Output’s Response to Change in Exchange Rate: Empirical Evidence from China

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Abstract

This study empirically investigates how China’s real output responds to the appreciation of Chinese exchange rate during the period 1980 to 2010. The aim is to explore whether the appreciation of yuan is expansionary or contractionary in China. Since similar empirical studies on the relationship between output and exchange rate are lacking, this empirical work contributes to serve as a guideline on possible directions of effects and future research and it provide several policy implications for China’s policymakers. Cointegration technique and error correction models by using aggregate annual data are applied for empirical analysis. This study finds evidence that yuan appreciation has a negative impact on China’s output in the long run, indicating currency appreciation is indeed contractionary in China which is consistent with theoretical expectation of current and previous studies. In addition, the empirical findings show that China’s real output is positively associated with expansionary monetary policy, fiscal policy and the world output.

Key-words: exchange rate, output’s response, China, cointegration, error correction
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1 Introduction

In this chapter, I put forward the research question of this study under investigation, started by the description of general research background why this topic is interesting and followed by the theoretical arguments of previous research related to this issue. The purpose of this study is brought to the forefront together with shedding light on the need for this empirical work and the structure of the thesis is also given at the end of this section in order to provide a good start for the study.

1.1 Background

China’s economy remarkably experienced unprecedented development and it achieved a successive of substantial economic growth over the period 1980 and 2010. In the past two decades, China’s average annual growth rate has been nearly 10% (WDI, 2011). China’s economy has been in face of continuously increasing trade surplus and rapid growth in foreign exchange rate reserves after joining in WTO in 2001, which makes Chinese exchange rate RMB to receive considerably global attention. The international community considers Chinese currency yuan to be undervalued in terms of increasingly huge current account surplus and thus putting tremendous pressure on Chinese authorities to revaluate the Chinese exchange rate RMB. The pressure of revaluation and the criticism of undervalued yuan are mainly from China’s major trading partners, such as Untied State, Japan and European countries. RMB revaluation makes Untied State in the state of expanding trade deficit and increasing the unemployment. They hope that the appreciation of Chinese currency yuan will serve as a tool to counterbalance trade imbalances. China is blamed for these ongoing imbalances which by facing with booming economy. The overheating and fast growing China’s economy intensifies the mounting external pressure of RMB revaluation. Therefore, this backdrop makes China to become an interesting case study to be investigated.

With regard to theoretical arguments concerning the impact of RMB revaluation on the Chinese economy is controversial, which arouses heated debate around the academic and policy circles at home and abroad. The academic scholars worldwide hold different views which can be summarized into two separate economic strands. The first claims that China should keep RMB stable and should not revaluate RMB so as to
avoid adverse effects. Mundell (2006) and Mudell (2004) stresses that it is unwise to appreciate RMB and claims that a sharp and rapid revaluation is damaging to China’s economy, lie in the fact that rapid revaluation will not only cut down growth, cause economic decline, loss in foreign direct investment, intensify deflationary pressure and decrease employment in China along with significantly shrinking of the profitability of China’s export enterprise. It will also in future destabilize the China’s economy and world economy, thus causing financial crisis. Mckinnon and Schnabl (2003) also oppose RMB revaluation because it exerts adverse effect on interest rate in China. On the other hand, keeping RMB stable plays an important role in stabilizing East Asian economies. Furthermore, Mckinnon and Schnabl (2009) point out that the gradual revaluation of RMB attracts speculative capital flows into China’s financial market which are so-called hot money will lead to the distortion of markets and the destabilization of China’s economy beyond the control. Zhang and Fung (2006) assess the overall impact of RMB revaluation on China’s economy from the perspective of output, overall welfare, trade, investment and consumption. They draw a conclusion that China will suffer from greatest loss which can be attributed to the adverse effects on output caused by the appreciation of yuan and Chinese yuan appreciation will not help to solve the problem of trade imbalances. The authors suggest that Chinese authorities need to minimize change in the value of the yuan. Zhang (2006) formulate Mundell-Stiglitz Hypothesis to quantitatively evaluate the impact of RMB revaluation on China’s economy coupled with several policy scenarios are analyzed. They find evidence that the RMB revaluation exerts adverse effects on China’s economy. RMB revaluation will slow down China’s output growth and erode the competitiveness of China’s export, unless additional policies are undertaken to remove and offset the negative impact, such as fiscal policy and monetary policy. Sun and Ma (2004) and Dai (2011) think that the revaluation of RMB is detriment to China’s economy and implementing appropriate expansionary fiscal or monetary policy can help to minimize the costs of revaluation in pursuit of long-term growth.

Representing the other strand, Tung and Baker (2004), Goldstein and Lardy (2003), Frankel (2006) are in favor of a revaluation. Tung and Baker (2004) think one-time maxi RMB revaluation serves for China’s self-interest, since it will cut down the hot money inflows, relieve the pressure of speculative attacks and enhance the Chinese consumers’ purchasing power by means of boosting per capita income. In the meantime, it also serves for the interest of global economy by correcting those
imbalances, for example it solves job loss problem in US and reduces the level of US trade deficit. Goldstein and Lardy (2003) and Goldstein (2003) argue moderate revaluation of RMB is not only consistent with China’s long-term interest but also beneficial to China’s economy, otherwise the undervalued yuan will bring ongoing net capital inflows of hot money. Frankel (2006) contends that a considerable appreciation of the yuan is deadly needed, due to the fact that revaluation of RMB serves the own interest of China. Shi (2006b) uses the Swan Diagram as a tool to explain gradual RMB appreciation is possible to solve the problem of external imbalance and internal imbalance in China. In addition, the author points that gradual revaluation realizes the smooth adjustment of the imbalances for the rest of world, such as moderating its effect on US trade deficit

The question of whether RMB should be revaluated in China is a central concern of Chinese policymakers which brings it to the forefront. The Chinese authorities and policymakers are unwilling to further revaluate RMB exchange rate. The main concern for this hesitation is that the Chinese authorities are in fear of the negative consequences stemming from RMB revaluation, which are based on the arguments held by prominent economists. To be more specific, these economists who oppose RMB revaluation contend that it has adverse impact on China’s output and leads to reduction in competitiveness of the China’s export sector, thereby increasing unemployment in China and destroying the domestic social stability (Mundell, 2006; Mckinnon and Schnabl, 2003). Another concern with Chinese government official’s worth to mention is that they are afraid of RMB revaluation being consistent with the expectation of traditional theory.

According to the view of traditional theory, currency appreciation is expected to be economically contractionary and currency depreciation expansionary. Currency appreciation in domestic currency will lead to a drop in nation’s real output through the multiplier effect and expenditure switching effect. The cost of purchase of inputs and capital goods from abroad tends to decrease and the relative price of domestic-made products to foreign products tends to increase as the results of appreciation. This will make the domestic product more expensive and switch the demand of domestic goods to imports of foreign goods, thus the export will drop and import will rise. Therefore, a reduction in net export and aggregate demand ultimately contracts the real output.
Contrary to the traditional view, the “New Structuralist” school has emphasized that the potential effect of appreciation or depreciation has been ignored. A growing number of literatures with theoretical arguments point out that devaluation of domestic currency is likely to be contractionary and appreciation of domestic currency is likely to be expansionary\(^1\) by providing various theoretical channels and mechanisms from supply side and demand side to explain\(^2\), which challenges the traditional view. Therefore, the output’s response to currency appreciation is ambiguous on theoretical background. On the empirical basis, a number of existing evidence can be found to support this validity of “contractionary devaluation” hypothesis, especially empirical studies for developing countries. Whether hypothesis is valid in China is still an empirical question deserved to explore.

No unanimous conclusion can be drawn from the literature about the impact of RMB revaluation on China’s economy and whether RMB should revaluate in the future or not. The main reason is related to the conflicting view whether the appreciation of the yuan in China is indeed contractionary as traditional theory expected or expansionary as predicted by New Structuralist School of economics. This conflicting view motivates additional empirical studies on the association between China’s real output and the RMB revaluation.

1.2 Purpose

Against the background above, the main purpose of this study is to empirically analyze the response of China’s output to Chinese exchange rate RMB revaluation over the period 1980 to 2010. The thesis will investigate whether a future appreciation of yuan is contractionary or expansionary in China and it will also test the “contractionary devaluation” hypothesis. Aggregate annual data during the period from 1980 to 2010 consisting of 31 observations is adopted for the empirical analysis. The cointegration technique of ARDL bounds testing approach proposed by Pesaran et al. (2001) as well as error correction model is employed to conduct the empirical work. This econometric technique is appropriate for small sample size in order to generate robust and consistent results without pre-testing unit root. Moreover, it also enables to achieve the

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\(^1\) This is so-called “contractionary devaluation” hypothesis.

\(^2\) The New Structuralist School offers various channels by means of income redistribution effect, expenditure reducing effect and real cash balance effect as well as real wealth effect from demand side and other channels from supply side. I will give more detailed explanations about the channels from the demand side and supply side which are presented in theoretical section 2.3 in this study.
long-run impact and short-run dynamic simultaneously. The empirical results derived from this study, have policy implications regarding how RMB revaluation will influence China’s real output.

In addition, this study also takes into consideration other major factors that may have effects on China real output by assessing their respective potential influence on output behavior. It is essential for the China’s authorities to qualify the relative importance and effectiveness of the domestic monetary policy, fiscal policy and foreign economic activity for policy options. The paper attempts to give an overall picture regarding the roles of the variables corresponding to these macroeconomic aspects plays in promoting economic growth in China, by means of discussing the sensitivity of real output behavior to China’s money supply, China’s government expenditure and world output, respectively. This empirical work enables Chinese policymakers to understand which factors play an influential role in stimulating China’s economy and which can be used as a tool to achieve and maintain long-term sustainable economic growth during the process of decision-making.

The paper mainly focuses on addressing the following three research questions:
1. To identify to what extent and how RMB revaluation influence China’s real output during the period 1980 to 2010.
2. To find out whether RMB revaluation is expansionary or contractionary in China. In other words, does RMB revaluation lead to output contraction or output expansion in China?
3. To check how China’s real output responds to other macroeconomic variables concerned in this study in addition to China’s real effective exchange rate.

1.3 Structure of thesis
The rest of the thesis is organized as follows: Section 2 provides theoretical background concerning the brief overview of China’s economy along with the historical evolution of RMB exchange rate regime in China during the period 1980 to 2010. This section also provides a detailed analysis of theoretical framework provided by traditional theory and New Structuralist School. The two different theories suggest

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3 This research question is also important. Investigation on how China’s real output responds to exchange rate policy, fiscal policy, monetary policy and foreign economic activity will provide opportunity to make inference for policymakers and influence policymaker’s decisions for policy options to achieve the economic goal of maintaining the sustainable long-term growth rate in China.
various channels through which an exchange rate change influences the real output and give necessary theoretical explanations. Section 3 systematically reviews previous empirical findings from the literature regarding the output response to exchange rate change from the perspective of previous studies for multi-country and country-specific, respectively. The empirical findings of China related to this research topic are also given at end of this part. Section 4 presents and specifies the theoretical model of this study for empirical analysis with a focus on explaining the economic model. The motivation and theoretical prediction of economic model are provided.. Section 5 presents the empirical analysis. It starts by describing the data and introduce the econometric methodology of this research based on bounds testing approach as well as error correction technique. CUSUM and CUSUMSQ stability test are employed for empirical analysis to check robustness of the statistical findings from this study and followed by reporting and discussing the estimation results. Section 6 draws conclusions and discusses relevant policy implications derived from this empirical work. The final section also clarifies the empirical contributions of the study and suggests future research.
2 Theoretical Background

In this chapter, I briefly outline macroeconomic performance of China’s economy and evolution of RMB exchange rate regime during 1980 to 2010. The aim is to provide a clear picture of China’s economy and some basic knowledge regarding evolution of China’s exchange rate regime to serve as relevant research background information. In addition, the theoretical framework provided by traditional theory and New Structuralist School related to this issue are reviewed, in order to fully understand how output responds to exchange rate change at the theoretical level.

2.1 China’s economy

China started to undertake market-oriented economic reforms with a strategy of opening up policy in 1978, aimed at achieving a transition from a centrally planned economy towards a market-oriented economy (Hu, 2005). China’s economy has remarkably experienced unprecedented development and reached an impressive growth over the period 1980 and 2010. According to data collected from World Bank, China has becomes one of the fastest growing countries in the world, coupled with the average annual growth rate of real GDP nearly 10%\(^4\). Real GDP in China initially was $183 billion in 1980 and since then it has increased to $3.24 trillion in 2010. China’s real GDP per capita has grown from $186.44 in 1980 to $2425.47 in 2010. The expansion of real GDP as well as real GDP per capita in 2010 has increased more than 18-fold and nearly 13-fold compared to 1980. The average annual growth rates between 1980 and 2010 of real GDP along with real GDP per capita are 10.02% and 8.89%, respectively. The remarkable economic achievements has notably improved the living standards for households and substantially reduced poverty and inequality in China.

After joining in WTO in 2001 and its integration into the global economy, trade liberalization, China has come to play a major role in world trade. China became the sixth largest country in global trade at the end of 2001 and it experienced fast economic growth. During the same period, the unemployment rate in China was around 3% and it has been relatively stable since then. In the past two decades, China shows a strong growth rate also in foreign direct investments. However, China’s

economy is also accompanied by external imbalances with a context of increasingly huge trade surplus particular with United States and rapid growth in foreign exchange rate reserves. In 2001, China’s foreign exchange reserves increased by 18.7 percent. China still suffered from trade deficits until 1990s and trade balance in surplus started in 1994 with export exceeding import. China trade surplus increased dramatically during the period 2003 to 2008. These external imbalances are has been a main motivation for an appreciation of the Chinese currency.

The financial crisis which started in the U.S. in 2008 brought great negative shocks also to China’s economy, thereby slowed down the growth rate. The annual growth rate of China’s real GDP significantly declined in 2008 and 2009, which dramatically dropped from 14.2 percent in 2007 to 9.23 percent in 2009. FDI, export, import and trade surplus in China also declined sharply in 2009 due to the crisis. But China’s economy recovered in 2010, on the ground that Chinese authorities adopted effective stimulus instruments of expansionary monetary policy and maintaining the yuan at 6.8 CNY/USD to stimulate the economic growth.

According to data collected from World Bank, at the end of 2010, the amount of China's GDP in current US dollar had reached to approximately $5.92 trillion and GDP per capita in current US dollar is $4428.46 and the growth rate of China real GDP has reached up to 10.4%. The same year China became the second largest economy in the world. Foreign direct investment (FDI) in China reached up to $124.9 billion and was the second largest in the world at the end of 2010 (Morrison, 2011). In year 2010, China held the largest foreign exchange reserves in world economy. Huge accumulation of China’s foreign reserves can be attributed to the large scale trade surplus and increasingly FDI. In 2010 China was the highest ranked country in term of merchandise exports ($1.75 trillion) and the sending in merchandise imports ($1.52 trillion). Moreover, since the exports are increasing at a faster rate than imports, the trade surplus and current account surplus continues to increase. China’s trade was $232 billion in 2010 compared to a deficit corresponding to $1 billion in 1978. The current account balance showed a surplus of $305.3 trillion in 2010. Meanwhile, China’s broad money supply $M_2$ amounts to 72.6 trillion yuan and the growth rate of $M_2$ was 18.95 percent on year-on-year basis in 2010. The government expenditure raised from 7.62 trillion yuan in 2009 to 8.98 trillion yuan in 2010. The annual growth rate of government expenditure was 17.8 percent at the end of 2010, which corresponds to an
increase of nearly 73 fold in comparison to the 1980 level.

2.2 Evolution of RMB exchange rate regime

Since 1980, the historical evolution of Chinese RMB exchange rate policy can be chronologically identified as three phases: 1980-1993, 1994-2005, and 2006-2010. Each of the phases is described below.

Phase 1, 1980 to 1993: A dual-track exchange rate regime which refers to two exchanges rate system was implemented in 1980. During the period 1981 to 1985, the coexistence of nontrade-related official rate and trade-related internal settlement rate was adopted (Kanamori et al., 2006). The internal rate is lower than the official rate which results in repeatedly and frequently depreciation of the overvalued official rate. The first depreciation occurred in 1981. The depreciation process was repeated for a long period of time. Over the period 1985 to 1994, the coexistence of official rate and market-based foreign exchange swap rate was reintroduced. By the end of 1993, RMB experiences 73% depreciation by compared to the value of 1979. The gap between the official and swap exchange rate gave rise to future reform of the exchange rate in 1994.

Phase 2, 1994 to 2005: At the beginning of the 1994, a single, unified and market-based managed floating exchange rate regime was adopted with the initial exchange rate at 8.7 CNY/USD with narrow band of 0.25 percent to float (Tung, 2007). The new regime is based on market demand and supply. RMB exchange rate experienced a transition via the unification of official rate and swap rate. RMB start to appreciate in 1994 and the value was revaluated to 8.28 at the end of 1997. During the periods 1994 to 2005, de facto dollar peg system was essentially adopted by the Chinese central bank, which fixed RMB to the US dollar roughly at 8.28 CNY/USD in 1997 with narrow band of 0.3 percent on daily basis which aimed at helping to stabilize financial crisis occurred in 1997. The value of the yuan was maintained relatively stable rather than substantially depreciated with the market expectation, which continue to maintain until July 2005.

Phase 3, 2005 to 2010: On July 21st 2005, People’s Bank of China (PBOC) announced that it will implement a new exchange rate policy of “a more flexible and managed floating exchange rate, which is based on market supply and demand with reference to
a basket of currencies and no longer pegged to the US dollar\(^5\) which is replaced by fixed to a basket of currencies. This new policy was in response to the mounting external pressure for the RMB revaluation. PBOC (2005) allows the appreciation of RMB and the value of RMB is adjusted to 8.11, thereby being modestly appreciated by 2.1 percent but the rate of appreciation is very slow and relatively steady. Till July 2008, RMB was appreciated by approximately 21%. After then, RMB was kept relatively stable at 6.83 yuan by the end of 2010 and the government stopped the appreciation of exchange rate policy in order to boost economy due to the global financial crisis in 2008 leading to great negative shocks to the export sectors in China.

However, the adoption of the new exchange rate policy in 2005 brings new waves of expectation for faster revaluation instead of the elimination of the external pressure, owing to the blame for increasingly huge accumulation of foreign reserves and the global imbalance. It can be found that the role of exchange rate policy in China played in the development of China’s economy is important and it is worth mentioning that although the China’s central bank (POBC) reformed exchange rate policy in the past three decades, but China’s real GDP annual average growth rate in general has been managed to be maintained stable and at high level around 10 percent.

2.3 Theoretical framework: Channels of exchange rate’s influence on output

On theoretical background, regarding the output response to exchange rate change is theoretically ambiguous. Currency devaluation can have either expansionary effect or contractionary effect on output, since there is a conflicting view for traditional theory and New Structuralist School. These two different theories suggest various channels through which an exchange rate change influences the real output and give necessary theoretical explanations. In order to make a full understanding of the potential output effects of exchange rate change, it is necessary to be aware that how these channels work at theoretical level.

According to the traditional theory, currency devaluation is expansionary and currency appreciation is contractionary through expenditure-switching effect. To be more

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precise, devaluation will give rise to an initial fall in relative price of domestic product to foreign product, thus export price decreases and becomes relative cheaper, while the import price increases and becomes relatively expensive. By means of expenditure switching effect, the demand of customers will be switched to relative cheaper domestic goods, which result in a substitution from foreign product to domestic product. A decrease in import and increase in export along with making export sectors more competiveness, thus currency depreciation will give rise to the increase in net export and expands the excess aggregate demand. Subsequently it boosts the national output. In the similar way, currency appreciation tend to cause an initial rise in the relative price of domestic products to foreign products as well as reduction in the cost of purchase of inputs and capital goods from abroad, making the domestic products more expensive, thereby export will decline and imported goods from abroad will substitute the domestic goods via expenditure switching effect and thus contracting the aggregate demand and ultimately tends to decrease output. On the other hand, currency depreciation will decrease the cost for foreign investors to invest in nation, thus attracting more foreign direct investment (FDI) by making the international investors to earn more future profits, which will promote output. On the contrary, currency appreciation will increase the cost for foreign investors to invest in countries, thus it leads to loss in FDI and cut down in output.

However, the “New Structuralists” school with several theoretical arguments challenges the traditional view. They provide various channels and mechanism in more detailed framework (Diaz-Alejandro, 1963; Van Wijnbergen, 1986; Cooper, 1971; Lizondo and Montiel, 1989; Krugman and Taylor, 1978; Frenkel and Janhson, 1976; Bruno, 1979; Branson, 1986; Hanson, 1983; Gylfason and Schmi, 1983). According to these authors, the channels can be sorted into two main categories: one category is aggregate demand side channels and the other is aggregate supply side channels.

Several demand side channels for contractionary effect of devaluation on real output are given below:

Hirschman (1949) argues that if a country initially is in the state of trade deficit, devaluation of domestic currency will result in decrease in real national income and have negative impact on aggregate demand. Since the price of import increases and the price of export decreases as the results of currency devaluation. A country in the
context of imports exceeding exports will lead to a decline in real national income and thereby a drop in aggregate demand and national output. This view is also supported by Cooper (1971) and Krugman and Taylor (1978).

Furthermore, Alexander (1952), Frankel and Johnson (1976) and Lizondo and Montiel (1989) point out another channel related to real cash balance effect through which devaluation lead to contraction in aggregate demand. Currency devaluation will increase the relative price of imported inputs to home-made final goods, thereby increasing overall price level at home, which tends to increase the demand for money and thus generating a decrease in the real supply of stock of money (M/P). Given that the excess money demand and a drop in real money balance caused by higher price level, the consumer will cut down the consumption expenditure so as to maintain the holding for real money at desired level (Lizondo and Montiel, 1989), thereby reducing the aggregate demand.

Moreover, Branson (1986), Van Wijnbergen(1986) and Bahmani-Oskooee et al. (2002) put emphasis on that currency devaluation can contract output through expenditure reducing effect. Devaluation will increase the price of imported capital goods and makes it more expensive at home and thus affect the profitability of firms which lead to a drop in investment expenditure. In addition, the interest rate will also increase in response to real devaluation, which tends to cut down the consumption expenditure and investment expenditure. As investment together with consumption is one of important components for aggregate demand, hence decreased investment expenditure and consumption expenditure will lower the aggregate demand.

Diaz-Alejandro (1963) and Krugman and Taylor (1978) insist that currency devaluation has income redistribution effect by reducing the aggregate demand and output. Devaluation tends to transfer the income from the labor groups toward the entrepreneur groups who have high marginal propensity to save for profit. On the one hand, currency devaluation will lead to gained profits for entrepreneurs and thus increasing the income and income share for the entrepreneur. On the other hand, there exist rigid nominal wages and the real wage (W/P) for labors will decrease in response to the rising price level of domestic production. As a consequence, the income share of labors and entrepreneurs will decrease and increase, respectively. Real income will shift from labors to entrepreneurs. The decreased income share of labors will lead to
the aggregate domestic expenditure to contract and national income to decrease and thereby ultimately lowering the aggregate demand and real output. In the similar way, currency appreciation will stimulate the demand and boost output by means of redistributing the income from the entrepreneurs to the labors. Because price level will decline and thus real wage tend to increase as the results of currency revaluation, the increases in income share of labors will expand the aggregate expenditure and stimulate domestic demand. As a consequence, currency appreciation can have expansionary effect on output.

Cooper (1971), Lizondo and Montiel (1989), Kamin and Roger (2000) and Bird and Rajan (2004) put emphasis on that real devaluation in domestic currency through balance sheet effect channel affect aggregate demand. Currency devaluation will increase the value of foreign liabilities in domestic currency, which will induce a rise in cost of external servicing debt in terms of domestic currency, because foreign currency is relatively more valuable than domestic currency after real devaluation. Consequently, devaluation tends to deteriorate the net wealth of balance sheet for a country with large external debt, which gives rise to balance-sheet adjustment. On the ground that the government expenditure will decrease in response to negative effect caused by devaluation. Therefore, aggregate demand and output tend to reduce.

Bahmani-Oskooee et al. (2002) and Kim and Ying (2007) stress that the devaluation caused by speculative attacks will give rise to uncertainty, such as the loss in accessibility to capital markets, which can weaken and harm the confidence of consumers. Devaluation may temporarily increase the expected inflation rate and expected nominal interest rate, because price adjustment to the new steady-state value is not immediate following the devaluation and it takes time for the process of price adjustment, thereby lowering and weakening investor confidence (Copelman and Werner, 1996; Narayan and Narayan, 2007; Kamin and Roger, 2000). The decreased consumer confidence and investor confidence will ultimately lead to drop in consumption and investment component as a consequence of devaluation and thus reducing aggregate demand and output.

Kamin and Roger (2000) and Narayan and Narayan (2007) suggest that capital outflows may be induced by currency devaluation which tends to cause the domestic investors spending and consumers spending to fall and diminish scale of production. It is risky
for a country in face capital outflow due to the possibility of being short of foreign reserves, since it plays essential role in maintaining stability of nation’s economy, thereby reducing aggregate demand.

In addition to the demand side channels mentioned above, supply side channels are also taken into account by the New Structuralist economists through which devaluation can exert contractionary effect on real output growth. The supply side channels are given in the following:

Bruno (1979), Branson (1986), Gylfason and Risager (1984), Hanson (1983), and Van Wijnbergen (1986) show that the main channel for supply side dominating is the cost of imported inputs. Domestic currency devaluation will lead to a decline in supply by means of increasing the firm’s cost of purchase of imported inputs, such as imported raw materials, intermediate production and capital goods, especially for semi-industrialized countries or a country which highly rely on these imported input in manufacturing production and cannot easily be domestically-produced at home. By means of making the price of imported inputs more expensive, the production cost of domestically-produced final good will also increase, which will reduce demand for the imported inputs and slows down the production due to lack of the sufficient input caused by higher cost of production and thus reducing the aggregate supply and the domestic output. Lizondo and Montiel (1989) content that the increasing the cost of imported input due to the fact that devaluation will diminish the profits of the non-traded sector and thus reducing domestic output. The author gives a typical example of Oil Countries. The production cost of firms increase in response to the increased oil price and thus the production will be reduced because of the high production cost. Therefore, the aggregate supply and output will contract.

Additionally, Gylfason and Risager (1984), Branson (1986) and van Wijnbergen (1986) give another supply side channel related to real wage indexation. They find that devaluation raises the overall domestic price level and cause a fall in real wage of workers in response to higher price with rigid nominal wage. As a consequence, the workers will bargain and call for higher nominal wage so as to protect and keep their purchasing power of wages high. If there existing the degree of wage indexation mechanism, the cost of production at home will also increase in response to the increased wages, which lead to contraction in aggregate supply and thus reducing competitiveness of export sectors and output.
Van Wijnbergen (1986) also point out that working capital as the additional supply side channel will give rise to gradual contraction in output after devaluation. Since the firm will be offered less real volume of bank credit following depreciation and the interest rate will rise in response to the devaluation. Therefore, the cost of working capital goes up thereby raising the production cost for those firms which financed working capital from the bank credit and heavily rely on it. Finally, a devaluation or depreciation will lead to reduction in aggregate supply and output.

To sum up, it can be concluded that currency depreciation tends to contract the output by means of various channels. Currency appreciation tends to boost output in the similar way. Such as income redistribution effect, real cash balance effect as well as expenditure reducing effect and so on. Whether currency depreciation is expansionary or contractionary depend on the relative strengths of contractionary effect of supply side and expansionary effect of demand side (Bahmani-Oskooee et al., 2002).
3 Empirical Literature Review

In this chapter, I will systematically review previous studies related to the output effect of exchange rate change from the perspective of multi-country and country-specific, respectively. By means of reviewing relevant existing literatures as proofs regarding the main empirical results, methodology and choice of variables related to this research topic aiming at providing a better understanding of my empirical work in the following section. The empirical findings of China concerning this topic will be presented at the end of this part.

Since there is no consensus regarding output response to exchange rate on theoretical background, thus “contractionary devaluation” hypothesis is of great interest for empirical analysis and has been empirically investigated by abundant studies. A number of literatures find evidence to support this hypothesis, especially empirical studies for developing countries. Various econometric techniques with diverse data samples period for different countries are employed for empirical research on this issue. So far, empirical evidence of existing literatures reveals that the test results are mixed and conflicting for different countries. Therefore, it is essential to systematically review previous empirical findings from the perspectives of the multi-country and country-specific in order to fully understand and find support for this empirical work.

3.1 Previous multi-country studies

Edwards (1986), Agenor (1991), Kamin and Klau (1998) and Moreno (1999) all use pooling time series into panel data for developing countries by employing fixed effect procedure to examine output response to exchange rate change. Edwards (1986) investigates 12 developing countries to analyze the short-run and long-run effects of devaluation on output. The paper finds the output response to devaluation in the first year is negative, but positive in the following year while neutral in the long run. The author also finds that money growth and government expenditure are positively associated with real GDP. Agenor (1991) finds evidence that unanticipated depreciation will boost output growth and exert an expansionary effect on output, whereas anticipated depreciation will reduce output growth, indicating contractionary devaluation effect. However, Morley (1992) use 2SLS regression model to find that depreciation tends to significantly contract output and exerts contractionary effect on output, mainly due to a sharp fall in investment spending, while monetary and fiscal
policy have insignificant impact on output and play minor role. Kamin and Klau (1998) use fixed effects panel regression and 2SLS regression by controlling external variables as well as error correction technique for 27 countries and the finding shows that devaluation has neutral long-run effect but contractionary in the short run. Moreno (1999) uses OLS regression as well as instrumental variable regression for 6 East Asia countries. The result shows that real depreciation has an adverse impact on economic activity in East Asia, indicating currency depreciation is contractionary.

Early studies mentioned above are based on panel regression analysis of time series data and they are criticized for the absence of testing the stationarity and thereby causing spurious regression problem (Upadhayaya, 1999; Narayan and Narayan, 2007). However, most of recent studies discussed below widely adopt cointegration test and error correction model as econometric technique to overcome spurious regression problem.

Chou and Chao (2001) use a newly developed ARDL bounds testing approach within the framework of ARDL model along with error correction model (ECM) to investigate the effectiveness of contractionary devaluation effect for five crisis-affected Asia countries in both short run and long run. Empirical results show that currency devaluation has contractionary impact on output for five countries in the short run but exerts no influence on output in the long run, indicating neutral effect in the long run.

Terence and Eric (2001) employ bounds testing approach developed by Pesaran et al. (2001) to study how output responds to the real exchange rate changes for four Eastern European (EU) economies within the framework IS-LM model. The empirical finding show that real appreciation have negative impact on output in Poland and positive impact for Slovakia but neutral impact for the other two countries in the long run.

Bahmani-Oskooee and Kandil (2007) and Bahmani-Oskooee and Kutan (2008) also adopt ARDL bounds testing approach of Pesaran et al. (2001) to study the short-run and long-run effects of currency devaluation on the domestic output growth for MENA countries (Middle East and North Africa) and Eastern European economies, respectively. These two literatures employ the same reduced form model and error correction model by accounting for the measures of exchange rate and the variables of monetary policy as well as fiscal policy. The former finds the evidence that the
contractionary and expansionary output effect for devaluation exist in MENA. The later also find mixed results for 9 European countries and shows that real depreciation has expansionary effect on output in 4 out of 9 countries and contractionary effect for another 4 countries and no effect for 1 country. The evidence shows that short-run effect cannot last into the long run.

Upadhayaya (1999), Bahmani-Oskooee (1998), Christopolulos (2004) and Kalyoncu et al. (2008) all use bivariate model with the inclusion of two variables output and real exchange rate to examine long-run effects and short-run effects of currency depreciation on output for different countries, respectively. They all employ cointegration technique and error correction model (ECM) for empirical analysis. Upadhayaya (1999) employs error correction model (ECM) by using ADF unit root test and Engle-Granger two step cointegration test for six Asia countries. The result shows that currency devaluation is neutral for 4 out of 6 countries in the long run and devaluation in the remaining two countries exerts contractionary long-run effect on output. Bahmani-Oskooee (1998) also use Engle-Granger cointegration approach and error correction model for 23 less developed countries. The finding reveals that devaluation has neutral impact on 23 LDC’s output in the long run, consistent with Chou and Chao (2001). Christopolulos (2004) and Kalyoncu et al. (2008) who find mixed results for output effect of deprecation in long run and short run for 11 Asia countries and 23 OECD countries, respectively.

Bahmani-Oskooee et al. (2002) use a reduced-form model with taking into consideration fiscal policy variables, monetary policy variables and external shock variables in addition to exchange rate variable to test the relationship between devaluation and output for five Asia countries by employing quarterly data for the period 1976 I to 1999 IV. The paper applies the augmented Dickey-Fuller test and Johansen-Juselius cointegration test as estimation technique to study the relationship. The stability of estimation coefficients are tested by CUSUM and CUSUMQ proposed by Brown et al. (1975) for robustness check. However, the paper finds mixed results for five Asia countries. The response of Korea’s output growth is insignificant to change in real effective exchange rate. There is a positive relationship between output and real effective exchange rate for Indonesia and Malaysia and but a negative relationship for Philippines and Thailand.
Nishigakisia (2007) uses cointegration approach with structural vector autoregressive model to examine the effects of East Asian currencies appreciation on East Asia’s output. The result indicates the appreciation of East Asian currencies exert expansionary effect for East Asian economies. However, Kim and Ying (2007) use cointegration technique with vector auto-regressive model to empirically analyze the impact of devaluation on output in seven East Asian countries. The finding shows that devaluation improves output, indicating the expansionary effect of devaluation in the majority of cases for East Asian countries.

3.2 Previous country-specific studies

In addition to multi-country studies related to output response to exchange rate change, country-specific studies are also of considerably significant interest and have been investigated by substantial empirical studies.

Narayan and Narayan (2007) empirically study the impact of devaluation on output in case of Fuji by using annual data for the period 1970 to 2000. This paper uses a reduced form model for empirical analysis which accounts for the measures of fiscal policy, monetary policy as well as external disturbance. She adopts ARDL bounds testing approach to cointegration. The ARDL-ECM model was estimated to test the long run relationship in Fuji. Hansen (1992) stability test was applied in order to test the stability of coefficients of estimation results. The paper finds that devaluation of Fuji’s dollar exert a positive and significant impact on Fuji’s output in the long run and short run. A 10 percent of devaluation will respectively lead to increase in output by 3.3% in the long run and 2.3% in the short run, which indicates currency devaluation is expansionary on output in case of Fuji. She also concludes that monetary policy measured as money supply and foreign income which is a proxy for external disturbances both have positive and significant impact in both long run and short run. A 1% increase in money supply will respectively yield improvement in output by 0.24% and 0.34% in the short run and long run, respectively. In addition, the finding reveals that fiscal policy proxied by government spending has a positive but insignificant impact on output in Fuji both in the long run and short run.

Ratha (2010) uses annual data spanning the period from 1973 to 2006 and employs a reduced form model by incorporating fiscal policy variable (government expenditure), money policy variable (money supply) and exchange rate policy variables (real
effective exchange rate) to analyze output effect of currency depreciation in India. The author also adopts ARDL bounds testing approach and implements stability test of CUSUM and CUSUMSQ. The empirical evidence shows that the depreciation of the rupee exerts a positive effect on economy activity in India in the long run but exerts a negative but insignificant negative impact in the short run. Therefore, the rupee depreciation isexpansory in the long run and natural in the short run in case of India. The finding also shows there is the presence of a long run relationship among India’s GDP, monetary policy, fiscal policy and exchange rate policy. As described by the author, all of these three policies can be used as effective policy tools in the long run.

Bahmani-Oskooee and Kandil (2007) use annual data for the sample periods 1959 to 2003 to analyze the impact of change in real exchange rate on output by taking into consideration monetary policy variable and fiscal policy variable in case of Iran. ARDL bounds testing approach and error correction model are employed. The fiscal policy and monetary policy are measured as government spending and broad money supply, respectively. The paper finds evidence that currency appreciation in Iran has expansionary output effect in the short run while it exerts contractionary output effect in the long run. As described by the authors that Iran’s real output are positively and statically significant influenced by fiscal policy and monetary policy both in the long run and in the short run as prediction.

Bahmani-Oskooee and Rhee (1997) use quarterly data to empirically investigate whether real depreciation in Korea is indeed expansionary or contractionary during the period 1971 to 1994 by applying Johansen and Juselius (1990) approach to cointegration. Monetary policy, fiscal policy and term of trade in addition to the exchange rate policy are taken into account in the reduced form model. The estimation results show real devaluation of the Korean currency won will have positive impact on Korea’s real output, indicating expansionary effect in case of Korea.

Hsing (2010) employ GARCH process (generalized autoregressive conditional heteroskedasticity) within the framework of IS-LM model to empirically examine the impact of currency depreciation in case of Thailand, and quarterly data during the period 1993 Q1 to 2001 Q1 is used in his study. The empirical results show that real depreciation of Thai currency baht as well as domestic debt both has adverse impact on real GDP in case of Thailand and a 1% rise in real exchange rate lead to decline real
GDP by 0.27% in the long run, indicating currency devaluation is contractionary. The finding also suggests that real output in Thailand is positively influenced by real money supply, government spending, world output and foreign debt which all have positive impact on real GDP. Hsing et al. (2005) use annual data over the period 1971 to 2001 and also employ the same methodology of GARCH in case of Costa Rica. The empirical finding show that real GDP in Costa Rica is positively influenced by real money supply M₂ and world output and real GDP is negatively related to the depreciation of currency colon, indicating contractionary effect of depreciation, while government spending has no statistically significant output effect in the long run.

Trung and Vinh (2011) use monthly data over the period 1995 I to 2009 III by applying ADF test and Johansen cointegration technique as well as error correction model to study the response of economic activity to change in real effective exchange rate, inflation and oil price in the case of Vietnam. They find evidence that output negatively responds to appreciation on in Vietnam. A 10% appreciation of Vietnam dong will decrease the economic activity by 10.78% in the long run. Vo et al. (2000) also use monthly data during 1992 to 1999 by using cointegration technique as well as error correction model to examine the output response of devaluation. The estimation results reveal that real depreciation exert positive and significant effect on output in Vietnam, which is in contrast with the finding of Trung and Vinh (2011).

Dornbusch and Werner (1994) find real appreciation in Mexico may hinder output growth while real depreciation will promote Mexico economic growth. On the contrary, Kamin and Rogers (2000) use quarterly data over the period 1981 to 1995 period with VAR model and cointegration test to study how both output and inflation react as a consequence of devaluation in case of Mexico and arrive at the opposite conclusion that negative impact on Mexico’s output in response to devaluation, indicating currency depreciation is contractionary in Mexico.

3.3 Previous studies for China

To author’s best knowledge, empirical studies on China with regard to this topic are scanty, instead most empirical studies focus on investigating how RMB revaluation affect trade balance or measuring the extent of misalignment of exchange rate in China. Moreover, econometric methods and sample periods applied to empirical analysis for this issue varies. By and large, the empirical results of previous studies on China show
that RMB revaluation has negative impact on China’s real output, indicating in general contractionary effect of currency appreciation in case of China.

Fan et al. (2005) and Wei (2006) both employ computable general equilibrium (CGE) model to quantitatively study economic effects of revaluing RMB on China’s overall economy. The former apply CGE with Social Accounting Matrix (SAM) technique and adopts scenario analysis to analyze the influence of revaluation on China’s Marco economy. The scenario analysis is from the perspective of following dominant aspects: international trade, domestic consumption, foreign direct investment, government spending and revenue. The paper concludes that RMB revaluation has little impact on GDP and FDI while revaluation will increase China’s foreign trade, government revenue and consumption. The latter paper finds there is nonlinear relationship between RMB appreciation and China's real GDP growth. A 5%, 10% and 20% RMB revaluation will respectively lead to 0.29%, 0.73% and 2.18% decrease in real GDP. With speed of revaluation increasing substantially, the negative impact on GDP intensifies more than proportionally. The author draws the conclusion that substantial appreciation (above 10%) has negative effects on Chinese macro economy. However, slight appreciation (below 5%) has little such impact.

Lu and Chen (2007) use annual data over the period 1995-2005 to empirically analyze how China’s GDP responds to RMB exchange rate change by using cointegration technique of two-step Engle-Granger and error correction model (ECM) as estimation method. The paper contends that multiplier effect is the main channel for RMB exchange rate to influence output. The empirical results find evidence that increase real effective exchange rate by 1% will lead to 0.12% decrease in the economic growth rate in China. The substantial appreciation is negatively associated with china economic growth through the multiplier effect and if revaluation is controlled within certain range, RMB revaluation will not remarkably influence economic growth.

Chen and Xia (2002) estimate a multivariate model by employing annual data covering the period from 1978 to 2000 to empirically test the response of China’s real output to RMB devaluation. The Johansen-Juselius cointegration as well as error correction model is used to investigate the long-run impact and the short-run dynamic, respectively. The finding suggests that decline REER by 1% will lead to raise GDP by 0.019% in the long run. Real devaluation of RMB will not have important influence on
aggregate output, since the real output response to change in REER is insensitive.

Hsing and Hsieh (2004) apply Johansen cointegration test with VAR model to investigate the overall impact of exchange rate policy, monetary policy and fiscal policy and inflation on real GDP in China by using annual data for the period 1980 to 2000. They find that in the short run RMB revaluation has positive effect on output, indicating the real appreciation of the yuan will improve China’s output while in the long run it has negative effect on output, implying revaluation will dampen output. The findings also show that real output is positively influenced by real money supply (M₂) in the short run and long run, monetary policy play more important role in boosting output than fiscal policy in the long run, while fiscal policy is more influential in the short run compared to monetary policy.

Shi (2006) uses quarterly data over the period 1991 Q₁ to 2005Q₃ by employing several unrestricted vector autoregression models (VAR) to investigate the effects of currency appreciation on real output growth in case of China. Four main variables are considered in the VAR models. Foreign GDP is the measure of external shocks. Inflation rate is an intermediate variable providing channels to link real exchange rate and output. Then three additional variables are taken into account as the measures of fiscal policy, monetary policy and international financial linkage, namely government spending, money supply (M₂) and US interest rate respectively. Dickey-Fuller (ADF) is adopted for unit root tests together with Johansen cointegration test and the impulse response function were performed to estimate the relationship between output and real effective exchange rate. The estimation results shows that China’s real GDP is negatively influenced by real effective exchange rate and RMB revaluation leads to a decrease in China’s output in the long run, suggesting that there is contractionary effect of RMB revaluation on China’s output.

Hsing and Hsieh (2009) use ADF cointegration test and Newey-West method to empirically assess how China’s real output responded to RMB revaluation with sample data between 1995 Q₁ and 2004Q₃. The article finds that real GDP is negatively influenced by RMB revaluation, indicating RMB revaluation is harmful to China’s output. The findings also reveal that real GDP in China is positively associated with real M₂ which is proxy for money policy and government spending is a proxy for fiscal policy. According to the estimated results, rise real effective exchange rate by 1%
would decline real GDP by 0.938%. It can be concluded that the contractionary effect of RMB revaluation in China, is consistent with expectation of traditional theory.

Table 3.1 and Table 3.2 summarize empirical literature reviews regarding output response to exchange rate change for previous multi-country and country-specific studies, respectively. It can be noted that empirical results are sensitive to sample period, country under consideration, model and methodologies used in study.

**Table 3.1 Empirical literature reviews for previous multi-country studies.**

<table>
<thead>
<tr>
<th>Author</th>
<th>Country/ data/ time period</th>
<th>Variables</th>
<th>Method</th>
<th>Summary of findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Edward (1989)</td>
<td>12 developing countries Pool time series/Panel data 1965-1980 period</td>
<td>Real output, real exchange rate, Money growth, government expenditure, term of trade.</td>
<td>OLS, 2SLS</td>
<td>Depreciation is contractionary in first year and expansionary in second year, but neutral in long run.</td>
</tr>
<tr>
<td>Agenor (1991)</td>
<td>23 developing countries Cross-section panel data /Pool time data 1978-1987</td>
<td>Real output, real exchange rate, Money supply, government spending, foreign output</td>
<td>OLS Fixed effect procedure</td>
<td>Unanticipated depreciation will boost output growth; anticipated depreciation reduces output growth.</td>
</tr>
<tr>
<td>Morley (1992)</td>
<td>28 less developing countries(LDC) Cross section data 1974-1984</td>
<td>Real output, real exchange rate, Money supply, fiscal balance export growth, term of trade</td>
<td>2SLS</td>
<td>Depreciation tends to decrease output and has negative impact on output.</td>
</tr>
<tr>
<td>Bahmani and Kandil2007</td>
<td>9 MENA countries Time series annual data: 1970-2004 period</td>
<td>GDP, REER, money supply, government spending</td>
<td>ARDL bounds test</td>
<td>contractionary and expansionary output effect of currency devaluation in MENA</td>
</tr>
<tr>
<td>Bahmani and Kutan (2008)</td>
<td>9 Eastern European countries Quarterly data</td>
<td>GDP,REER, money supply, government spending</td>
<td>ARDL bounds test</td>
<td>Mixed results for 9 European countries</td>
</tr>
<tr>
<td>Bahmani (1998)</td>
<td>23 LDC</td>
<td>Real output, Real exchange rate</td>
<td>E-G test, ECM</td>
<td>Devaluation has neutral impact on 23 LDC’s output in long run</td>
</tr>
<tr>
<td>Kalyoncu et.al.(2008)</td>
<td>23OECD countries Quarterly data</td>
<td>Real output, Real exchange rate</td>
<td>ADF test, E-G test</td>
<td>Mix results for different countries in the long run and short run.</td>
</tr>
<tr>
<td>Christopolul (2006)</td>
<td>11 Asia countries</td>
<td>Real output,</td>
<td>ADF</td>
<td>Devaluation is contractionary for</td>
</tr>
</tbody>
</table>
Panel data / time series data 1968-1999 period  
Panel data / time series data 1968-1999 period

Real exchange rate Johansen test, ECM 5 out of 11 countries in long run, others are expansionary

Panel data / time series data 1968-1999 period

Real output, Real exchange rate, real money supply, government spending, foreign output and world energy price ADF test J-J test ECM CUSUM Mixed results for five Asia countries.

Table 3.2 Empirical literature reviews for previous country-specific studies.

<table>
<thead>
<tr>
<th>Author</th>
<th>Countries/data/time period</th>
<th>Variables</th>
<th>Method</th>
<th>Summary of findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Narayan (2007)</td>
<td>Fuji Annual data 1970-2000</td>
<td>Real GDP, REER, money supply, government spending, foreign output</td>
<td>ARDL bounds testing, ECM Hansen test</td>
<td>Devaluation has a positive and significant impact on Fuji’s real output in long run and short run</td>
</tr>
<tr>
<td>Ratha (2010)</td>
<td>India Annual data 1973-2006</td>
<td>Real GDP, REER, money supply, government expenditure</td>
<td>ARDL bounds testing ECM CUSUM test</td>
<td>Devaluation has long-run positive effect on economy activity in but exerts a short-run negative but insignificant impact in India.</td>
</tr>
<tr>
<td>Bahmani-Oskooee and Kandil (2007)</td>
<td>Iran Annual data 1959 to 2003</td>
<td>Real GDP, REER, money supply, government spending</td>
<td>ARDL bounds testing ECM</td>
<td>Appreciation exerts a positive impact on output in short run while negative effect in long run</td>
</tr>
<tr>
<td>Bahmani-Oskooee and Rhee (1997)</td>
<td>Korea Quarterly data 1979 I to 1994 IV</td>
<td>Real GDP, REER, money supply, government spending, term of trade</td>
<td>Johansen test J-J test ECM</td>
<td>Depreciation has indeed expansionary effect on real output in Korea</td>
</tr>
<tr>
<td>Hsing (2010)</td>
<td>Thailand quarterly data 1993 Q1 to 2001 Q1</td>
<td>Real GDP, REER, money supply, world income, government expenditure, foreign debt, domestic debt</td>
<td>GARCH</td>
<td>Depreciation has a adverse impact on real output in Thailand</td>
</tr>
<tr>
<td>Hsing et al. (2005)</td>
<td>Costa Rica Annual data 1971 to 2001</td>
<td>Real GDP, real exchange rate, money supply, government spending and tax revenue, world income</td>
<td>GARCH</td>
<td>Depreciation has a adverse impact on real output in Costa Rica</td>
</tr>
<tr>
<td>Trung and Vinh (2011)</td>
<td>Vietnam monthly data 1995 I to 2009 III</td>
<td>Real GDP, real exchange rate, oil price, inflation</td>
<td>ADF test, Johansen test ECM</td>
<td>Appreciation has negative and significant impact on output growth in Vietnam</td>
</tr>
<tr>
<td>Hsing and Hsieh (2004)</td>
<td>China Annual data 1980 to 2000</td>
<td>Real GDP, real exchange rate, monetary policy and fiscal policy variable, world output</td>
<td>Johansen test</td>
<td>Revaluation has positive impact on output in short run and negative impact in long run</td>
</tr>
<tr>
<td>Hsing and Hsieh (2009)</td>
<td>China quarterly data 1995 I to 2004 III</td>
<td>Real GDP, REER, M2, Government spending, stock price, deficit/GDP</td>
<td>ADF test New-West test cointegration</td>
<td>Revaluation is harmful to China’s output in long run. 1% revaluation decrease real GDP by 0.938%.</td>
</tr>
</tbody>
</table>
4 Theoretical Model

In this chapter, I will introduce the theoretical model of my thesis by briefly outlining and commenting on previous research related to model specification and choice of variables aiming at providing a good explanation for the use of theoretical model. The motivation and contribution of this model for empirical work are emphasized. In addition, theoretical expectations of this model are clearly pointed out.

By systematically reviewing existing studies related to the output effect of exchange rate change on output mentioned previously, it could be found that some scholars use bivariate model for empirical analysis on this issue with the inclusion of two variables real output and real exchange rate in their literatures. (Bahmani-Oskooee et al., 1998; Upadhayaya, 1999; Kalyoncu et al., 2008; Christopolulos, 2004). However, Edward (1986) contended that using bivariate model could give rise to unreliable and biased estimated results due to omitted variables problem. He argued that it is crucial to take into considerations the possible role of other important elements that have influence on output when investigating the output effect of exchange rate. He suggested that important factors like monetary policy, fiscal policy and external shock should be accounted for in a multivariate model which is an advance over the bivariate model. The multivariate model extended by incorporating the corresponding variables of monetary policy, fiscal policy and external shock is widely used by abundant scholars for empirical analysis of output effect of exchange rate in the existing literatures6.

According to Narayan and Narayan (2007), given that 31 annual observations in their study regarding output effect of devaluation in case of Fuji, they argues that variables corresponding to fiscal, monetary and external disturbance by taking into account model are enough to study the output response to exchange rate change. The explanations are given as follows: First, adding one more variable into the model will cause the loss in degree of freedom problem and consequently makes the validity of elasticity in estimation results highly questionable. Second, on the ground that the objective and nature of their study is to examine the output response to exchange rate rather than examining the relevant factor for output from aggregate demand side and

aggregate supply side, the choice of variables in the model are sufficient and in line with the existing literature while adding other influencing factors into the model will be more lengthy and beyond the scope of the objective in their study. Trung and Vinh (2011) also justify that including more variables in the model will lead to the decrease in the degree of the freedom.

Motivated by the above scholars, I will use a reduced-form model in this study to explore whether RMB revaluation is contractionary or expansionary in China. The choice of model specification and variables are based on previous studies of Moreno (19999), Bahmani-Oskooee et al. (2002), Hsing and Hsieh (2004), and Narayan and Narayan (2007). They all account for fiscal policy and monetary policy along with external shock in their study. Bahmani-Oskooee et al. (2002) and Narayan and Narayan (2007) both used internal sector and external sector as main channels to drive the economies. Money policy and fiscal policy are taken as a proxy of the internal sector, while exchange rate and foreign output are used to capture external sector in their studies.

Following these scholars mentioned above, this study will also incorporate four key determinants of output growth into the model: real effective exchange rate, money policy variable, fiscal policy variable and external shock variables, in order to examine how they respectively influence China’s real output behavior. The knowledge of China’s real output behavior influenced by the monetary policy, fiscal policy and external shock are of particular direct relevance for economic policy, lie in the fact that profound policy implications can be derived from this knowledge which is helpful for Chinese policymakers in future design of effective policies. The main objective is to empirically analyze the response of China’s real output to RMB revaluation, so the sensitivity of China’s real output to real effective exchange rate is a key concern for China’s policymakers. Another concern of this study is to identify to what extent and how China’s real output will statistically respond to domestic monetary policy, fiscal policy and external shock, respectively. It provides opportunity for policymakers to attain a comprehensive understanding of their respective potential influence and importance on economic activity and thus influencing the decision-making process on policy design and served as policy options.

Government expenditure and money supply are respectively measured as the
instruments of fiscal and monetary policy. Meanwhile, external shock is proxied by the world output in this study. All the variables in the model are aggregate annual data covering sample period 1980 to 2010 to examine and forecast the potential effect of the variables concerned on influencing China’s economy.

The reduced form theoretical model employed in this study is in the following form:

$$GDP_t = f(\text{REER}_t, M_t, \text{GOV}_t, \text{YW}_t)$$

I will use the above reduced model in log form to serve as the baseline long run model to examine the existence of long-run cointegration relationship among the dependent variable and explanatory variables in China for the sample period 1980 to 2010, which is specified in the form of equation (1). The model is expressed in the following form:

$$\ln GDP_t = \alpha + \beta_1 \ln \text{REER}_t + \beta_2 \ln M_t + \beta_3 \ln \text{GOV}_t + \beta_4 \text{YW}_t + \epsilon_t \quad (1)$$

Here,

- \(\ln GDP\) = China’s aggregate real Gross Domestic Product in natural log form.
- \(\ln \text{REER}\) = China real effective exchange rate in natural log form.
- \(\ln M\) = China’s broad money supply \((M_2)\) in natural log form.
- \(\ln \text{GOV}\) = China’s government expenditure in natural log form.
- \(\text{YW}\) = World output index

In equation (1), GDP is a proxy for real output in China, M, GOV and YW serve as the measures of monetary policy, fiscal policy and external shock, respectively. The subscript \(t\) represents time period range from 1980 to 2010, \(\alpha\) is constant term, \(\epsilon_t\) is error term and \(\beta_i\) is the elasticity of the explanatory variable to be estimated.

The parameter \(\beta_1\) in the model measures the sensitivity of the dependant variable to the relevant explanatory variable.

The \(\beta_4\) in equation (1) is the sensitivity of China’s real output to change in China’s REER. It captures the effect of RMB revaluation on output in case of China, which is the primary empirical concern and interest in this study.
According to traditional theory, revaluation of currency is expected to reduce export through increasing the relative price of domestic goods, but also reduce the cost of purchase of inputs and capital goods from abroad and hence imported goods will substitute the domestic goods and thus contracting the aggregate demand, which tends to decrease output. Therefore, currency appreciation is expected to be negatively associated with output and has a contractionary output effect in conventional view. Furthermore, in reference to previous studies regarding the output response to RMB exchange rate, the existing evidence shows that in general RMB revaluation exert a negative influence on China’s output in long run, which is in line with the view of traditional theory related to the contractionary output effect of currency appreciation.

To motivate the empirical analysis, in accordance with the rational expectations of traditional theory and the findings of previous studies for China (Shi, 2006; Hsing and Hsieh, 2009; Hsing and Hsieh, 2004), we can draw on the prediction of the theoretical model, the coefficient of REER in this study is expected to carry a negative sign, that is $\beta_1 < 0$. It suggests that a rise in REER by 1% lead to $\beta_1 \%$ decline in output. If it is statically significant, it indicates RMB revaluation exerts a contractionary output effect in China. If not statically significant, it suggests that output effect of RMB revaluation is neutral in China.

The parameter $\beta_2$, $\beta_3$, $\beta_4$ reflect the sensitivity of China’s real output to change in China’s money supply, China’s government expenditure and world output, respectively. They capture their respective potential effect of domestic monetary policy, fiscal policy and foreign economic activity on real output in China.

According to the empirical studies by Edwards (1986), Moreno (1999), Bahmani-Oskooee et al. (2002), Narayan and Narayan (2007) and Hsing (2010), money supply and government spending are both expected to carry positive sign, because expansionary monetary policy and fiscal policy are considered that positively respond to domestic output based on the traditional theory. In addition, these scholars emphasize that foreign output is expected to have the positive sign, an increase in foreign output will raise the demand for domestic export, thus increasing domestic output.

Following them, we expect that the coefficients of China’s broad money supply, China’s government expenditure and world output in this study all carry positive sign as follows:
\( \beta_2 > 0, \beta_3 > 0 \) and \( \beta_4 > 0 \).

The expected positive elasticity for money supply and government expenditure, indicating that domestic money policy and fiscal policy are expected to positively influence the performance of China’s output. A 1% increase in money supply and government expenditure will lead to a \( \beta_2 \% \) and \( \beta_3 \% \) rise in China’s output, respectively. The coefficient of world output is positive as we expected, suggesting that China’s output is positive response to world output. A 1% increase in world output will yield \( \beta_4 \% \) increase in China’s output.

It is necessary and crucial to put emphasis on the motivation and contribution of the use of this theoretical model to motivate and conduct the empirical work, which can be summarized as follows: The primary motivation of the use of the model aiming at examining and forecasting whether the output effect of revaluation is contractionary or expansionary in the long run, so we pay more attention to the empirical results of \( \beta_1 \).

More specifically, we are interested in the relevant implication derived from the empirical results of this study concerning the effect of RMB revaluation on the output performance for China’s economy. This is the major empirical concern of this empirical work, on the ground that it can provide useful policy implication for policy makers to make a better understanding of the effectiveness of the exchange rate policy as an instrument to influence real output performance in China. It is vital to guide China’s policy makers’ decision regarding the formulation of relevant exchange rate policy in the future and provide more statistical support for the authorities to intervene in the policy design. This is one contribution of using this model for empirical work.

In addition, the empirical work by adopting this model can also contribute to obtain other useful empirical implications from the theoretical model, given that the empirical results can be used for forecasting. Therefore, it can be as a benchmark and guidelines to provide evidence for policy makers. On the one hand, we can know the extents of their respective influence on China’s real output in the long run, by comparing their respective estimated elasticities \( \beta_1 \), thus we can make a comprehensive understanding of their potential different effect on China’s real output behavior and forecast which variable in the model play more influential role in boosting output via comparative static analysis mentioned above. On the other hand, from the policy standpoint, we can provide evidence that which stabilization policy gives better performance in maintaining sustainable economic growth, by comparing their magnitudes of coefficients. We can qualify their relative importance with regard to stimulating
China’s economy. It provides a good reference for Chinese authorities regarding which policy can be considered to pursue sustainable economic growth and is of particular relevance for the policy makers with respect to formulating useful policy and then putting in force to achieve the success of policy.

Therefore, the theoretical model and the variables in this study are well supported by the motivations as described above and they reasonably create a background for the empirical work to test the effectiveness of monetary and fiscal policy and external shock on influencing real output in China, respectively. The forecasting power of the empirical results in this study may serve the policy maker’s interest for policy options.
5 Empirical Analysis

In this chapter, I will conduct empirical analysis to answer research questions, started by describing the data and presenting empirical methodology of this research on basis of bounds testing approach and error correction technique along with CUSUM and CUSUMSQ stability test aiming at checking the robustness of statistical findings. The motivation of the empirical methodology is clearly point out. Estimation results with discussion and analysis are reported at the end of this section.

5.1 Data

This empirical work employs aggregate annual time series data for a total of 31 observations under consideration spanning the time over the period 1980 to 2010 so as to empirically study the response of real output in China to RMB revaluation. Since aggregate annual data during this period for the following relevant variables are available. Five variables are used in the study, namely China’s real GDP, China’s real effective exchange rate, China’s government expenditure, China’s broad money supply and world output index. The above variables are expressed in natural logarithms form except world output index. The use of natural log form in this study is for the sake of interpreting the estimations results directly in terms of elasticities. The notable benefits of using log form worth mentioned are that log form can reduce the problem of heteroscedasticity and also avoid the problem of muticollinearity in the estimation so as to derive more accurate results (Gujarati, 1995; Garfar, 1988). The annual data of real effective exchange rate for China for empirical work can be collected from International Financial Statistics. The annual data of China’s real GDP, money supply, government expenditure in this study is available from the China statistic yearbook 2011 and National Bureau of statistics of China. World GDP and GDP deflator in world output index are collected from the World Development Indicator (WDI) in World Bank database (2011). Further details on the definitions and source of data are given in a Data Appendix.

5.2 Methodology

This empirical study adopts recent cointegration analysis technique of ARDL bounds testing approach proposed by Pesaran et al. (2001), along with the use of error
correction model to investigate how China’s real output responds to RMB revaluation covered the period over 1980 to 2010. According to Pesaran et al. (2001), firstly, this approach can obtain super consistent, unbiased and robust results of the long run elasticity and short run elasticity for small sample sizes. Secondly, all variables in ARDL approach are assumed to be endogenous and the endogenetity problem can be effectively avoided by using an appropriate augmentation in the two-step procedure of bounds testing approach and the series correlation problem can also be corrected and avoided within the ARDL framework by introducing the dynamic structure of lag variables (Halicioglu, 2004; Zambe Serge Constant and Yue, 2010; Ghatak and Siddiki, 2001; Rashid, 2010).

The choice of bounds testing approach to cointegration in this study, as an alternative of other cointegration technique is based on the following considerations stated below:

First, it can be applied with limited sample data and performs well and efficiently for small sample size. Given annual time series in this study spanned over 31 years which results in a sample size of 31 observations, hence it is quite appropriate for currency case. With better small sample properties, it is far superior to the traditional bivariate Engle and Granger (E-G) two step residual-based cointegration, multivariate system-based for Johansen and Juselius cointegration and maximum likelihood based Johansen cointegration, all of which require large sample size for validity and are not reliable for small sample size (Narayan, 2005; Tang, 2007; Ozturk and Acaravci, 2011).

Secondly, the integration order for relevant variables are not necessarily the same, since it can be applied regardless of whether the order of integration of regressors are I(1), I(0) or mixture of both and thus there is no needs for pre-testing the unit root and order of integration (Choong el at., 2005; Pesaran and Shin, 1999; Akinlo, 2006; Sharifi-Renani, 2007 and so on). Whereas, traditional cointegration tests need that the underlying variables integrated of the same order and inevitably involve pre-testing unit root which will induce a low power problem with uncertainty for analysis (Pesaran et al., 2001). Besides, Johansen test and Johansen and Juselius test require estimating large number of specifications and a system of equations (Tang, 2007). The benefit of

8 By reviewing the existing literatures shown in previous section, we can clearly find that the ARDL bounds testing approach are widely used for currency case with annual observations by most of scholars in their study.
this methodology compared with the traditional cointegration approaches is that it is less cumbersome to use and the variables are not transformed much and as such result is easier to interpret.

Motivated by the advantages of ARDL bounds testing and given a small sample size with 31 observations in my study, the application of this more advanced and robust cointegration technique of ARDL approach can obtain a more reliable and robust estimation results than the use of traditional cointegration approach which is unreliable for small sample size. Therefore, ARDL bounds testing approach is quiet appropriate application and it provides interesting venue for empirical analysis of this study.

Besides, this study also adopts CUSUM (cumulative sum of recursive residual) and CUSUMSQ (cumulative sum of squared recursive residuals) test for robustness check which is proposed by Brown et al. (1975), aiming at testing the stability of coefficients in the long run model for robustness check of the statistical findings. Assessing the stability of the model is crucial, due to the fact that if we can confirm estimation results of this study is stable over the period 1980 to 2010, which will make our prediction and statistic inference more reliable and robust so that the empirical results derived from this study are safe to provide reliable policy implication for policy makers and guide them to formulate a more effective policy. Lie in the fact that the stability test creates the background for achieving the success of policy, so it is also an important part of this empirical work.

Prior to empirical analysis, it is worth to mention that ARDL bounds testing approach and the analysis procedures that I will conduct in this study, will be achieved in three stages:

In the first stage, bounds testing procedure will be conducted. According to Pesaran et al. (2001), bounds testing procedure involves sub-two steps:

The first sub-step is to estimate the following autoregressive distributed lag formulated in form of error correction model (conditional ARDL-ECM) in equation (2) by application of OLS method, once order of lag length on the each first differenced variable in equation (2) is identified.

\[ \Delta \ln GDP_t = \alpha + \sum_{i=1}^{p} \lambda_i \Delta \ln GDP_{t-i} + \sum_{i=0}^{p} \lambda_2 \Delta \ln REER_{t-i} + \sum_{i=0}^{p} \lambda_3 \Delta \ln M_{t-i} + \]
\[ \sum_{i=0}^{p} \lambda_4 \Delta \ln \text{GOV}_{t-i} + \sum_{i=0}^{p} \lambda_5 \Delta \text{YW}_{t-i} + \sigma_1 \ln \text{GDP}_{t-1} + \sigma_2 \ln \text{REER}_{t-1} + \sigma_3 \ln \text{M}_{t-1} + \sigma_4 \ln \text{GOV}_{t-1} + \sigma_5 \text{YW}_{t-1} + \varepsilon_t \]  

(2)

Where Δ is first-differenced operator, α is a constant, \( \varepsilon_t \) is error term and \( \sigma_i \) is the estimated coefficient of one period lagged level of variables which represents long run multiplier, while \( \lambda_i \) capture the short run dynamic effect on GDP. \( p \) is the maximum order of lag length. All variables in equation (2) are previously explained.

The second sub-step is to conduct joint significance F-test for equation (2) to test the presence of cointegration in equation (1), which requires to impose restrictions on \( \sigma_i \) in equation (2), the estimated coefficient of one period lagged level of variables, namely \( \ln \text{GDP}_{t-1}, \ln \text{REER}_{t-1}, \ln \text{M}_{t-1}, \ln \text{GOV}_{t-1}, \text{YW}_{t-1} \), jointly equal to zero.

The null hypothesis of F-test is cointegration while the alternative hypothesis cointegration among variables concerned, denoted as follows:

\( H_0: \sigma_1=\sigma_2=\sigma_3=\sigma_4 = \sigma_5=0 \), indicating no cointegration.

\( H_1: \sigma_1 \neq \sigma_2 \neq \sigma_3 \neq \sigma_4 \neq \sigma_5 \neq 0 \), indicating cointegration.

Each variable in equation (1) is used as dependent variables to calculate F-statistic to ascertain the unique cointegration relationship in the model, which is denoted by \( F_y \) (GDP \( | \) REER, GOV, YW), \( F_{\text{REER}}(\text{REER} \mid \text{GDP, M, GOV, YW}) \), \( F_M \) (M \( | \) GDP, REER, GOV, YW), \( F_{\text{GOV}}(\text{GOV} \mid \text{GDP, REER, M, YW}) \), \( F_{\text{YW}}(\text{YW} \mid \text{GDP, REER, M, GOV}) \).

Pesaran et al. (2001) point out that the F-test is non-standard distribution with the null hypothesis of no cointegration, irrespective of whether integration order of regressors are I(0) or I(1) the mixture of both and he provides new critical value for F-test⁹. The critical value of F-test in bounds testing is determined by the number of regressors \( k \) contained in model, the number of observations \( n \) and whether intercept and trend are included in the ARDL model. Narayan (2004) provides two sets of critical value of F-test for small sample sizes (30-80 observations) which are appropriate for this empirical work. The decision of cointegration involves in comparing the F-statistic with critical value bounds. At given conventional level of significance of \( t \) (t=1%, 5% or 10%), She argue that if the calculated F-statistics is bigger than respective upper critical bound I(1), then the null hypothesis \( H_0 \) is rejected, implying cointegration. If

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⁹ Pesaran et al.(2001) provide critical values of bounds testing based on large sample sizes of 500 and 1000 observations and 20,000 to 40,000 replications, respectively (Narayan, 2004).
the calculated F-statistic is smaller than the lower critical bound I(0), then Ho is accepted, indicating absence of cointegration. If test statistic falls inside the lower and upper critical bound value, the result is inconclusive (Narayan, 2004).

In the second stage, if the unique cointegration is ascertained, the long run and short run elasticities are estimated by using conditional ARDL long-run model in equation (3) and corresponding error correction short-run model in equation (4).

In relation with estimation of the second stage, attention must be paid to a number of issues. Firstly, it is essential to select optimal lags length in conditional ARDL long run model in equation (3) before estimating long run elasticities. Selecting the appropriate optimal lag structure in ARDL long-run model will be based on Schwarz Bayesian Criterion (SBC). Then, long run elasticities could be obtained by estimating selected ARDL model.

\[ \ln GDP_t = \alpha_1 + \sum_{i=1}^{q_1} \gamma_i \ln GDP_{t-i} + \sum_{i=0}^{p_1} \delta_i \ln REER_{t-i} + \sum_{i=0}^{p_2} \mu_i \ln M_{t-i} + \sum_{i=0}^{p_3} \omega_i \ln GOV_{t-i} + \sum_{i=0}^{p_4} \varphi_i \ln W_{t-i} + e_t \]

(3)

Where, p and q are the optimal lag lengths.

The ARDL model of bounds testing approach includes the lagged dependent variables to distinguish and achieve the short-run effect and long-run effect simultaneously. Consequently, the short run elasticity and long run elasticity differs and should be distinguished. We can derive the long run elasticity from estimates of ARDL in equation (3) to establish the long run relationship for equation (1):

\[ \ln GDP_t = \alpha + \beta_1 \ln REER_t + \beta_2 \ln M_t + \beta_3 \ln GOV_t + \beta_4 \ln W_t + e_t \]

The long run coefficient of real effective exchange rate \(\beta_1\) is obtained as \(\beta_1 = \sum_{i=0}^{p_1} \delta_i / (1 - \sum_{i=1}^{q_1} \gamma_i)\). In the similar way, the long-run elasticity of money supply, government spending and world output are respectively computed as \(\beta_2 = \sum_{i=0}^{p_2} \mu_i / (1 - \sum_{i=1}^{q_1} \gamma_i)\), \(\beta_3 = \sum_{i=0}^{p_3} \omega_i / (1 - \sum_{i=1}^{q_1} \gamma_i)\) and \(\beta_4 = \sum_{i=0}^{p_4} \varphi_i / (1 - \sum_{i=1}^{q_1} \gamma_i)\).

Secondly, the short run elasticities could be obtained by estimating an ECM
representation for selected ARDL model in equation (4):

\[
\Delta \ln \text{GDP}_t = \alpha_2 + \sum_{i=1}^{q_1} \gamma_i \Delta \ln \text{GDP}_{t-i} + \sum_{i=0}^{p_1} \gamma_i \Delta \ln \text{REER}_{t-i} + \sum_{i=0}^{p_2} \mu_i \Delta \ln \text{M}_{t-i} + \\
\sum_{i=1}^{q_1} \Delta \ln \text{GOV}_{t-i} + \sum_{i=0}^{p_2} \Delta \ln \text{YW}_{t-i} + \theta \text{ECM}_{t-1} + \epsilon_t
\]  

(4)

Where,

\[
\text{ECM}_t = \ln \text{GDP}_t - \alpha_1 - \sum_{i=1}^{q_1} \gamma_i \ln \text{GDP}_{t-i} - \sum_{i=0}^{p_1} \delta_i \ln \text{REER}_{t-i} - \sum_{i=0}^{p_2} \mu_i \ln \text{M}_{t-i} - \\
\sum_{i=1}^{q_1} \omega_i \ln \text{GOV}_{t-i} - \sum_{i=0}^{p_2} \phi_i \ln \text{YW}_{t-i}
\]

(5)

In equation (4), \( \theta \) measures the speed of the adjustment. It is expected to be negative sign and statistically significance, implying the convergence toward long-run equilibrium. \( \text{ECM}_{t-1} \) is error correction term with one-period lag which can be derived from equation (3) through the linear transformation. The coefficient \( \gamma_i \) of the remaining variables in equation (4) represents the short run dynamic.

In the third stage, it is vital and necessary to assess the stability of the estimated long-run parameters in the theoretical model so as to check the robustness of the empirical results, which is also one concern of study. On the ground that once we ascertain the validity of our empirical results, it will provide effective and important policy implication for policymakers. To this end, this study will adopt the CUSUM and CUSUMSQ stability test.

The null hypothesis for both tests is that all coefficients in the mode are stable. If the respective plots of CUSUM as well as CUSUMSQ both stay within and do not cross the critical bound line at 5 percent significance level, we cannot reject the null hypothesis, indicating that all coefficients of results are stable.

If we do not reject Ho, the long-run estimation results of my study are stable over the period 1980 to 2010, which make our empirical results more reliable and robust. If we reject Ho, it suggests the coefficients in the model are unstable over period 1980 to 2010. In this study, we expect all coefficients in the mode are stable.
5.3 Empirical results

5.3.1 Cointegration analysis

In the first stage, I apply bounds testing approach to test the existence of cointegration in equation (1) by conducting F-test\(^{10}\). According to Bahmani-Oskooee and Goswami (2003), F-test results are sensitive to lag length. Therefore, it is an important task to identify the appropriate order of lag length in equation (2), before embarking on the estimation to calculate the \(F_y\)-statistic. Given that the samples in our study are on annual basis and following the strategy of previous studies which adopted Hendry "General to Specific Approach” to choose lag length\(^{11}\), we estimate equation (2) with lag lengths ranging from 2 to 3 for each first differenced variable respectively. Since the limited sample size of 31 annual observations in my study is relatively small, we obtain the critical values of F-test from Narayan (2004) who provides appropriate and specific critical values for this case. We extract the critical values of F-test for a model contained with 4 regressors and 31 observations and with an intercept which refers to case II. Then, we calculate the \(F_y\)-statistics for these two lag lengths and compare the calculated \(F_y\)-statistics with the two sets of critical value \(I(0)\) and \(I(1)\) at different significance levels, respectively. The calculated F-statistic results denoted as \(F_y\) (GDP | REER, M, GOV, YW) for different lag length are reported in table 5.1.

<table>
<thead>
<tr>
<th>Order of Lag</th>
<th>The calculated (F_y)-statistic</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>1.6480</td>
<td>no cointegration</td>
</tr>
<tr>
<td>3</td>
<td>14.0252</td>
<td>cointegration</td>
</tr>
</tbody>
</table>

Table 5.1 The calculated \(F_y\)-statistic for different lag length

\(^{10}\) In this paper, I will use Microfit for window 4.1 version statistical software which specifically designed by Pesaran and Pesaran (2003) to conduct the estimation of ARDL bounds test cointegration approach. All the long-run and short-run results of ARDL model and error correction model in the following estimation are obtained from Microfit 4.1.

\(^{11}\) Pesaran et al (2001) suggest that the length of lag is chosen by user and suggestion on fixed lag length to conduct the F-test. He proposes that for annual observation usually adopting the order of lag 2 or 3 to select the parsimonious specification. Besides, when using annual data for ARDL estimation, most of scholars usually use 2 or 3 as the optimal lag length in their study to select a parsimonious model by gradually eliminating not significant lag length, in order to economize on the degree of freedom (Halicioglu, 2004; Narayan and Narayan, 2007; Tang, 2002; Dritsakis, 2011 and so on). According to the rule of thumb, on the basis of annual data the maximum lag length is 3 (Tang, 2007).
As shown in table 5.1, it can be noted that the calculated $F_y$-statistic differs at each lag length. When lag lengths is 2, the calculated $F_y$-statistic 1.68, is lower than the lower critical value bound of 2.581 at 10 percent significance level. Hence, Ho cannot be rejected, suggesting no cointegration by using lag length 2. However, when lag length is 3, the calculated $F_y$-statistic is 14.0252, greater than the upper critical bound of 5.785 at 1 percent significant level. Ho is rejected, indicating cointegration among China’s output and the explanatory variables at this lag length. Hence, the lag length of 3 will be used to conduct the following estimation.

Pesaran et al. (1999) emphasize it is not appropriate for more than one cointegration among the explanatory variables and dependent variables when conducting bounds testing approach. A unique cointegration in equation (1) is expected. Therefore, each variable is used as dependent variables so as to identify the unique cointegration relationship. The cointegration test results of F-statistic and the critical value are shown in table 5.2.

<table>
<thead>
<tr>
<th>Table 5.2 Cointegration test results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Critical values bounds of F-statistic: case II intercept and no trend</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>k</th>
<th>90% level</th>
<th>95% level</th>
<th>99% level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I(0)</td>
<td>I(1)</td>
<td>I(0)</td>
</tr>
<tr>
<td>4</td>
<td>2.581</td>
<td>3.513</td>
<td>3.003</td>
</tr>
</tbody>
</table>

Calculated $F_y$ (GDP | REER, M, GOV, YW)$=14.0252$
Calculated $F_{REER}$(REER | GDP, M, GOV, YW)$=2.8701$
Calculated $F_{M}$ (M | GDP, REER, GOV, YW)$=2.1948$
Calculated $F_{Gov}$(GOV | GDP, REER, M, YW)$=2.2816$
Calculated $F_{YW}$(YW | GDP, REER, M, GOV)$=2.3013$

Note: Critical value is extracted from Narayan(2004)

As shown in table 5.2, we can clearly find that when China’s GDP is used as the dependent variables, the $F_y$-statistic of 14.0252 is bigger than 5.785 at 1 percent significance level, we rejected the null hypothesis of no cointegration, so the presence of cointegration among China’s output and explanatory variables concerned. While it can be observed that when other variables in equation 1 respectively act as dependent
variable, namely China’s real effective exchange rate, China’s money supply, China’s government expenditure and world output, all the corresponding calculated F-statistic indicate no cointegration relationship. To be more precise, the calculated $F_{\text{REER}}$-stastic of 2.8701 is smaller than the lower critical value bound of 3.003 at 5 percent significance level. The calculated $F_{\text{M}}$-statistic of 2.1948, $F_{\text{GOV}}$-statistic of 2.2816 and $F_{\text{YW}}$-statistic of 2.3013, are all found to be lower than the lower bound critical value of 2.581 at the 10 percent level of significant. Hence, Ho cannot be rejected, when the remaining variables are respectively used as dependent variable. As described by Narayan and Narayan (2004), it is worth pointing out that the use of ARDL bounds testing approach can reveal exactly which variable is appropriately supposed to be as dependent variables in the model.

As the consequence, the calculated F-statistic results in this study confirms that there exists a unique cointegration over the sample period 1980 to 2010 when China’s GDP is taken as dependent variable.

5.3.2 Long run and short run elasticities

Since significant and unique cointegration relationship is already ascertained in this study, the second stage is to employ ARDL approach so as to estimate the corresponding long run and short run elasticities for conditional ARDL long-run model along with corresponding short-run error correction model. It is essential to choose the optimal lag structure of conditional ARDL long-run model in equation (3). The maximum order of 3 lag is accounted for ARDL model in equation (3) due to annual observations employed in this study. The optimal lag structure selected by either SBC or AIC. In accordance with the Pesaran and Shin (1997), Schwarz Bayesian Criterion performs slightly better and more effective than Akaike Information Criterion, because SBC is a consistent model selection criterion while AIC is not\textsuperscript{12}. This is also supported by other scholars who prefer to use SBC rather than AIC in their estimation, since the performance of SBC is better for small sample size in comparison to AIC. They argue that SBC are chosen as the model selection criterion in their study for the sake of selecting more parsimonious specifications. On the other hand, the prediction power of SBC is superior to AIC for small sample size\textsuperscript{13}. Following these scholars, I will use the

\textsuperscript{12} For future details see Pesaran and Shin (1997).
\textsuperscript{13} This view is supported by Pahlavani et al., 2005; Ozturk and Acaravci, 2011; Ratha, 2010; Paul et al., 2011; Duasa, 2007 and so on. They also give additional explanations that SBC is better than AIC, because of adding additional lag in the model will cause the problem of loss of degree of freedom. As suggested by Persaran et al.(2001), using SBC ensures that there is no evidence of serial correlation (Duasa, 2007)
model selection criteria, namely minimizing the Schwarz Bayesian Criterion (SBC) for robust empirical results, owing to small sample size consisted of 31 observations in this study. According to SBC selection criterion, the selection results for optimal order of lag in ARDL model is ARDL (1, 1, 2, 1, 1).

In next step, we proceed to estimate ARDL model in equation (3), the estimates of the selected ARDL(1,1,2,1,1) regression based on SBC are displayed in the following table 5.3.

Table 5.3 ARDL estimates selected based on SBC

<table>
<thead>
<tr>
<th>Autoregressive Distributed Lag Estimates</th>
<th>ARDL(1,1,2,1,1) selected based on SBC</th>
<th>Dependent variable is lnGDP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regressor</td>
<td>Coefficient</td>
<td>Standard Error</td>
</tr>
<tr>
<td>lnGDP_{t-1}</td>
<td>0.63139</td>
<td>0.11312</td>
</tr>
<tr>
<td>lnREER_t</td>
<td>0.10859</td>
<td>0.074549</td>
</tr>
<tr>
<td>lnREER_{t-1}</td>
<td>-0.22873</td>
<td>0.066936</td>
</tr>
<tr>
<td>lnM_t</td>
<td>0.30249</td>
<td>0.15994</td>
</tr>
<tr>
<td>lnM_{t-1}</td>
<td>0.16749</td>
<td>0.26166</td>
</tr>
<tr>
<td>lnM_{t-2}</td>
<td>-0.32077</td>
<td>0.12575</td>
</tr>
<tr>
<td>lnGOV_{t}</td>
<td>0.82722</td>
<td>0.15679</td>
</tr>
<tr>
<td>lnGOV_{t-1}</td>
<td>-0.71049</td>
<td>0.13313</td>
</tr>
<tr>
<td>YW_{t}</td>
<td>0.40198</td>
<td>0.11472</td>
</tr>
<tr>
<td>YW_{t-1}</td>
<td>-0.31798</td>
<td>0.12622</td>
</tr>
<tr>
<td>Intercept</td>
<td>1.6997</td>
<td>0.39686</td>
</tr>
</tbody>
</table>

The above table shows that change in real effective exchange rate (REER) has an immediate effect and another adjustment effect with one year lag. lnREER_{t} captures the direct effect and lnREER_{t-1} represents one year lagged effect. The coefficient of lnREER_{t-1} is -0.22873 and statistically significant at 1 percent level, which indicates a 10% increase in REER lagged by one year will result in decline the output by 2.283%. The coefficient of lnGDP_{t-1} is 0.63139 and statistically significant at 1 percent level.

14 These sentences are directly extracted from Microfit 4.1 version
implying the output is positively influenced by its lagged own output. The coefficient of $YW_{t-1}$ is -0.31798 which implies that a 10% increase in one year lagged world output will decrease the output by 3.178%.

The ARDL model includes the lagged dependent variables, which indicate that the short run elasticity and long run elasticity differs and should be distinguished. The long run elasticities is obtained from ARDL (1,1,2,1,1) model based on SBC which are presented in tables 5.4 and the short run elasticities are reported in table 5.5.

### Tables 5.4 Long run results based on SBC

**Estimated Long Run Coefficients using ARDL Approach**

ARDL(1,1,2,1,1) selected based on SBC

<table>
<thead>
<tr>
<th>Dependent variable is lnGDP</th>
<th>Regressor</th>
<th>Coefficient</th>
<th>Standard Error</th>
<th>T-Ratio</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>lnREER_t</td>
<td>-0.32592</td>
<td>0.11587</td>
<td>-2.8124</td>
<td>0.026</td>
<td></td>
</tr>
<tr>
<td>lnM_t</td>
<td>0.40479</td>
<td>0.18767</td>
<td>2.1569</td>
<td>0.046</td>
<td></td>
</tr>
<tr>
<td>lnGOV_t</td>
<td>0.31667</td>
<td>0.22076</td>
<td>1.4344</td>
<td>0.170</td>
<td></td>
</tr>
<tr>
<td>YW_t</td>
<td>0.22788</td>
<td>0.06878</td>
<td>3.3131</td>
<td>0.007</td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>4.6111</td>
<td>1.6055</td>
<td>2.8720</td>
<td>0.011</td>
<td></td>
</tr>
</tbody>
</table>

### Tables 5.5 Short-run results based on SBC

**Error Correction Representation for Selected ARDL Model**

ARDL(1,1,2,1,1) selected based on SBC

<table>
<thead>
<tr>
<th>Dependent variable is ΔlnGDP</th>
<th>Regressor</th>
<th>Coefficient</th>
<th>Standard Error</th>
<th>T-Ratio</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ΔlnREER_t</td>
<td>0.10859</td>
<td>0.074549</td>
<td>1.4566</td>
<td>0.160</td>
<td></td>
</tr>
<tr>
<td>ΔlnM_t</td>
<td>0.30249</td>
<td>0.15994</td>
<td>1.8912</td>
<td>0.072</td>
<td></td>
</tr>
<tr>
<td>ΔlnlnM_{t−1}</td>
<td>0.32077</td>
<td>0.12575</td>
<td>2.5508</td>
<td>0.019</td>
<td></td>
</tr>
<tr>
<td>ΔlnGOV_t</td>
<td>0.82722</td>
<td>0.15679</td>
<td>5.2760</td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td>ΔYW_t</td>
<td>0.40198</td>
<td>0.11472</td>
<td>3.5041</td>
<td>0.002</td>
<td></td>
</tr>
<tr>
<td>ΔIntercept</td>
<td>1.6997</td>
<td>0.39686</td>
<td>4.2829</td>
<td>0.000</td>
<td></td>
</tr>
</tbody>
</table>

---

15 These sentences are directly extracted from Microfit 4.1 version
| ECM(-1) | -0.36861 | 0.11312 | -3.2587 | 0.004 |
| ECM= LNGDP + 0.32592*LNREER-0.40479*LNM -0.31667*LNGOV -0.22788*YW -4.6111*INPT |
| AdjustedR-Squared | 0.85472 |
| R-Squared | 0.90853 |
| SE of regression | 0.023547 |
| F(6,21) | 28.1411[0.000] |

As shown in table 5.4 and table 5.5, we can clearly see that the estimated long-run and short-run coefficients of REER vary which indicates that the yuan appreciation has different impact on real output for China in the long run and short run. Since the response of China’s real output to the appreciation of the yuan is major concern of this study, it deserves a more detail analysis. The estimated long-run results based on SBC in table 5.4 shows that REER carries expected negative sign in the long run. The long-run elasticity of REER is -0.32592 and statistically significant at 5 percent level. It indicates that the size of effect of RMB revaluation on China’s real output is around 0.326 and yuan revaluation 1% will decline China’s GDP by 0.326% in the long run. One reason for that size can be attributed that we do not consider the effect of inflation in the model, so the size of effect of real effective exchange rate on China’s output is likely to a little bit bigger without capturing the inflation. If we take into account the inflation effect, the size of effect on China’s output is likely to be smaller than 0.326. We find that during the period 1980 to 2010, revaluation of RMB has a negative (positive) influence on China’s output and it tends to reduce China’s output in the long run. Therefore, it can be concluded that RMB revaluation is contractionary to China’s economy in the long run. This finding of long-run impact of REER on output is not only consistent with the prediction of this study but also consistent with the previous studies by Shi (2006), Hsing and Hsieh (2004) and Hsing and Hsieh (2009) in case of China. They all find RMB appreciation will decline China’s output in the long run. Hsing and Hsieh (2009) find that a 1% real appreciation of the yuan will decline China’s GDP by 0.938%. The contractionary output effect of RMB revaluation is consistent with the theoretical expectations of traditional theory, while it does not work as what predicted by the New Structuralist school. Therefore, the contractionary devaluation hypothesis will not succeed in China and the appreciation of the yuan is indeed contractionary in China.
A possible reason for this negative and significant impact of RMB revaluation in the long run is that the real appreciation of the yuan will mainly work through the expenditure switching effect by increasing the relative price of Chinese-made product to the foreign-made product which results in the export price becomes more expensive and import price becomes relatively cheaper, thereby switching the demand of domestic goods to a relative cheaper foreign goods and a substitution from the export of Chinese-made product to the import of foreign-made product, indicating a decrease in export and increase in import in China. Thus yuan appreciation will give rise to the decline in net export, erode the competiveness and profit of the China’s export and contract aggregate demand for domestic production. China’s output will decline as the result of decreasing production capacity of manufacture industry in China. The expenditure switching effect domains, on the ground that the export sector is regarded as the main driver of economic growth performance in China which plays important role in promoting economic growth, since it provides and creates job for a significant portion of widespread lay-off and unemployment workers in China, given the nature of export and other sectors in China is mainly consisted of labor intensive workers (Sun and Ma, 2005). Besides, China is an export-led country owing to cheap and low labor cost and it sells goods much cheaper than the similar foreign-produced goods to its trade partners. The relatively low price of Chinese-produced goods will enhance the competiveness of export sectors to compete in the international market. A significant shrinkage in the competiveness and profit of the export sector will lead to substantial unemployment in China and decrease productivity, thereby cutting down China’s output. Therefore, the appreciation of yuan exerts an adverse effect on China’s output in the long run and is detrimental to China’s economy. On the other hand, FDI plays a crucial role in stimulating China’s economy, given it role in promoting employment and technological change for different sectors in China. China has been absorbing great bulk of capital inflows from foreign direct investment so as to promote the technological progress. China’s RMB revaluation will increase the cost for foreign investors to invest in China and lower the cost of overseas investment for domestic investors, thus leading to the loss in foreign direct investment and decrease foreign reserve together with speeding up the capital outflow. The diminishing inflow of FDI and increasingly capital outflow will cut down China’s output. As highlighted by Shi (2006), the role of income distribution effect, real cash balance effect plays is minor combined with China’s actual conditions and besides the effect of supply side channels is uncertain and not remarkable. Therefore, contractionary devaluation hypothesis will
However, the short-run results based on SBC in table 5.5 reported the coefficient of REER is 0.10859 in the short run but statistically insignificant at 10 percent level, which indicates in the short run real appreciation of the yuan exerts a positive but insignificant impact on China's output. It is worth mentioned that Hsing and Hsieh (2004) also find a positive elasticity of REER in the short run in case of China. Besides, Ratha (2010) also finds evidence of a positive and insignificant elasticity of REER in short run in case of India, indicating currency appreciation has positive but insignificant impact on India’s output in the short run. According to empirical findings of Bahmani-Oskooee and Kandil (2007), in the short run currency appreciation exert positive effect on output in case of Iran. Therefore, we can conclude that in the short run the output effect as the results of RMB revaluation in China is positive but statistically insignificant, namely neutral which as evident by positive but insignificant short-run elasticity of REER shown in table 5.5.

It is interesting that the short-run impact of RMB revaluation on China’s real output is in contrast to long-run impact in this study. More specifically, REER exerts a negative and significant influence on China’s output in the long run while it exert a positive but insignificant influence in the short run. Therefore, we can conclude that the short run effect of the appreciation of the yuan will not last into long run in China. This finding is consistent with Ratha (2010) who also finds evidence that currency appreciation has a negative impact on economic activity in the long run but exerts a positive but insignificant impact in the short run in case of India. The different impacts of revaluation of yuan that exert in the long run and short run, indicating that there is time lag of the adjustment in realizing negative consequences of the revaluation of yuan on China’s output. A possible reason for the different impacts is that it takes time for the Chinese exporters who actually need some reaction time to adjust the new relative prices of domestic products to foreign products as the results of the appreciation of the yuan. Moreover, it takes time for trade flows from the initial changes in relative price then to affect the change in trade volume, since the price changes will not lead to a change in volume immediately. As a consequence, the price effect outweigh the quantity effect in the short run which result in the quantity of trade keeps unchanged and constant although the relative price already changes. Therefore, appreciation tends to improve the trade balance and thus output in short run although in our finding this
impact is not significant. More importantly, it is evident that indeed the existence of adjustment lags in China’s trade sector and other sectors and thus China’s economy should spend time in adjusting to the adverse impact during the process of adjustment to a short run shock (Hsing and Hsieh, 2004).

As shown in 5.4, it also can be found that long-run estimated results of other variables such as money supply, government expenditure and world output, all carry expected positive sign, which is consistent with prediction of this study and the rational expectations of Moreno (1999), Bahmani-Oskooee et al. (2002) and Narayan and Narayan (2007). The long-run results in table 5.4 implies China’s output positively respond to the monetary policy, fiscal policy and external shock in the long run. Money supply, government expenditure and world output all have positive impact on China’s real output, but the magnitudes of their respective influence on output and the estimated elasticities vary in the long run. Money supply is statistically significant at 1 percent level and world output is significant at 5 percent levels, respectively, while the government spending is not statistically significant in long run. However, in short run, the coefficients of these three variables are all positive and statistically significant. As a whole, money supply, government spending and world outputs are indeed positively associated with the China’s output as expected of this study.

To be more precise, money supply shown in table 5.4 carries a positive long-run coefficient of 0.40479 which is statistically significant and indicates a 1% increase in money supply will significantly raise China’s real output by 0.405% in the long run. Hsing and Hsieh (2009) as well as Hsing (2010) also arrive at the same conclusion that real M2 has positive and significant impact on China’s real GDP in the long run. Consequently, monetary policy is positively associated with China’s output and statistically significant. However, the long run coefficient of government expenditure is positive 0.31667 but it is not statistically significant at 10 percent level. A 1% rise in China’s government expenditure will results in an increase in China’s real output by 0.405% in the long run but statistically insignificant, indicating the response of fiscal policy to output is said to neutral in the long run. This insignificant long-run impact of government spending is consistent with Narayan and Narayan (2007), who find fiscal policy measured in government spending exerts a positive but insignificant impact on Fuji’s output in the long run. Therefore, we can conclude that monetary policy plays more influential and significant role in boosting China’s real output in the long run as
compared to fiscal policy. This finding is supported by the results of Hsing and Hsieh (2004), who also find that monetary policy is more influential in comparison to fiscal policy in the long run in case of China.

The short-run results in table 5.5 reveal that the short-run impact of money supply and government expenditure on output are both positive and statistically significant. Consequently, monetary policy measured in money supply together with fiscal policy proxied by government expenditure is both positively related to China’s output in the short run. As found in table 5.5, that money supply in current year and with one year lag both have positive impact on output and statistically significant in short run. The contemporaneous effect of broad money is that a 1% rise in money supply in current year will raise output by 0.30249%. One year lagged effect of money supply in short run is that a 1% rise in money supply with one year lag will raise output by 0.32077%. The strength of money supply on output is weaker in short run and thus it provides statistically evidence that the strength of monetary policy is stronger in long run than the short run, when it comes to promoting output performance. The short-run coefficient of government expenditure carries a positive and highly significant sign, which is 0.82722, indicating a 1% rise in government expenditure will yield 0.82722% improvement in China’s output in short run. Moreover, fiscal policy plays more vital role in boosting economic growth in the short run, given that the respective magnitude of money supply and government expenditure is 0.30249 and 0.82722 in the short run, indicating China’s output is less sensitive to monetary policy than fiscal policy. This result is consistent with Hsing and Hsieh (2004), who find evidence that fiscal policy is more useful in the short run as compared to monetary policy in case of China. Therefore, China’s policy makers need differently carry out the fiscal policy and monetary policy for long run and short run.

Besides, world output also exerts positive effect on output in both the long run and short run. The coefficients of world output are 0.22788 and 0.40198, respectively and they both are statistically significant at 1 percent level, implying a 1% rise in world output induces an approximately 0.23% increase in China’s output in the long run and raises real output by approximately 0.4% in the short run. Therefore, it is worth noting that foreign economic activity exerts a positive influence on real output in China and the expansion of world output will boost domestic output growth in China. This suggests that foreign economic activity also plays a crucial role in boosting China’s
output. The positive relationship between world output and China’s domestic output found in this study, are also in line with the findings of Bahmani-Oskooee et al. (2002), Narayan and Narayan (2007) and Hsing (2010). They also found positive effect of foreign output on domestic output of Asia countries, Fuji and Thailand respectively. A recovery of global economy will contribute to boost and help China’s economy while a recession of global economy is expected to hurt China’s economy. Therefore, China’s economy is affected by the foreign economic activity.

It is clear to find that the influence of the variables concerned in this study on China’s output varies, by comparative static analysis concerning their respective magnitude of long-run and short-run coefficients. As shown in table 5.4, as far as the influential role is concerned, money supply rank first, exchange rate rank second and followed by world output, in terms of the extent of significant long-run elasticity. Therefore, expansionary monetary policy, exchange rate and world output play important role in stimulating China’s economy in the long run and can be effectively used as tools to achieve and maintain a long term sustainable economic growth in China while fiscal policy does not work in long run due to not statistically significant.

Turning to short-run results based on SBC shown in table 5.5, we proceed to investigate the short run dynamic. The estimated coefficient of $ECM_{t-1}$ of -0.36861 is negative with correct sign and highly significant at 1 percent level, which is consistent with our expectation, indicating economic activity convergence toward the long-run equilibrium. The expected negative effect further confirms and reinforces indeed the existence of stable cointegration among China’s output as well as other macroeconomic variables. An absolute value of 0.36861 for $ECM_{t-1}$ represents a moderate speed of the economic activity in China convergence toward its equilibrium, which implies that China’s economy has an automatic adjustment mechanism and the deviation in China’s real GDP from long-run equilibrium in previous year is corrected by 36.861% in current year.

We used adjusted $R^2$ as the measure of overall goodness of fit. The value of adjusted $R^2$ is 0.85472 which indicate that approximately 85.47 percent of variation in China’s real output is explained by other variables consisted of right-hand side model, reflecting good fit for model. Hence, the estimated model is reasonably well behaved.

16 The size of $R^2$ is 0.90853, which can be also used to interpret the explanation power of the model and judge the fit of the model.
and fit the data well.

5.3.3 Stability test for robustness check

In the next stage, the stability of estimated coefficients in the model is examined by CUSUM and CUSUMSQ tests in order to check and confirm the robustness of empirical result in this study. The null hypothesis of both tests is all coefficients in the mode are stable.

The plot of CUSUM as well as CUSUMSQ in form of graphical representation is presented in figures 4 and figure 5, respectively. We can see clearly from the two figures, the plots of two statistics both stay within the critical bounds at 5 percent level, so the null hypothesis is accepted. Therefore, there is evident that the coefficients of this empirical work are considered to be stable over the period 1980 to 2010, which make our empirical results more reliable and robust. We can confidently conclude that the robust empirical results of this study provide effective prediction and reliable statistic inference regarding policy implication for policy makers who can rely on this empirical result and hence they can build confidence with respect to designing and formulating effective policy in the future.
6 Concluding remarks

In this chapter, I will summarize the key findings of this empirical work which is in line with the theoretical expectation of this study and draw conclusion on relevant policy implications together with clarifying the contribution of this empirical work and suggestions for future research within this topic.

6.1 Summary

To sum up, the response of China’s output to Chinese exchange rate RMB revaluation has been empirically analyzed by using annual data during 1980 to 2010 to study whether currency appreciation is expansionary or contractionary in case of China. A reduced-form model is employed for empirical analysis which is based on cointegration technique of bounds testing approach and error correction technique. CUSUM and CUSUMSQ stability tests are also applied for statistical robustness check.

This empirical work finds unique cointegration among China’s real output and other variables covering the period 1980 to 2010. The empirical findings of this study provide evidence that RMB revaluation exert a negative influence on China’s real output in long run. To be more precise, a 1% revaluation of RMB will lead to China’s output fall by 0.32592%, indicating real appreciation of currency is indeed contractionary in China. This result is not only consistent with the expectation of traditional theory but also in line with the findings of previous studies by Shi (2006), Hsing and Hsieh (2004) and Hsing and Hsieh (2009) in case of China. They all find RMB appreciation will decline China’s output. However, RMB revaluation has a positive but insignificant effect on real output in short run. This short-run finding is also supported by Hsing and Hsieh (2004). Possible explanations are provided for those findings in the thesis. In addition, the respective response of China’s output to the fiscal policy variable, monetary policy variable and world output are investigated aiming at providing strategic policy options for Chinese policymakers. The empirical findings show that China’s real output is positively associated with domestic monetary policy, fiscal policy and foreign economic activity both in long run and short run, although fiscal policy variable of government expenditure is statistically insignificant in the long run. The findings indicate monetary policy plays the most influential role in
boosting China’s output and world output also play crucial role while fiscal policy are ineffective on boosting China’s economy in the long run. This finding is also supported by Narayan and Narayan (2007) who get the same conclusion in case of Fuji. More importantly, the CUSUM and CUSUMSQ stability tests confirm the empirical results derived from this study are stable and robust.

6.2 Policy implication

The empirical work of this study is meaningful and of particular relevance for policy. It has the international economy and future role of Yuan in focus and provides deep insights into several important policy implications for China’s policymakers. Firstly, in light of empirical findings derived from this study, we can find that the view of New Structuralist School concerning expansionary appreciation may not apply to China. Instead, conventional wisdom regarding currency appreciation tends to be contractionary exists in China, so the fear of negative consequences stemming from revaluation RMB for Chinese authorities is necessary and indispensable. During the process of decision-making regarding design of sound exchange rate policy and in pursuit of sustainable long-term economic growth, China’s policy makers and government officials should adopt a strategy of stable exchange rate policy. In other words, the central bank should keep a relatively stable Yuan and should not allow RMB to sharply appreciate in the future, given empirical results derived from this study find evidence the appreciation of yuan tends to cut down real GDP, suggesting contractionary effect of RMB revaluation will hurt China’s economy in long run. More importantly, this suggestion is consistent with arguments of Mundell (2004) and Mickinnon and Schnabl (2003). Therefore, it is desirable to maintain the stability of the yuan to achieve long-term growth in China and reinforce the competitiveness of China’s economy.

Additionally, the empirical findings offer a multiple of alternative strategic policy options for Chinese government officials to maintain sustainable economic growth by evaluating the respective potential influence of monetary policy and fiscal policy variables as well as foreign economic activity on China’s real output behavior. In view of the long-run results, money supply exerts a positive effect on China’s output while government expenditure has a positive but insignificant effect. Given that monetary policy plays the most influential role in boosting output, we can draw a conclusion that expansionary monetary policy good policy option for Chinese authorities which can be
severed as an option to promote growth in the long run. However, China’s real output is insensitive to government expenditure, so fiscal policy is ineffective on boosting China’s economy in the long run and should be treated with caution. Therefore, we conclude that fiscal policy is not a wise choice for government officials as policy option. Moreover, the empirical results also support that world output growth will contribute to boosting domestic real output in China. Therefore, foreign economic activity also plays a crucial role in boosting China’s output and can be taken into account by China’s government officials. Sun and Ma (2004), Dai (2011) and Zhang (2006) also agree that RMB is detrimental to China’s economy and are in support of additional policy options should be undertaken by China’s central bank. They suggest implementing appropriate expansionary monetary policy to offset and remove the negative impact of RMB revaluation so as to achieve the ultimate goal of sustainable long-term growth in China.

Finally, given that RMB revaluation exerts adverse impact on China’s economy, it is important for Chinese policymakers to encourage export sectors to innovate and make technological change. Since the export sectors in China is mainly consisted of labor-intensive rather than technology-intensive which maker export sectors suffer from great shocks as a result of revaluation. In recent years, China mainly imports the high-technology abroad and the import of technology tends to be less due to the high cost of that import. So the Chinese export sectors should improve the technology content of products with high quality, lie in the fact that it is crucial for a national to compete with the high-technology among the trade partners rather than the low cost of similar products. Therefore, one future goal for Chinese government officials is to promote the technological progress of export sectors. With high technology, China’s export sectors will become more competitiveness in international market and earn more profits to boost productivity and employment, all of which will minimize the cost of revaluation to stimulate China’s economy.

**6.3 Contribution and suggestion for future study**

**6.3.1 Contribution**

There are several major contributions of this empirical work, which are listed in the following:

Firstly, this empirical work uses a different methodology to answer same question which is meaningful to derive several useful policy implications as mentioned above
and it is helpful to answer questions regarding the no consensus in the existing literature, thus can ultimately provide some evidence for future study on this topic in China. It is worth noting that this empirical work lay down a solid foundation for China’s policy makers to achieve maintain a long-term sustainable economic growth by providing variety of strategic policy options.

Secondly, the use of ARDL bounds test approach in this study makes a methodological contribution in the existing literatures related to this topic for China. Due to the fact that so far, to the best of our knowledge, lack of application with respect to the autoregressive distributed lag (ARDL) approach, no published studies use this method to investigate the effect of currency appreciation on China’s output. Therefore, with application of ARDL bounds testing approach this study can be regarded as the extension of the previous studies on this topic for China.

Thirdly, this study also contributes to testing the stability of coefficients in the theoretical model by implementing CUSUM and CUSUMSQ stability test. Since no evidence shows that the existing literatures regarding this topic for China to test the stability of coefficients. Therefore, stability test in our study is not only crucial and necessary to make our prediction and statistical inference more reliable, but also is an advance over the existing literatures on this issue for China.

6.3.2 Suggestion for future study

By summarizing review of the existing literatures, it can be found that the empirical result is sensitive to measures of the variables along with time span of the sample period employed under investigation as well as the methodology used in the study. Several potential areas can be recommended for future research on this topic for China.

Future research can focus on examining different measures of variables by comparing the empirical results to find which one is more appropriate to use as policy tools. Different outcomes may yield different policy implications according to the way variables are expressed. For example, in accordance with the previous study of Hsing (2004) and Hsing (2010), government deficit or debt and the ratio of government deficit to real GDP in an attempt to be employed as the measure of fiscal policy and the ratio of money supply to the real GDP or interest rate used as the measure of monetary policy.

It would be also interesting for future research to exploit inflation, energy use and CO₂
as three other dimensions than output and exchange rate relationships. On the ground that in recent year inflation has increased in China and energy and environment are crucial factor of production and consequence.

Future research can consider other methods in systematic sensitivity analysis of the results if sample size can be extended sufficiently large. For example time period of sample is quarterly data or monthly data, VAR model can be employed and other methodologies for cointegration within this topic, such as Johansen and Juselius cointegration test as well as Johansen cointegration test can be conducted, since they are quite appropriate for large sample size.
**Reference**


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Appendix I

Figure 1. China’s Real GDP:1980-2010. Source: World Bank

Figure 2. Growth rate of GDP and GDP per captia:1980-2010. Source: World Bank

Figure 3. Real GDP and RMB real effective exchange rate: 1980-2010

Source: IMF and World Bank.
Figure 4. Plot of CUSUM statistic for coefficient stability for ARDL model selected by SBC

Figure 5. Plot of CUSUMSQ statistic for coefficient stability for ARDL model selected by SBC
Table 2.1 China’s Foreign Exchange Reserve and its annual growth rate: 1980-1994

<table>
<thead>
<tr>
<th>Year</th>
<th>China Foreign Exchange Reserve (100 million US$)</th>
<th>Annual growth rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980</td>
<td>-12.96</td>
<td>NA</td>
</tr>
<tr>
<td>1981</td>
<td>27.08</td>
<td>-3.08951</td>
</tr>
<tr>
<td>1982</td>
<td>69.86</td>
<td>1.579764</td>
</tr>
<tr>
<td>1983</td>
<td>89.01</td>
<td>0.27412</td>
</tr>
<tr>
<td>1984</td>
<td>82.2</td>
<td>-0.07651</td>
</tr>
<tr>
<td>1985</td>
<td>26.44</td>
<td>-0.67835</td>
</tr>
<tr>
<td>1986</td>
<td>20.72</td>
<td>-0.21634</td>
</tr>
<tr>
<td>1987</td>
<td>29.23</td>
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</tr>
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<td>33.72</td>
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</tr>
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</tr>
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<td>0.95727</td>
</tr>
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</tr>
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<td>211.99</td>
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<td>1994</td>
<td>516.2</td>
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<td></td>
<td>Average level</td>
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<td></td>
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<td>1994</td>
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</tr>
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<td>1995</td>
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<td>1996</td>
<td>1050.29</td>
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**Data source:** http://www.chinatoday.com/fin/china_foreign_exchange_reserve.htm

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Appendix II

Data Sources:

All data are on annual basis during the period 1980 to 2010 which are obtained from the following sources:

(a) International Financial Statistics (IFS) (2011)

(b) China statistic yearbook (2011) and National Bureau of statistics of China.

(c) World Development Indicator (WDI) in World Bank database (2011)

Variables:

GDP = China’s real gross domestic product measured in 100 million of Chinese currency yuan which are obtained from source (b).

REER = China RMB real effective exchange rate collected from source (a). A rise in REER indicates real revaluation of Chinese RMB.

YW = World output index. Nominal world GDP available from source (c) deflated by GDP deflator available from source (c), then transformed into index value by using year 2000 as base year, which is proxy for external shock.

M = China’s broad money supply $M_2$ measured in 100 million of yuan which are obtained from source (b) and is proxy for monetary policy.

GOV = China’s government expenditure measured in 100 in 100 million of yuan which are obtained from source (b) and is proxy for fiscal policy.
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Figure 4: Plot of CUSUM statistic for coefficient stability test

Figure 5: Plot of CUSUMSQ statistic for coefficient stability test