + \alpha_4 \mathrm{P}_{\mathrm{au}} + \alpha_5 P_{cn} + \varepsilon_t \quad (3)$$

$$\Delta \mathrm{Ln}(EX) = a + \sum_{k=1}^{\mathrm{n}} \beta_{t-k} \Delta LnGDP_{t-k}^{\mathrm{C}} + \sum_{k=0}^{n} \pi_{t-k} \Delta LnREX_{\mathrm{t\text{-}k}} + \lambda_1 Ln(EX)_{t-1} + \lambda_2 LnGDP_{t-1}^{C} + \lambda_3 LnREX_{t-1} + \sigma_t \quad (4)$$

Model 3

The dependent variable for Model 3 is the trade balance between Australia and China. The trade balance is affected by all the factors we used in Model 1 and Model 2. So the main function expression and the model expression are as follows:

TB=EX/M

TB=f (GDPa, GDPc, REX, Pc, Pa) (5)

$$\ln \mathrm{BT}_t = \chi_0 + \chi_1 \ln GDP_{au} + \chi_2 \ln GDP_{cn} + \chi_3 \ln REX_t + \chi_4 \mathrm{P}_{\mathrm{au}} + \chi_5 P_{cn} + \mu_t \quad (6)$$

$$\Delta \mathrm{LnTB} = \Delta \mathrm{Ln}(\frac{X_i}{M_i}) = a + \sum_{k=1}^{\mathrm{n}} \beta_{t-k} \Delta LnY_{t-k}^{AU} + \sum_{k=0}^{n} \gamma_{t-k} \Delta LnY_{t-k}^{C} + \sum_{k=0}^{n} \pi_{t-k} \Delta LnREX_{\mathrm{t\text{-}k}} + \lambda_1 Ln(\frac{X_i}{M_i})_{t-1} + \lambda_2 LnY_{t-1}^{AU} + \lambda_3 LnY_{t-1}^{C} + \lambda_4 LnREX_{t-1} + \sigma_t \quad (7)$$

4.3. Statistic analysis

From the statistical analysis, we can see that the average value of Australia's imports from China during 1990 to 2016 is about 2.2 billion dollars, while the average value of exports to China is higher than its import value, with around 2.7 billion dollars. The average GDP income level in China is about five times more than that of Australia, while the average China's good price is about 26.79% price level in Australia. It be seen that there is a big gaps between the price levels in these two countries and people's spending habits will be affected accordingly. The average level of the real exchange rate is one Chinese Yuan to about 0.167 Australian dollars.

It is said that if the variable obeys the normal distribution, Skewness value is zero and Kurtosis value is 3, so that the value of JB statistics is zero. If the variable is not a normal distributed variable, the JB statistic will be a gradually increasing value. From the standard deviation, the overall sample size of the sample is small, especially the value of kurtosis indicates that these sample data are basically close to the normal distribution (normal distribution kurtosis level is 3), while Skewness shows that these data are normal Distribution of smaller deviations (normal distribution Skewness value of 0). Before undertaking the VEC model, we will first

conduct some tests on the data to make sure that the bias of the empirical results is small.

Table 1. *Statistical analysis*

	IM	EX	TB	GDPA	GDPC	PPPA	PPPC	REX
Mean	22015712	27070668	5054956	732932800	3606875000	1.064	0.392	0.167
Median	14256029	9088832	-627359.8	466853200	1660288000	1.044	0.343	0.161
Maximum	61785151	86581015	39336442	1567179000	11199145000	1.588	0.572	0.234
Minimum	1331050	1292788	-6910893	311425900	3608585000	0.699	0.258	0.140
Std. Dev.	19616323	30838338	13236975	441495.3	3704111	0.235	0.102	0.026
Skewness	0.625	0.906	1.294	0.701	0.996	0.592	0.714	1.712
Kurtosis	2.025	2.152	3.295	1.951	2.485	2.679	1.962	4.758
Jarque-Bera	2.827	4.504	7.637	3.453	4.765	1.694	3.506	16.659

4.4. ADF test

As can be seen from the results of the ADF test, the series LNEX, LNPA, LNPC, LNTB are not smooth sequence that they both have a unit root. For nonstationary series, they cannot be regressed correctly. But from the first order and second order differences of each series, these data become smooth series. Therefore, we can use the co-integration test and continue to further check whether co-integration of the variables can be established.

Table 2. *Unit root test*

	Test Statistic	p-value for Z(t)	unit root
LNEX	-0.899	0.7884	Y
LNIM	-3.64**	0.005	N
LNPA	-1.302	0.6281	Y
LNPC	-0.143	0.945	Y
LNREX	-2.728*	0.0692	N
LNTB	-0.709	0.8443	Y
DLNEX	-1.972	0.2988	Y
D2LNREX	-3.98***	0.0015	N
DLNPA	-4.126***	0.0009	N
DLNPC	-2.989**	0.0359	N
DLNTB	-3.947***	0.0017	N

4.5. Cointegration test

Trace test and maximum eigenvalue test were performed on each of the six sequence combinations of the three models, results are showed in Tables 3 and 4. It can be seen from Table 3 that in the case of a co-integration vector of 0, the trace statistics is greater than the critical value, so the null hypothesis can be rejected. That is, there is at least one cointegration relationship between these vectors.

Conversely, under the test that the three is at most one co-integration vector, if the trace statistics is less than the critical value, it means accepting the null hypothesis, indicating that there is at most one vector relationship between these four vectors.

Therefore, it can be concluded from Table 3 and Table 4 that these six vectors exist in all three models and there is more than one cointegration relationship. The maximum eigenvalue test also leads to the same conclusion.

Table 3. *Unrestricted Cointegration Rank Test (Trace)*

	Model 1				Model 2				Model 3			
No. of CE(s)	Eigen	Stat	Crit	Prob	Eigen	Stat	Crit	Prob	Eigen	Stat	Crit	Prob
None *	0.92	105.75	47.86	0	0.92	116.9	47.86	0	0.91	103.61	47.86	0
At most 1 *	0.68	48.22	29.8	0	0.72	58.8	29.8	0	0.66	48.82	29.8	0
At most 2 *	0.5	21.77	15.49	0.01	0.6	29.71	15.49	0	0.51	23.98	15.49	0
At most 3 *	0.22	5.84	3.84	0.02	0.31	8.63	3.84	0	0.28	7.4	3.84	0.01

Table 4. Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

	Model 1				Model 2				Model 3			
No. of CE(s)	Eigen	Stat	Crit	Prob	Eigen	Stat	Crit	Prob	Eigen	Stat	Crit	Prob
None *	0.92	57.53	27.58	0	0.92	58.09	27.58	0	0.91	54.79	27.58	0
At most 1 *	0.68	26.45	21.13	0.01	0.72	29.09	21.13	0	0.66	24.85	21.13	0.01
At most 2 *	0.5	15.93	14.26	0.03	0.6	21.08	14.26	0	0.51	16.58	14.26	0.02
At most 3 *	0.22	5.84	3.84	0.02	0.31	8.63	3.84	0	0.28	7.4	3.84	0.01

4.6. VEC model analysis

In the test of cointegration relationship, scholars have the following two discriminating methods. The first method is to test the residuals produced by the cointegration equation and judge the rationality and stability of the whole cointegration equation from the residual test results. The other is to determine the coefficient of the cointegration equation, and thus find the cointegration relationship. This article's approach is to use the second cointegration test because the use of residual covariance test can only be carried out on a single equation, and the second method of co-integration can test multiple equations.

Table 5. *VEC model analysis for model 1*

		DLNEX	DLNPA	D2LNPC	LNREX
Granger Results	DLNEX		1.45915	0.94579	0.9079
			-0.2573	-0.4068	-0.4202
	DLNPA	0.2732		0.79764	1.18718
		-0.7639		-0.4657	-0.3267
	D2LNPC	0.93163	0.08002		5.61084
		-0.4121	-0.9234		-0.0128
	LNREX	0.81449	0.18013	21.9192	
		-0.4577	-0.8366	0	

The first number in each data indicates the statistical significance of lagged items in each variable. The numbers in brackets indicate the corresponding P values.

Table 6. *VEC model analysis for model 2*

		DLNIM	DLNPA	D2LNPC	LNREX
Granger Results	DLNIM		7.62173	2.3536	0.09751
			-0.004	-0.1236	-0.9076
	DLNPA	0.23219		0.79764	1.18718
		-0.7951		-0.4657	-0.3267
	D2LNPC	1.66672	0.08002		5.61084
		-0.2167	-0.9234		-0.0128
	LNREX	3.91592	0.18013	21.9192	
		-0.0387	-0.8366	0	

The first number in each data indicates the statistical significance of lagged items in each variable. The numbers in brackets indicate the corresponding P values.

Table 7. *VEC model analysis for model 3*

		DLNTB	DLNPA	D2LNPC	LNREX
Granger Results	DLNTB		1.44526	0.20999	0.69064
			-0.2605	-0.8126	-0.5134
	DLNPA	1.0456		0.79764	1.18718
		-0.3709		-0.4657	-0.3267
	D2LNPC	1.25797	0.08002		5.61084
		-0.3081	-0.9234		-0.0128
	LNREX	0.1888	0.18013	21.9192	
		-0.8295	-0.8366	0	

The first number in each data indicates the statistical significance of lagged items in each variable. The numbers in brackets indicate the corresponding P values.

From the Granger test results of Model 1, it can be seen that the price level in China is the Granger cause for the fluctuations of the real effective exchange rate between China and Australia and thus affecting Australia's exports to China during 1990 to 2016. It shows that the price of Chinese products will play a role in Australia's economic development.

In order to maintain the real exchange rate stability between the two countries, the relevant departments in the People's Republic of China may promulgate some policies to control the price level.

From Model 2, it can be seen that the Australian imports to China are affected by the prices of Australian domestic products. When the prices of local products are high, Australia's imports of Chinese products will increase. When the prices of local products drop, Australia's imports of Chinese products will decrease.

From Model 3, we know that the prices of Australian products, the prices of Chinese products and the actual effective exchange rate between the two countries are the important reasons for the trade balance in Australia. Australia's trade balance improves when the exchange rate of RMB against the Australian dollar increases (the Australian dollar depreciates). On the contrary, it will worsen the trade balance in Australia.

4.7. Impulse response function analysis

The implication of impulse response is that the effect of impulse on a certain variable in different periods. The meaning of variance decomposition is that the prediction variance of variables at different time points can be decomposed into different parts of impact interpretation, and when N is large, it can be understood as the contribution of shock to the fluctuation of variables.

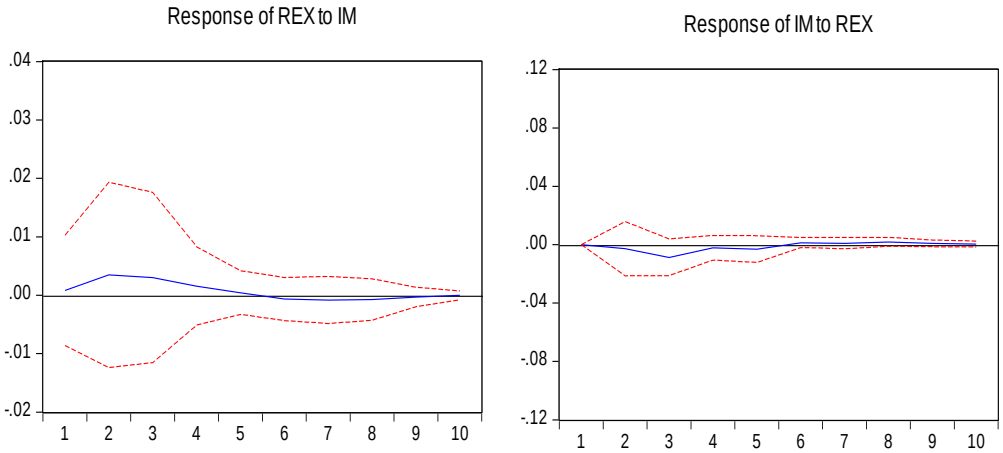

Figure 2. *Impulse response function analysis for model 1*

The blue line is the fluctuations of bilateral real exchange rate and the red line is the response of the changes of Australia's imports from China. The upper half represents the positive impact of the exchange rate while the lower half represents the reverse shock.

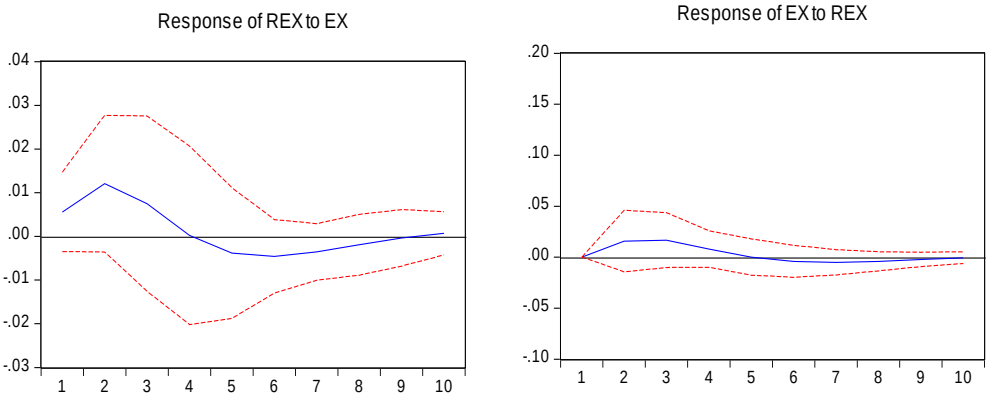

Figure 3. *Impulse response function analysis for model 2*

The blue line is the fluctuations of bilateral real exchange rate and the red line is the response of the changes of Australia's exports to China. The upper half represents the positive impact of the exchange rate while the lower half represents the reverse shock.

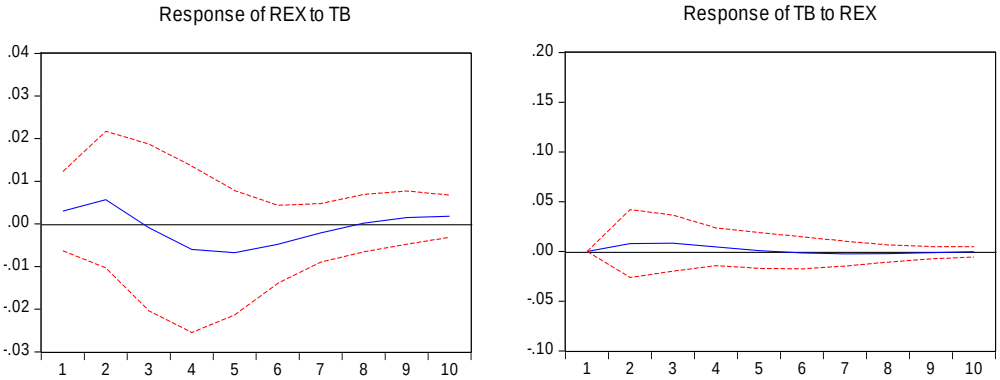

Figure 4. *Impulse response function analysis for model 3*

The blue line is the fluctuations of bilateral real exchange rate and the red line is the response of the changes of the trade balance. The upper half represents the positive impact of the exchange rate while the lower half represents the reverse shock.

5. Conclusions and suggestions

5.1. Conclusions

From the pulse effect diagram to see the following conclusions:

(2) The one-time fluctuation of the real exchange rate between Australia and China in the first phase will cause Australia to make changes to China in the second phase, but with little change and stable in the long run.

(2) The one-time fluctuation of the real exchange rate between China and Australia in the first phase will lead to a large change in Australia's exports to China at the end of the first period and will stabilize over the long term.

(3) The one-time fluctuation of the real exchange rate between China and Australia in the second phase will cause a great change in the trade balance in the second phase but will stabilize in the long run.

To sum up the above analysis, the real effective exchange rate fluctuations will have a positive short-term effect on Australia's export and trade balance to China and

will not change much in the long run. The impact of exchange rate on the trade balance mainly reflects the Australian export to China.

5.2. Suggestions

In the real economic life, the balance of trade between China and Australia will not only be affected by the fluctuation of the bilateral exchange rate, but also depends on the degree of response of the supply price. Since China and Australia signed the free trade agreement in 2014, the J-Curve effect is amplified by the trade agreement because of the agreed supply prices. After the devaluation of Chinese Yuan, the real expense of Australia import from China will decrease and Australia will import more Chinese products as the import prices are fixed in the trade agreement. An effective control of the fluctuation in bilateral AUD - CNY exchange rate would help to reduce the trade volatility between China and Australia. As we can see from the empirical analysis part, the real effective exchange rate fluctuations will have a positive short-term effect on Australia's export and trade balance to China and will not change much in the long run.

To develop economic and trade relations between China and Australia, we need to adapt to the transformation process of the two countries and shift the focus of trade types from resources to services. We believe that a friendly and harmonious trade relationship would bring opportunities for bilateral service trade cooperation between China and Australia.

This article has created a new understanding of the trade relations between China and Australia and made literature contributions. The empirical results in this paper are different from those in previous studies suggesting the J-Curve of exchange rate fluctuations, this paper suggest that the fluctuations of real exchange rate will have impacts for China and Australia in the short run, especially for Australia's exports to China. However, these impacts will not last into long run. As to what factors in the long term have cushioned the impact of exchange rate fluctuations on the trade relations between Australia and China, we still need to continue exploring.

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