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Master's Thesis of Economics

Will the KRW Appreciation Attack the Trade and Economy of the South Korea?

– By Using the VAR Model –

원화의 평가절상이 한국 경제에 미치는 영향

January 2019

Graduate School of Social Sciences
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Abstract

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The purpose of this paper is to forecast how the current and capital accounts would change through Korean currency appreciation and to investigate whether there will be the same economic recession like Japan in Korea. Based on the amount of trade surplus from South Korea to the U.S., the United States government has been accusing the South Korean government of depreciating its currency in order to encourage its exports. Also, as the U.S. government imposed a trade intervention on China and the Korean exchange reserve reached more than 400 billion dollars, there is a possibility that South Korea should appreciate its currency value. This paper uses the VAR model, which includes endogenous variables from Korea and exogenous variables from the United States. The main results are, after appreciation of KRW, the effects on current and capital accounts are insignificant, while responses of real GDP and real money supply significantly

decrease due to the real consumption decreasing and money contraction, respectively. In addition, by replacing the real money supply with the price level, the response of exports is insignificant, while the response of imports, importing prices in terms of both KRW and U.S. dollar terms and exporting prices in terms of U.S. dollars, significantly increase. On the other hand, responses of the exporting price in terms of KRW significantly decrease so that the Korean economic system appears to be at an intermediate pricing system. Furthermore, as the exchange rate regime has been changed from fixed to floating rate since the 1997 currency crisis, responses of the real GDP and the price level since 1980 declined, whereas that of real money balance increased; these are different from the results since 2000. Additionally, this paper covers the literature on not only how much the Korean exchange rate has been misaligned but also how much it has been undervalued. In the end (see Appendix) no variables responded except the won-dollar exchange rate, even if the U.S. import tariff shock happens.

Keyword : Current Account, Dollar, Exchange Rate Appreciation/Depreciation, KRW, Long-term Recession, South Korea, Trade Surplus/Deficit, United States.
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Chapter 1. Introduction

The South Korean foreign exchange reserve has recently recorded more than 400 billion dollars, which is the first time that it has ever passed that amount. According to the Bank of Korea (2018), it was over 400.3 billion dollars in June, 2018, but quickly exceeded this, reaching 402.4 billion dollars in July. Therefore, the fact remains that the export and economic system of Korea has been stable since the 1997 currency crisis in Asian countries where the South Korean foreign exchange reserve has renewed its improved record.

However, there is a possibility that the Unites States government would not be comfortable about the news of this increased amount of the foreign exchange reserve because of its enormous cumulated trade deficit from 1980s. The United States government has been arguing with the Chinese government when it comes to its trade deficit, which is caused by the Chinese bilateral trade surplus. Furthermore, the U.S. government claims that not just China but South Korea also has had a large amount of trade profit by selling their major exporting manufactured goods, which has also had a negative impact on the U.S. manufacturing industry. Additionally, Bernanke (2005) proposed that as there has been a huge global imbalance in the international trade market between the United States and Asian countries, which have gained dollars

from selling their exported product to the U.S. and saved many dollars to their reserves, saving glut; these Asian countries have also cumulated deficits and invested them again to the U.S. financial market. The fact that domestic excess savings in Asian countries has induced the global imbalances of trade between the U.S. and Asia is one of the most plausible reasons why the global financial crisis happened.

Also, U.S. Congressional research (2017) pointed out that the Korean government is likely to manipulate and undervalue its currency in order to make its exporting price lower. Officially, according to the Bank of Korea, South Korea has been working on the free floating rate regime. However, in reality it has intentionally undervalued the currency in order to keep the export price competitive in the global market. Furthermore, the U.S. Treasury report (April, 2018) said South Korea seems to have undervalued its currency since 2010, which means the Treasury suspects Korea has intervened in its foreign currency market. Therefore, there is a possibility that the U.S. government might finally announce that South Korea is a "Currency Manipulator," which would place a lot of pressure on the Korean trade market. Thus, even though the Korean government decided to announce how to operate its foreign currency market transparently in the beginning of 2019, if the U.S. government asks South Korea not to manipulate but to appreciate its currency value, there would be no choice for South Korea but to follow the

international society rule to appreciate the value of its currency, like how Japan made their Yen/dollar exchange rate lower after the Plaza agreement.

The most foreseeable impact of domestic currency appreciation is the negative effect on the current account and trade balance of the nation because currency appreciation makes its export price higher, which means the products lose their price competitiveness. After the currency appreciation following the Plaza agreement, Japan suffered from its economic recession for a decade. Likewise, as South Korea has a number of similarities to the Japanese industrial and trading system and economic growth process, it is important to determine how and how much the KRW appreciation would either affect or attack the Korean economy. Ultimately, there is a possibility that Korea would suffer the same stagnation as Japan after its currency appreciation.

The purpose of this paper is to find out how the current and capital account would change through the Korean currency appreciation and whether there would be the long-term stagnation in Korea like in Japan. The main model used here is the VAR model, adjusted from Kim et al. (2016), which demonstrated how the RMB appreciation would affect the Chinese trade system and its economy. In other words, this paper will attempt to forecast how the KRW appreciation in the dollar/won exchange rate could impact the current and capital account, real GDP, and real money supply of South Korea. In

addition, how the nominal exchange rate could also affect the price level, exports and imports volume, and their price in both won and dollars will all be analyzed. Furthermore, as the exchange rate policies have been changed from fixed to floating regime since the 1997 currency crisis, comparing the results of data analyses of these two different policies will be performed. To begin, this paper will cover through the literature review how much the Korean exchange rate has been misaligned and undervalued. In the end, (see Appendix) this will reflect how the pattern of Korean trade with the U.S. would be changed by including the U.S. importing tariff on Korean manufactured goods.

Chapter 2. Literature Review

The most curious points associated with Korean currency are (ⅰ) how the Korean government actually manages its exchange rate policy, even though it announced following the floating exchange rate system, and (ⅱ) how much the KRW is undervalued. Thus, several papers associated with these two issues need to be discussed.

(ⅰ) Has Korea Literally Floated its Currency?

Even though South Korea has officially adopted a floating exchange rate system since the 1997 currency crisis, the U.S. government and some economists, and some of them in South Korean tend not to trust the Korean government. Not just the U.S. congressional research service (2017) observed that Korean exchange rate policy seems to be a de facto pegged exchange rate policy[1], but Park et al (2001) said that the South Korean government intervened in the exchange rate

[1] In order to make the exchange rate stable and less volatile (around ₩1,100 per a dollar), if the exchange rate relatively increases, the government releases more dollars to let it down; or if it relatively decreases, then the central bank will set the upper aim of the exchange rate by collecting more dollars.

market to prevent the ruthless capital outflows right after the crisis. Since the crisis, according to Bernanke (2005), East Asian countries that suffered from the currency crises at the late of 1990s, such as Korea and Thailand, tend to use their foreign exchange reserves as their national insurance for capital outflow, which affects the global imbalances.

There are a few indicators that the Treasury watches for to judge a country as a currency manipulator: (1) trade and current account balances; (2) protracted large-scale intervention in one direction; (3) rapid foreign exchange reserve accumulation; (4) capital controls and payments restrictions; (5) measures of undervaluation and real effective exchange rate movements; and (6) unusually heavy reliance on net exports for growth. Based on these indicators, Korea has been suspected as a currency manipulator because of (i) large dependence of the external demand and export, accounting for 5.1% of its GDP, the sixth straight year over 3 percent of the GDP, and more than $20 billion with U.S. bilateral trade; and (ii) its purchasing foreign currency accounts for at least 2% of the GDP over a 12-month period in 2017, resulting in foreign exchange reserve accumulation and weaker won than justified by its macroeconomic fundamentals.

In spite of this research about the intervention of Korea, there is also some research which says the Korean government changed its exchange rate regime from pegged to

the floating rate regime, except for right after the currency crisis in 1997 to prevent its currency from plummeting or becoming too volatile (Yu Hsing, 2009; Patnaik, I, et al., 2010; and Takuji Kinkyo, 2004). However, these researchers cover the data from about a decade ago, and there is little research on the Korean exchange rate regime currently, where further research is needed. These papers are summarized in Table 1.

Table 1

Research about the Actual Korean Exchange Rate Policy

Authors	Method (Data)	Year	Policy
Congressional Research Service: East Asia's Foreign Exchange Rate Policies (2017)	Relative Changes in Value of KRW relative to the USD (CRS calculations using data from IMF)	2008 2015 2016 2017	A de facto pegged exchange rate policy Sustained depreciation against the U.S. dollar
Park et al. (2001)	Granger Causality, Variance decomposition (volatility of exchange rate and interest rate (Bond), stock price (KOSPI))	pre-crisis: 1990.5.2-1997.9.30, crisis: 1997.10.1-1998.9.30, post-crisis: 1998.10.1-1999.9.30	The exchange rate market of Korea had been intervened after the crisis by bond and stock.
Yu Hsing (2009)	PPP using PPI, UIP and extended IS-LM, Monetary Supply	1980-.1-2008.2	From Pegged exchange rate to Floating
Treasury Report (April, 2018)	Current Account surplus, GDP, bilateral trade surplus with the U.S.	2010-	De facto Pegged

Takuji Kinkyo (2004)	Official Policy	1982-1983 1986-1987 1998-1995	US dollar peg Multiple Currency Basket Undervalued Market Average Rate System
Patnaik, I, et al. (2010)	Regression to check flexibility	1991.01.11- 1995.01.27- 1997.11.21- 1998.09.18- 2006.05.26 -2008.02.22 2008.02.29	Pegged to the USD More flexible but Peg Insignificant Intermediate regime Peg but changed its basket weight Floating

Although South Korea officially works on the floating system, from these results it is suspected that it manipulates its currency value because the Korean economy is especially based on the foreign exporting market. Additionally, high levels of trade surplus and foreign exchange reserve are also attributed to the manipulation.

(ii) Is the KRW Undervalued and by How Much?

According to these papers, it is likely that Korea has manipulated its currency for many reasons. Therefore, it is also necessary to check how and how much it is manipulated in order to make this clear.

A variety of methods and data were used by a number of the authors that were summarized in the following method. Most of them are based on Purchasing Power Parity (PPP) whose equilibrium exchange rate is calculated by the ratio of price levels between two nations given by: $\tilde{S}_t = P_t^*/P_t$, where $\tilde{S}_t$ is the equilibrium nominal exchange rate, or PPP rate, and P_t^* and P_t are foreign and domestic price levels, respectively. As the nominal exchange rate is defined as the price of domestic currency in terms of foreign currency, which is the foreign price level divided by the domestic one, an increase of it means appreciation of the domestic currency. Among these extended PPP models, some are absolute PPP models, but others are relative PPP or PPP adjusted by the Balassa-Samuelson hypothesis, which considers not only the tradable sector that the original PPP model includes but also non-tradable sector such as labor. According to the Balassa-Samuelson approach, the relative price of non-traded goods tends to be lower in low-income countries because the productivity differential is larger in the tradable sector than in the non-tradable sector, as economic growth is more likely

based on the productivity growth of manufacturing sectors, which is classified into tradable goods. Also, the Economist magazine has shown the PPP rates based on the Big Mac price index since April, 2001, indicating an average 18.1% estimate of undervaluation. As a further PPP extension, the PWT method, a database with information on relative levels of income, output, input and productivity, was used.

Another particular method is Fundamental Equilibrium Exchange Rate (FEER) of the macroeconomic balance approach. It has been used by Jeong, S. and Mazier, J. (2003) in order to get over the limitation of reduced equation, and by Behavioral Equilibrium Exchange Rate (BEER) and NATREX (Stein & Alii, 1995) by simultaneously attaining the external (sustainable CUR) and internal (full utilization of productive potential) equilibrium. As for the BEER method, utilized by Baak, S. (2012), the undervaluation was estimated by using a reduced equation of terms of trade, relative price of non-tradable to tradable goods, net foreign assets, and real interest rate differential. As for other methods, estimating the correct exchange rate could be calculated and compared to the real data or weighted least squares regression by using the panel data.

Table 2

A Summary of Estimates for the KRW Under-or Overvaluation

Authors	Method (Data)	Year	Undervalue (overvaluation if (-))	Comment
Chinn (2000)	PPI-deflated real rates CPI-deflated real rates (1975-1996)	May 1997	2% 9%	
Baak, S. (2012)	BEER (1982Q1-2009Q4)	1996Q1 1998Q1 2007Q1 2008Q4	-20.9% 34.9% -20% 32%	
Michael R. Pakko and Patricia S. Pollard (2003),	PWT The Economist Big Mac surveys	2000	PWT: 35 Big Mac: -8	
Jeong, S. and Mazier, J. (2003)	FEER (1988-2000)	From the middle of the 1980s Before Asian crisis	REER: 19% NX: 60% REER: -14% NX: -25%	
Zhang, Zhibai (2012)	PPP with the Penn effect	1980-2010	-	

Eiji Ogawa (2009)	PPP	From July 2004 to July 2007 After	-20% +	
Byunghwan Son (2018)	Real Exchange rate Penal data	-1978 1980-1987 1988-1997	+ 0 -	
The Economist Big Mac surveys	Absolute PPP	2001.04 2002.04 2003.04 2004.05 2005.06 2006.01 2006.05 2007.01 2007.06 2008.06 2009.07 2010.01 2010.07 2011.07 2012.01 2012.07 2013.01 2013.07 2014.01 2014.07 2015.01 2015.07 2016.01 2016.07 2017.01 2017.07 2018.1	10.9% 4.5% 0.2% 6.2% 18.7% 18.8% 15.3% 4.2% 7.8% 12% 27.5% 16.7% 24.4% 13.8% 23.9% 25.7% 22.0% 24.6% 25.0% 16.5% 21.0% 21.5% 27.2% 23.5% 27.3% 27.5% 22.1%	Big Mac Standard

Eiji Ogawa and Zhiqian Wang (2012)	Rate of Change of Balassa-Samuelson Effect	2000-2010	+	
Taizo Motonishi (2009)	Absolute PPP-income relationship using Panel data 1) Total Misalignment 2) Partial Misalignment 3) Based on WLS estimates	1) 1996 1998 2) 1996 1998 1999-2006 2007 3) 2007	1) -24.1 20.7 2) -41.4 4.6 - -7.5 3) 15.3	
MASUJIMA Yuki (2015)	1)BEER with a Pooled Dynamic Ordinary Least Square 2)FEER	1) 2008Q3-2013Q4 2014 2) 2007Q1-2014Q4	1) + - 2) +	
Takuji Kinkyo (2004)	FEER	 1982Q1-1983Q2 1986 1987 1990-1995 1997Q1-1997Q3	-8-9% 8% 15% 0 -20%	

Thus, among these summarized papers that used various methods, the Korean won was likely to be overvalued before the crisis but it became undervalued after that. For the purposes of this paper, it is meaningful to focus on the currency undervaluation in the post-crisis. Though most of the measures point out the undervaluation of KRW after the currency crisis, it is ambiguous which method is the best way to measure currency misalignment because of the large variances between the results. In spite of the uncertainty due to the large discrepancies on the magnitude of undervaluation, it is not arguable that the consensus among these papers is that there has been the undervaluation of Korean currency.

(iii) Effects of Exchange Rate Changes on Trade Balance

Before the model setting, a brief review of the theories and arguments is needed on the effects of the exchange rate changes on the current account/trade balance, especially in the context of the Korean economy. These theories can be classified through the pricing methods of exporting and importing.

The traditional open economy model, such as the Mundell-Flemming-Dornbusch model and the basic new open economy model from Obstfeld and Rogoff (1995), assumes producers' currency pricing, which means the prices of exports and imports are expressed in terms of producers' (or exporting country's) currency. In other words, Korean exports are in terms of KRW, whereas Korean imports from the United States are in terms of U.S. dollars. In this case, if the value of KRW appreciates, the export price in KRW will increase while the import price in U.S. dollars will decrease, but the export price in U.S. dollars and the import price in KRW will not change through the 'complete pass-through'. Thus, the trade balance can be worse because of the negative impact on the volume effect is likely to be larger than the positive one on the value effect.

Another pricing policy is the local country' s currency, in which the prices of exports are set in term of the importing country' s currency, such as U.S. dollars, and imports to Korea are set in terms of KRW. Through this policy, the price of the exports tends to be stable and thus keeps customers because the prices are set by the importing country' s perspective. Therefore, the volume effect will not change due to the stable importing country' s demand, whereas the value effect can be worse. This pricing policy tends to be shown in recent studies.

The other policy is external currency pricing where all the prices are set in term of one external currency, mostly U.S. dollars, regardless of whether the country is on the exporting or importing side. Thus, the exporting price will not change but the importing price will decrease. The volume effect will be worse due to the increased imports, but the value effect is uncertain because both the exports and imports value will decrease.

In the intermediate case, where the incomplete or partial pass-through happens, the effect would be similar to the case between the producer' s currency pricing and the local currency pricing. Not only the volume effect that decreases the export quantity and increases the import quantity will appear, but also the value effect that decreases exports and increases imports in the local currency will happen.

These four implications of the pricing methods are summarized to the Table 3.[2]

In summary, the direction of the value effect is the same as that of the KRW price. The direction of the volume effect on exports is opposite to that of export price in terms of U.S. dollars because demand for Korean exports in the U.S. market negatively depends on the dollar price of exports; on the other hand, the direction of the volume effect imports negatively depends on the KRW price of imports.

The currency pricing policy of Korea will be investigated by analyzing export and import changes in their price and volume within the effect of KRW appreciation. However, according to Hyunbae et al. (2017), as the Korean economy is based on *Vertical Integration*[3] and intra-firm trade, little or no effect of exchange rate changes on Korea's trade balance can be observed.

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[2] Even though the same findings were summarized in Kim et al (2016), they are reorganized in Table 3 for ease of comprehension.

[3] According to Hyunbae et al. (2017), Vertical Integration is a production network for Asian countries, which affiliates firms having high levels of employment and owning a large number of affiliates, accounting for most of the intra-firm trade flows between parent firms and their foreign affiliates. This induces the small price elasticities of import demand and weak volume effects on imports.

Table 3

Implications of KRW Appreciation

Pricing	Volume Effect					Value Effect		
Producer Currency Pricing (PCP)	P(ex) ₩	–	D(ex)	↓↓	↓↓	EX (₩)	–	↑↑
	P(ex) $	↑↑						
	P(im) ₩	↓↓	D(im)	↑↑		IM ($)	↓↓	
	P(im) $	–						
Local Currency Pricing (LCP)	P(ex) ₩	↓↓	D(ex)	–	–	EX ($)	↓↓	
	P(ex) $	–						
	P(im) ₩	–	D(im)	–		IM (₩)	–	
	P(im) $	↑↑						
Intermediate case	P(ex) ₩	↓	D(ex)	↓	↓	EX	↓	
	P(ex) $	↑						
	P(im) ₩	↓	D(im)	↑		IM	↓	
	P(im) $	↑						
External Currency Pricing (ECP)	P(ex) ₩	↓↓	D(ex)	–	↓↓	EX ($)	↓↓	
	P(ex) $	–						
	P(im) ₩	↓↓	D(im)	↑↑		IM ($)	↓↓	
	P(im) $	–						

Chapter 3. The Model and Empirical Evidence

According to the literature review, though South Korea claimed to perform floating exchange rate system, in fact, it seems that there somehow is intervention from the government for a stable currency value. Additionally, it can be confirmed that the KRW has been depreciated to foster exporting. Therefore, based on the literature review, if the global trade market imposes a sanction on South Korea not to intervene in its foreign exchange rate market, then the country would finally face a situation where it must appreciate its currency value. Thus, the main questions around the KRW undervaluation are (ⅰ) through which path and how much the Korean economy will be affected by these external exchange rate changes, and (ⅱ) whether there is a possibility that the Korean economy will suffer from long-term economic stagnation like Japan after the suggested appreciation of the KRW? Therefore, by using the structural VAR model, these questions can be analyzed in this section and the results about the further specific transmission will be covered by the robustness test.

First, the baseline VAR model includes the following endogenous variables: the capital account as a ratio to the trend GDP (KAR), real GDP (RY), real money supply (RM), the current account as a ratio to the trend GDP (CAR), and the nominal exchange rate against the U.S. dollar (NX) [4].

The fitted value used was the Trend GDP, which is from the regression of the nominal GDP to a linear trend without a constant. The capital and current accounts are divided by Trend GDP in order to remove the inflation term from the nominal index. The real money supply (RM) is calculated by money supply (M1) over consumer price index, and the nominal exchange rate (NX) is defined as U.S. dollars per won. Thus, if the KRW appreciates, then NX will increase. The reason the nominal value was used is that the economic agents tend to respond sensitively to the nominal exchange rate.

Furthermore, 2 external variables are also included in this model: one is the foreign interest rate (RF) and the other is foreign real income (RYF). The U.S. three-month Treasury bill rate was used as the foreign interest rate (RF) and the U.S. real GDP was used as the foreign output (RF). These external variables are employed for controlling the exogenous shocks other than the KRW appreciation shock.

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[4] The real exchange rate (RX), which is Consumer Price Index in U.S. over Consumer Price Index, in South Korea was also used to compare with the nominal exchange rate. However, there were no large differences between them.

Throughout all the variables inside the model, except for the interest rate, capital, and current account ratio (multiplied by 100), every variable is in logarithm (multiplied by 100). Equation (1) shows the main reduced form of the VAR model given by:

$$\begin{pmatrix} KAR_t \\ RY_t \\ RM_t \\ CAR_t \\ NX_t \end{pmatrix} = \begin{pmatrix} a_1 \\ a_2 \\ a_3 \\ a_4 \\ a_5 \end{pmatrix} + A_{ij}(L) \begin{pmatrix} KAR_{t-1} \\ RY_{t-1} \\ RM_{t-1} \\ CAR_{t-1} \\ NX_{t-1} \end{pmatrix} + B_{ij}(L) \begin{pmatrix} RF_t \\ RYF_t \end{pmatrix} + \begin{pmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \\ \varepsilon_{4t} \\ \varepsilon_{5t} \end{pmatrix} \quad (1)$$

where $A_{ij}(L)$ and $B_{ij}(L)$ are 5×5 and 5×2 matrices of polynomials in lag operator L, respectively.

When it comes to ordering of the variables, the nominal exchange rate is the last in order to extract the changes from the nominal exchange rate by removing the contemporaneous effect from the nominal exchange rate. Because the currency appreciation could affect all of the endogenous variables, which could also make contemporaneous little shocks among themselves, it is hard to distinguish the pure appreciation shock. As the point of this paper is to figure out the economic changes from the KRW appreciation, this restriction can be justified. Such structural VAR models with exchange rates in past studies often allowed for contemporaneous shocks. However, in this model, by identifying exogenous changes in

the exchange rate by controlling for its endogenous changes, finding the pure effect of the exchange rate could be possible, distinguishing the current work from past studies. Kim et al. (2016) used this identification method in order to analyze the RMB appreciation shocks to the Chinese economy.[5]

This paper analyzed the quarterly time series data from 2000:1−2017:2. For Korea, since the beginning of the capital account record, the exchange rate policy had been a de facto pegged−system and it changed to the floating policy after the currency crisis in 1997. Based on this history it is possible that the data before 1997 could distort the main results. Thus, the main analysis is limited to the years 2000:1 to 2017:2, and it will be compared to the results of 1980:1−2017:2 in the robustness test.[6]

[5] Based on this work, the current paper also follows Bayesian inference with Monte Carlo study. This statistical inference is not problematic in the presence of unit roots and cointegrating relation. See Sims (1988) as well as Sims and Uhlig (1991).

[6] As Korea started to pay their national debt from 1999:4, using data before 2000 seems inappropriate and could distort the results because the economy was still unstable and there were a number of restructuring changes in the financial market.

Chapter 4. Empirical Results [7]

Figure 1 suggests that the impulse responses to exchange rate shocks over 16 quarters with 95% percent error bands. Note that the exchange rate is defined as U.S. dollars per KRW. Therefore, the panels of Figure 1 show the responses to appreciation of the KRW. The exchange rate shock appreciates the exchange rate by 3.1 percent on impact, which declines to the initial level in about 10 quarters. Neither the current account nor the capital account responds significantly as indicated by wide probability bands. Real output increases a little by 0.12 percent in the short run, but continuously decreases in 3 quarters since it peaks its maximum with a 95 percent probability. The real money decreases in the short run but returns to the initial level in nine quarters. [8]

These results can be explained by the traditional theory that output declines under the currency appreciation via the expenditure switching effect. Also, the Korean economy transmissions are similar to the Chinese case, comparable to the results of Kim et al (2016).

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[7] The lag of the baseline model was analyzed by the lag criterion and was set to 2. All data from 2000:1 were suited to lag 2, and from 1980:1 were to lag 4.

[8] In order to lessen the bias from the period of the financial crisis and make sure the main results remain the same, a model including a dummy variable was analyzed. This yielded the same results as the baseline model.

The reason for there being little or no effects of exchange rate changes on the current account or trade balance can be attributed to the vertically integrated trade in East Asia. As Korea mainly manages its economic system by importing the intermediate goods and exporting the final manufactured products, the quantity of Korean imports tends to depend mostly on that of Korean exports, leading to small price elasticities of import demand and weak volume effects on Korean imports, which is similar to China and Japan.

Figure 1

Impulse Responses to Exchange Rate Shocks:
Baseline Model

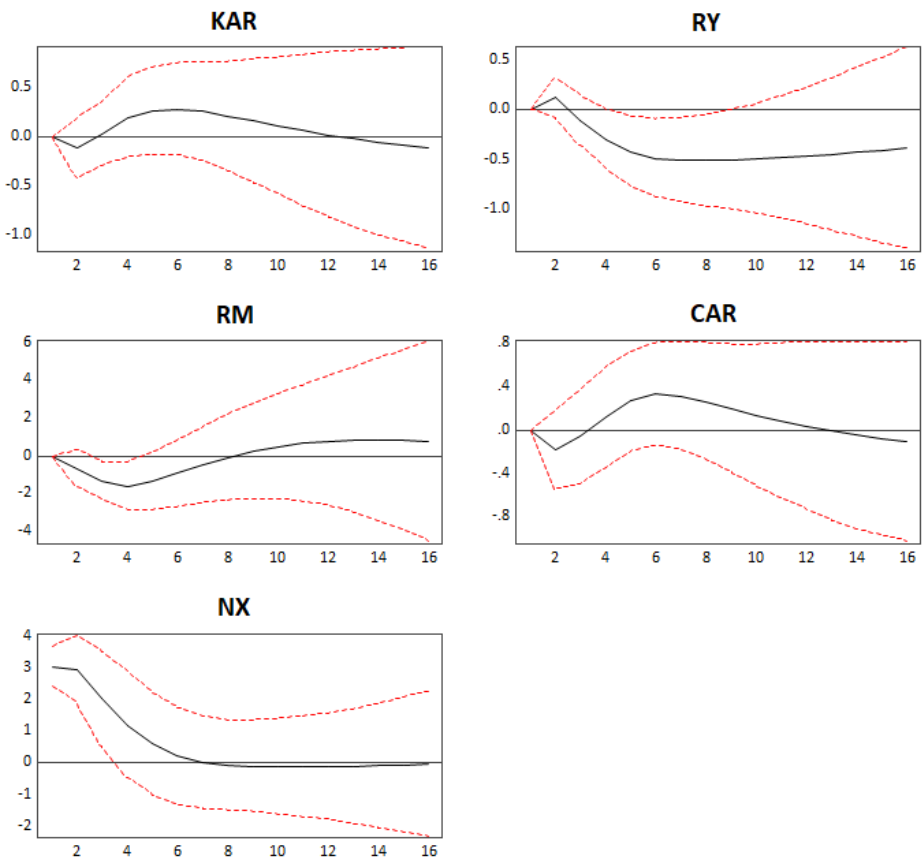
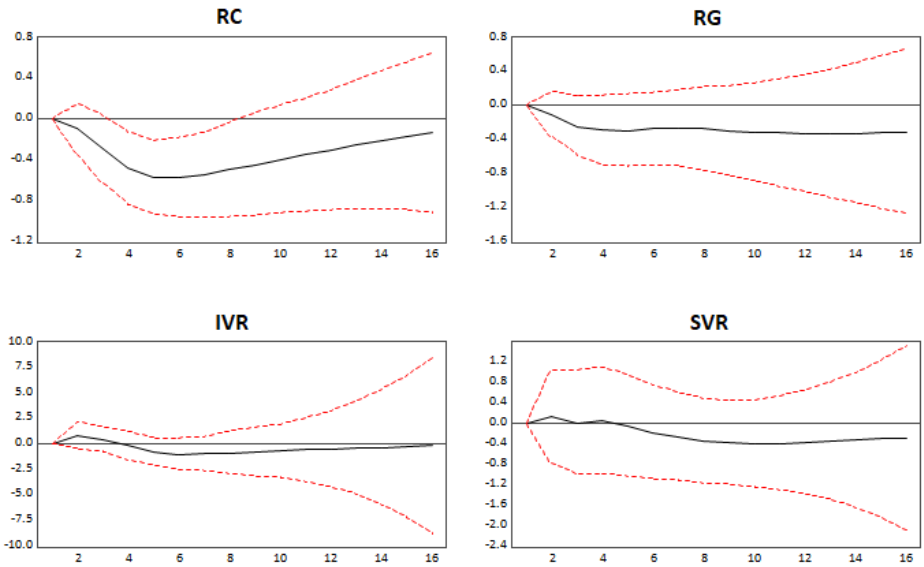


Figure 2

Impulse Responses to Exchange Rate Shocks:
GDP Components



As it is clear that there will be a long stagnation in South Korea due to its currency appreciation, it is necessary to figure out which GDP component is the key reason for this result. Therefore, Figure 2 shows the responses of various components of GDP to exchange rate shocks over 16 quarters. RC, RG, IVR, SVR stand for real consumption, real government, fixed investment and national saving, respectively[9]. IVR and SVR are measured as ratios to trend GDP.

In Korea, private consumption decreases, which contributes to the decline in real GDP after exchange rate appreciation. This may be related to the decrease in real money supply following currency appreciation (Figure 1), which suggests that the currency appreciation may induce or be accompanied by monetary contraction. Also, it induces a real consumption decrease, which may be reduced due to the monetary contraction policy. As the response of the real government expenditure is insignificant, it seems that the consumption decreasing is the main key to the reduction of the real GDP. The responses of national saving and investment do not change much, which is consistent with the small effect on current account.

[9] As the exchange rate is contemporaneously exogenous to the real GDP, the real variables RC and RG are also assumed to be contemporaneously exogenous. Each variable was added one by one to the baseline model as a way of removing contemporaneous exchange rate shock.

Chapter 5. Robustness Test

(i) Price Level

In order to examine responses of the export and import volume and their price, checking the response of the price level seems to be needed even though the real money supply showed more clarified economic transmission paths. However, due to the short period of data, the model including both the real money supply and the price level was too heavy to yield significant results. Therefore, the model is modified to add a new endogenous variable of price level (P) and an external variable of foreign price level (PF), ruling out the original variable of real money supply (RM). The price level data were determined by the consumer price indexes of Korea and the United States. Equation (2) shows the modified, reduced-form model given by:

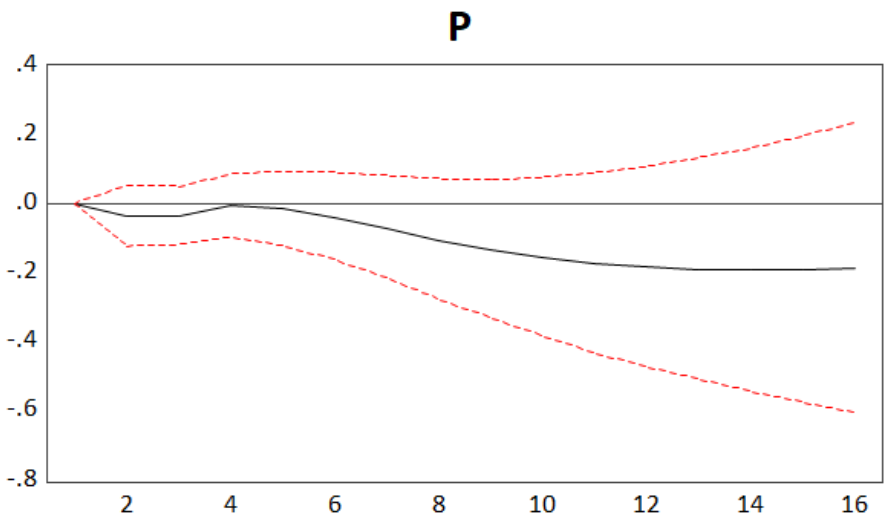
$$\begin{pmatrix} KAR_t \\ RY_t \\ P_t \\ CAR_t \\ NX_t \end{pmatrix} = \begin{pmatrix} a_1 \\ a_2 \\ a_3 \\ a_4 \\ a_5 \end{pmatrix} + A_{ij}(L) \begin{pmatrix} KAR_{t-1} \\ RY_{t-1} \\ P_{t-1} \\ CAR_{t-1} \\ NX_{t-1} \end{pmatrix} + B_{ij}(L) \begin{pmatrix} RF_t \\ RYF_t \\ PF_t \end{pmatrix} + \begin{pmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \\ \varepsilon_{4t} \\ \varepsilon_{5t} \end{pmatrix} \quad (2)$$

where $A_{ij}(L)$ and $B_{ij}(L)$ are 5×5 and 5×3 matrices of polynomials in lag operator L, respectively.

Figure 3 shows the response of the price level over 16 quarters, but the exchange rate appreciation shocks are likely to make an insignificant impact to the price level with 95 percent probability. Other responses were similar to the baseline model which includes the real money supply. Similar to how response to the price level in China was also insignificant according to Kim et al. (2016), it seems that China and Korea share many similarities between their economies, especially with vertically integrated trade.

Figure 3

Impulse Responses to Exchange Rate Shocks: Price Level



(ii) Export and Import

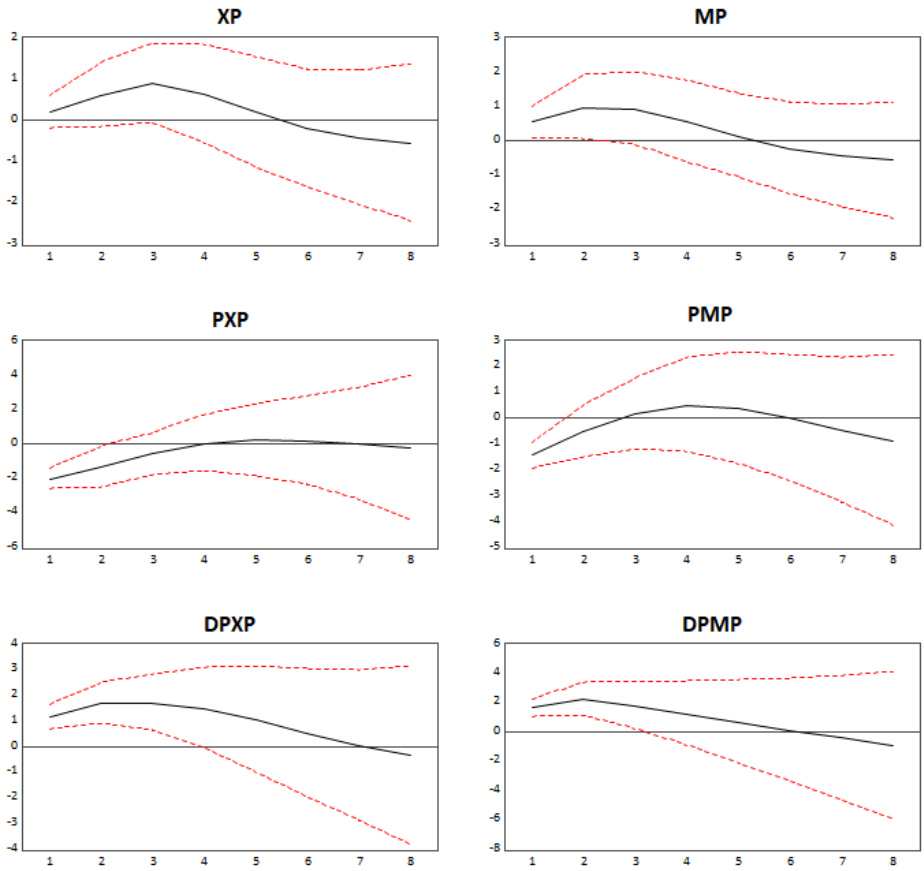
To investigate the responses of the capital and current account and real output in more detail, the model should be extended to include more components of trade-related variables. Thus, exports in the local currency (XP, as a ratio of the trend GDP), imports in local currency (MP, as a ratio of the trend GDP), export price in local currency (PXP), import price in local currency (PMP), export price in U.S. dollars (DPXP) and import price in U.S. dollars (DPMP) were considered as additional variables in the model. Based on the model in equation (2), the current model was extended by adding these variables one by one, similar to those in the baseline model.

Figure 4 shows how these variables respond over 8 quarters, although the changes are small, mostly due to the short period. Export and import prices in terms of U.S. dollars increased while those prices in terms of KRW decreased with an appreciation of the domestic currency. This indicates intermediate or partial passing through in the currency pricing policy. The reason why the response of exports in local currency turns out insignificant can also be attributed to the both the volume effect (as the U.S. dollar price of exports increases) and the value effect (as the won price of exports declines). The imports in won increases in the short term because the volume effect dominates, whereas the value

effects takes over in the long term, finally decreasing the KRW price of imports. Also, the insignificant response of the current account could also be because of the insignificant exports in terms of won. According to Kim et al (2016), as Japan also follows the intermediate case, Korea has many similarities to the Japanese trading system.

Figure 4

Impulse Responses to Exchange Rate Shocks: Export and Import



(iii) Since 1980

South Korea had chosen the fixed exchange rate since 1980, but it changed it to the floating system in the 1997 currency crisis and still officially uses it to this day. Thus, the data before 2000 seems inappropriate to analyze how the Korean economy will change after its currency appreciation. However, comparing differences between these 2 periods, from 1980 and from 2000, can be important as the policy has changed. Therefore, in this section, data analysis including both real money supply and the price level from 1980 is performed by modifying the baseline model.[10] Equation (3) denotes the modified model given by:

$$\begin{pmatrix} KAR_t \\ RY_t \\ P_t \\ CAR_t \\ NX_t \end{pmatrix} = \begin{pmatrix} a_1 \\ a_2 \\ a_3 \\ a_4 \\ a_5 \end{pmatrix} + A_{ij}(L) \begin{pmatrix} KAR_{t-1} \\ RY_{t-1} \\ P_{t-1} \\ RM_{t-1} \\ CAR_{t-1} \\ NX_{t-1} \end{pmatrix} + B_{ij}(L) \begin{pmatrix} RF_t \\ RYF_t \\ PF_t \end{pmatrix} + \begin{pmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \\ \varepsilon_{4t} \\ \varepsilon_{5t} \end{pmatrix} \quad (3)$$

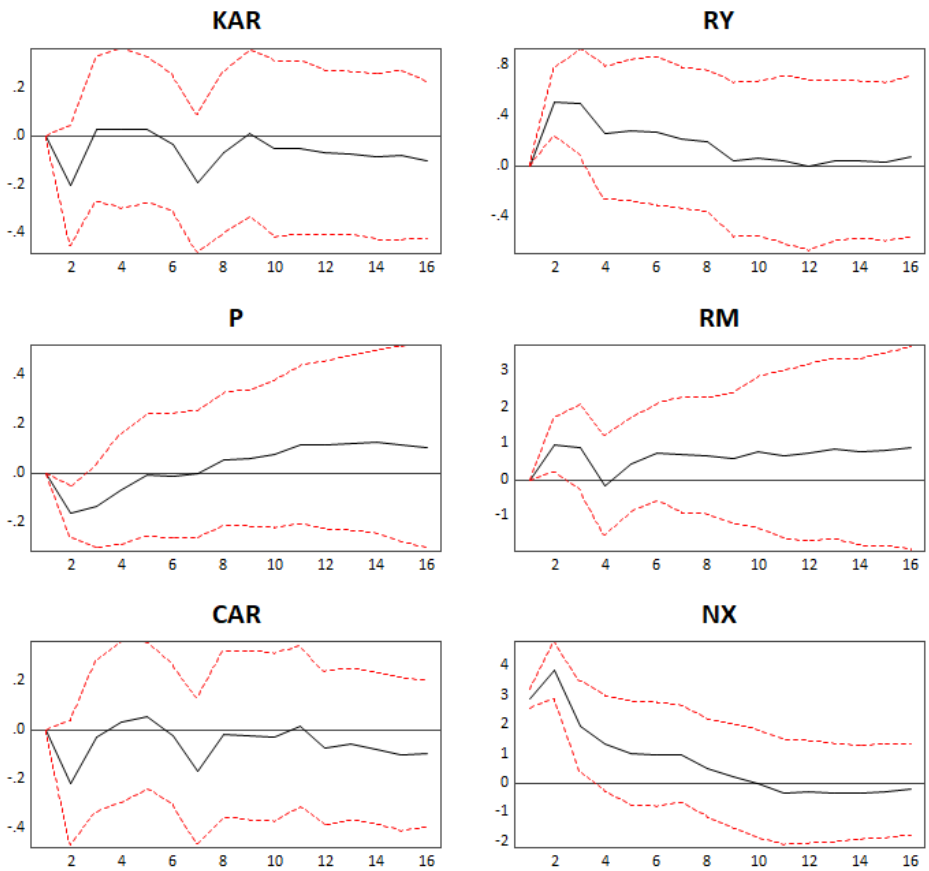
where $A_{ij}(L)$ and $B_{ij}(L)$ are 6×5 and 6×3 matrices of polynomials in lag operator L, respectively.

[10] As the period is longer than before, the model could yield significant results despite including both variables. As far as ordering variables, according to Kim et al. (2016), the price level is more likely to affect to the real money supply rather than the opposite, if the relation between the price level and the real money supply is considered.

Figure 5 displays the results of the model analysis over 16 quarters. The exchange rate appreciation shock is 2.9 percent at the initial time, increases by 3.9 percent at 2 quarters, and then declines to the initial level in about 10 quarters. The main differences between these periods are the direction of the real GDP, the price level, and real money supply. The real GDP increases, although it peaks to 0.51 percent at the second quarter and then decreases continuously but stays around the initial value, as opposed to the same component in the 2000 data, which continuously decreases below the negative value until the end. Likewise, the real money supply increases by 1 percent at about 3 quarters, touches down the initial value at 4 quarters, and then increases again steadily around 0.7 percent, but the same component of the shorter-period version decreases and returns to the initial value at about 9 quarters. As for the price level, it is insignificant in the data after 2000, but in this data the price level declines by −0.16 percent at 2 quarters and returns to approximately the initial level at about 5 quarters to 7 quarters. The capital and current account are insignificant, similar to the shorter data.

Figure 5

Impulse Responses to Exchange Rate Shocks:
Compared to Since 1980



The main reasons for the difference between the 2 periods are likely due to the policy changes. As South Korea officially used the fixed exchange rate policy, it is more likely that the economic transmission path is totally different form the system with the floating exchange rate. Also, going through the currency crisis could also be one of the reasons that the Korean economy has changed in a number of ways, such as restructuring or the downsizing weak companies or enhancing the liberalization of the financial market.

(iv) Contemporaneous Shock

The baseline model was set to figure out the pure effects of the exchange rate appreciation. However, it is necessary to examine how contemporaneously the KRW appreciation will affect the Korean economy. Thus, an alternative identification scheme is used to show the contemporaneous shock of the exchange rate appreciation by ordering the components oppositely so that it conforms to the following order: NX, KAR, RY, RM, and CAR. The opposite ordering allows the contemporaneous interactions among variables, which means the exchange rate is allowed to affect all endogenous variables contemporaneously but not the other way around.

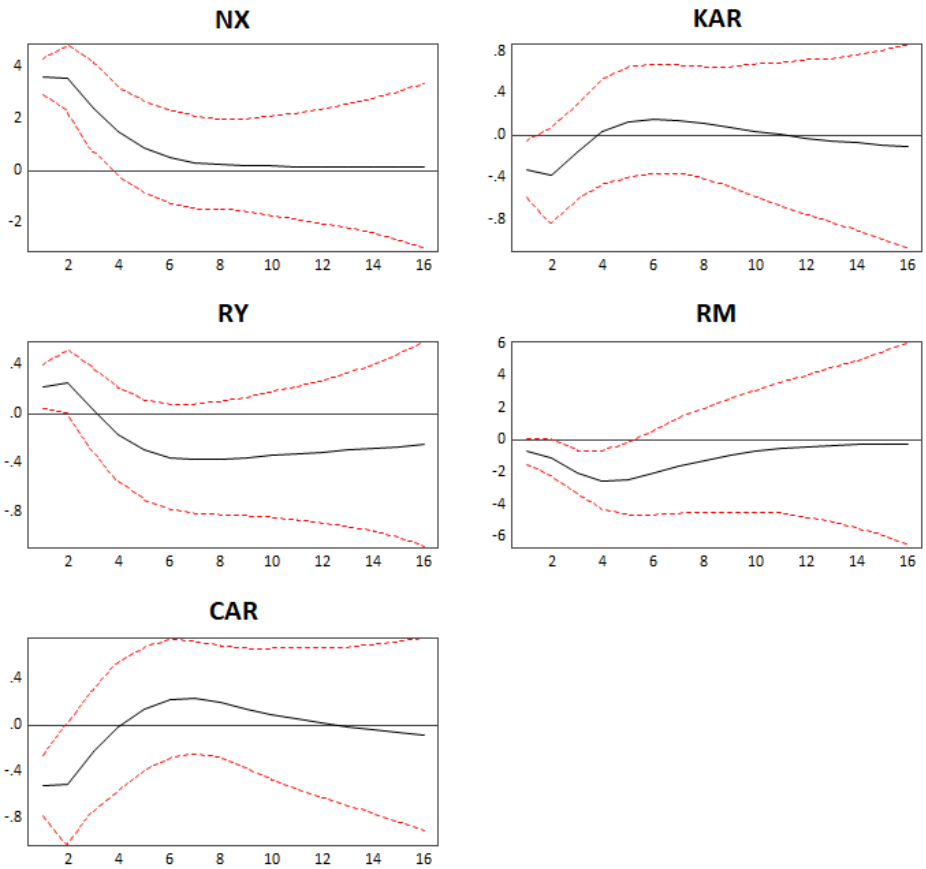
Figure 6 reports the results over 16 quarters with 95% percent error bands. In this analysis, the exchange rate appreciation shock increases to 3.6% percent and gradually decreases. In the case of the real GDP, it increases until the second quarter and returns to the initial value after the third quarter by declining continuously. As for the real money supply, RM decreases beginning in the first period but increases after the fourth quarter and returns around the initial value in the end. However, the capital account significantly decreases to −0.32% but increases and reverts to approximately the initial value; likewise, the current account significantly decreases to −0.52% but increases to 0.23% until around the sixth quarter and then gradually declines. These

results are in stark contrast to the analysis of the pure effect of the exchange rate appreciation.

According to these results, the directions of real output and RM are nearly identical to the restricted baseline model, though the real GDP clearly increases in the short term. However, as the primary purpose here is to estimate the pure effect of the exchange rate shock, the differences with the baseline model can be ignored. Nevertheless, as the capital and current account do in fact become significant, further research about the specific components of the GDP and current account with saving and investment might be needed.

Figure 6

Impulse Responses to Exchange Rate Shocks:
Contemporaneous Identification Scheme



Chapter 6. Conclusion

South Korea has been pressured due to its tremendous trade surplus, especially to the United States. South Korea has been suspected of being a currency manipulator because its economic growth has depended on international trade and it has largely accumulated its economic profit from this sector. In addition, as its foreign exchange reserve has recently reached an all-time-high, the trade pressure is likely to be stronger as long as the United States is sensitive to its tremendous trade deficit and global imbalance after the financial crisis. As the U.S. government issues warning through the tariff in the trade war by attributing its economic loss to the East Asia, especially China and Korea, it is possible that the U.S. government will ask Korea to let its currency appreciate. Thus, this paper forecasts how and through which path KRW appreciation will affect the Korean economy.

According to the literature review, even though Korea officially claimed to change its exchange rate regime from a fixed (pegged) exchange rate to the floating rate after the 1997 currency crisis, it has been suspected to be a currency manipulator. Much research argues that the Korean government has intervened in its exchange rate market in order to make the exchange rate stable or encourage exporting due to the undervaluation. According to several

papers, it appears that the KRW tends to be undervalued after the currency crisis.

In order to investigate the transmission after the currency appreciation, the VAR model with exogenous variables was used. Results indicate Korea will suffer from a long-term recession like Japan after its currency appreciation, whereas there were insignificant effects on the current and capital accounts. Regarding the response of the real money balance, the money contraction due to the exchange rate appreciation can explain its fall, which can also induce a decrease in the real consumption.

As for other results, the response of the price level does not change too much but it significantly enables responses to exports and imports. From the responses, Korea seems to be an intermediate pricing system, which is between the producer's currency pricing and local currency pricing. Further, it is likely that the reason why current account has changed little is because of the insignificant response of exports in local currency. These insignificances can be explained by the vertically integrated trade system in East Asia, especially Korea, China, and Japan.

Also, by comparing the results to the data from 1980 to those from 2000, many differences arise, such as how the response of real output and money balance increases and that of the price level decreases. That's because the exchange rate policy changed after the currency crisis.

Additionally, as the United States has recently been raising its importing tariff to apply much pressure on the Asian trade market, investigating the tariff increasing shock could be important. Therefore, it will be covered in the Appendix.

Ultimately, the current analyses demonstrate that there will be a long-term stagnation in Korea through the currency appreciation, but the U.S. trade deficit from South Korea cannot be fixed as Korea's current account does not seem to fall significantly. As for the tariff strategy, it is also not the cure for the global imbalance for the United States. Thus, it is foreseeable that if the U.S. government uses these strategies only to fix its trade deficit, the results might be disappointing. Also, distinct from Japan and China, the real consumption was decreased in Korea, which is likely sensitive to the monetary contraction policy.

Chapter 7. Appendix

(i) Data Resources

a. South Korea

Data on GDP and its components (and their deflators), CPI, capital and current account, nominal exchange rate, export and import price in local currency and U.S. dollars were obtained from Bank of Korea. The balance of capital account and financial account were used as the capital account. Data on the nominal exchange rate against the U.S. dollar (period average) was obtained from the reciprocal of the original one. Exports and imports in the local currency were extracted from OECD Quarterly National Account. Data on M1 was gained from Federal Reserve Economic Data. Seasonally unadjusted data were seasonally adjusted using the X-12 ARIMA method[11], except for the nominal exchange rate. Data on bilateral exports to the United States in U.S. dollars in the following section were obtained from Direction of Trade Statistics (IMF).

[11] According to the Bank of Korea, Korea uses its own distinctive seasonally adjusted method, BOK-X-12-ARIMA, so that the X-12-ARIMA method, generally used in the United States, appears better than the X-11 method, which was used in Kim et al. (2016).

b. The United States

All data series were obtained from Federal Reserve Economic Data. The three-month Treasury bill rate was used as the short-term interest rate. Data on the import tariff on Korean manufactured goods in the following section was gained from United States International Trade Commission. Seasonally unadjusted data was seasonally adjusted using the X-12 ARIMA method.

(ii) Does U.S. Import Tariff Yield Significant Effects?

As the U.S. government tries to impose more import tariffs on Chinese products as a warning for its exploitation of trade surplus, there is a possibility that Korea would also be one of the countries that the U.S. government considers imposing more import tariffs on due to its large trade profits from the U.S. Therefore, investigating how the import tariff can affect the Korean exchange rate and its economy might be needed in order to prepare for that case.

The increasing tariff is likely to affect the current and capital account, real GDP and real money supply of Korea because the trade magnitude with the U.S. has accounted for a large proportion of its trade. In order to observe how the tariff affects the Korean economy, the baseline model should be modified so that the current account is affected by the tariff

directly, including the tariff as an endogenous variable. This renders two shocks for this model: contemporaneous tariff increasing shock to the current account and exchange rate, and external currency appreciation shock as before.

The new tariff variable is set by dividing the import tariff on Korea by exports to the United States in U.S. dollars as a ratio of the trend GDP. All variables were in logarithm and multiplied by 100.

Figure 7 reports the responses of the tariff increasing shock and exchange appreciation shock over 16 quarters.[12] The tariff increasing shock elevates the tariff rate by 13 percent on impact with 95 percent probability, which decreases to the initial level in about 11 quarters. The exchange rate shock appreciates the exchange rate with the same pattern. As for the exchange rate shock, the response of the real GDP to the exchange rate appreciation changes to insignificance. Other responses to it were similar to the results of the baseline model.

When it comes to the tariff increasing shock, there is no significant response from the current account even if it is set to yield a contemporaneously shock. Furthermore, neither capital account, nor real GDP, nor real money supply is

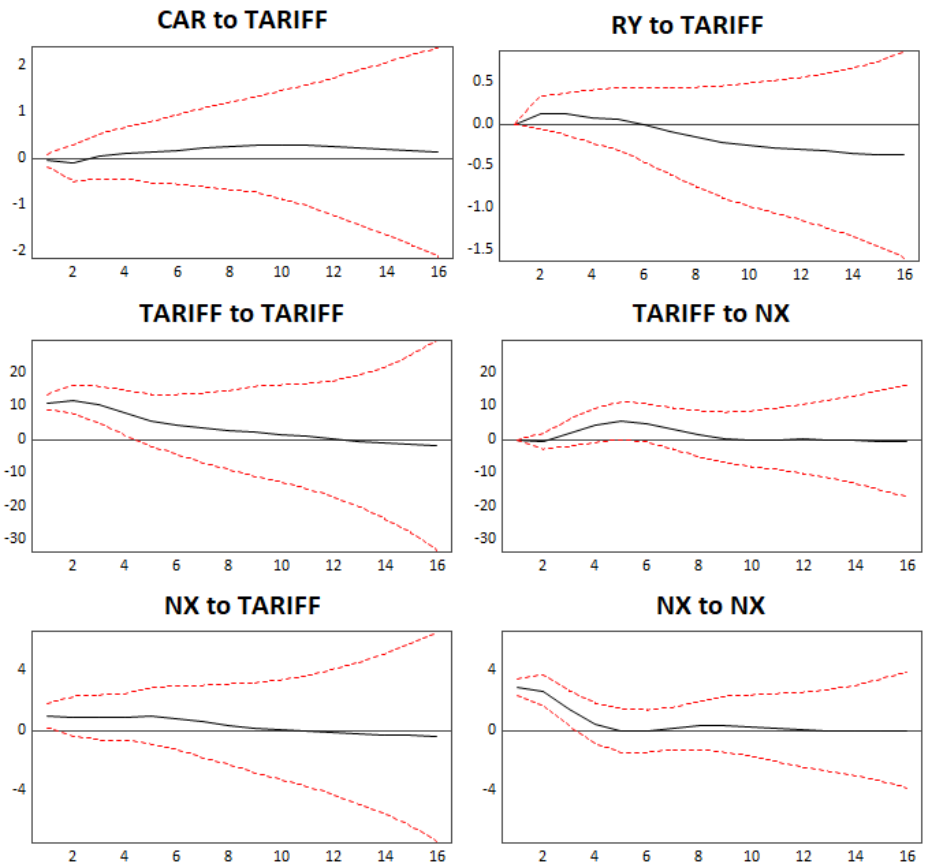
[12] The tariff increasing shock unexpectedly affects neither the real GDP, current and capital accounts, nor real money supply. This seems to be because the tariff shock is too small to attack the whole Korean economy even though U.S. trade is important to Korea.

significant. Only the exchange rate responded to the tariff increasing, in which the exchange rate goes up by 1 percent until the tenth quarter, different from zero with 95 percent probability. This makes sense as the tariff is more likely to rely on the external decision than the exchange rate. Thus, the response of the tariff to the exchange rate appreciation is insignificant.

However, it is certain that more specific and comprehensive research will be needed in addition to this analysis. This will provide a great opportunity for the subsequent research to study the U.S. import tariff and bilateral trade from the United States to Korea.

Figure 7

Impulse Responses to Exchange Rate Shocks:
Adding Tariff Increasing Shock



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Abstract in Korean

국문 요약

본 논문은 원화의 평가절상으로 인해 한국의 경상수지 및 자본 수지가 변화하는 양상과, 이로 인해 한국에 일본과 같은 경기 침체가 발생할 여부가 있는지에 대한 연구를 한다. 미국은 한국이 대미 무역으로 막대한 무역 이익을 취하고 있음을 들어 한국이 공식적으로는 변동환율제를 취한다 하지만 자국의 수출을 장려하기 위해 원 달러 환율을 조작해왔다고 경고한다. 외환위기의 아픔이 있어 외환을 축적해두는 한국 및 아시아 국가들과 달리 경상수지 적자로 무역 불균형을 체험하고 있는 미국은 글로벌 금융위기에 대한 원인을 이것으로 들며 한국과 중국 및 아시아 국가들에게 압박을 가하고 있다.

특히나 한국의 외환보유고가 올해 7월 최초로 4000억 달러를 넘고, 미국 정부가 한국이 수출 증진을 위해 환율을 조작하고 있다는 의심을 꾸준히 해 왔단 점에서 한국은 자국 통화의 가치를 평가절상 할 수 밖에 없는 위치로 내몰릴 수 있다. 따라서 이러한 미국의 원 달러 환율 상승 압박의 결과인 원화의 평가 절상이 한국에 어떠한 영향을 줄지에 대해 예측하는 것은 이에 대한 대비책으로서 필요한 부분이다.

본 연구에서는 한국의 내생 변수와 미국의 외생 변수를 사용한 VAR 모델을 활용하여 이러한 사안에 대해 예측해보았다. 데이터는 한국은행, IMF, FRED, OECD에서 각자 가져왔으며,

데이터 분석은 1997년 외환위기 이후 변동환율제를 시행했음을 고려해 외국 부채 상환을 시작한 2000년 1분기를 이후로 데이터를 분석하였다.

논문의 주요 결과로는 한국의 경상수지 및 자본수지에는 변화가 미미했지만, 실질통화공급 및 실질GDP는 감소하는 결과를 가져왔다. 이는 원 달러 환율의 평가절상으로 통화 긴축정책이 발생하여 실질 통화공급이 감소하게 되었고, 이로 인해 GDP 구성요소 중 실질 소비가 감소하게 되어 결과적으로 실질 GDP가 감소하게 되었다고 할 수 있다.

추가적인 연구사안으로는 실질 통화공급 대신 한국 및 미국의 물가를 모델에 추가해 분석하였으나 원화의 평가절상으로는 물가의 유의미한 변화를 주지 못하였다.

뿐만 아니라 한국의 경상수지에 관하여 원화가치로 나타낸 수출입, 원화와 달러 가치로 각각 나타난 수출입 가격을 분석하여, 한국의 수출입품이 중간적 가격 설정 모델 (Intermediate Pricing Model)을 따르고 있음을 확인할 수 있었다.

게다가 자본수지 및 자본계정에 대한 기록이 시작되었던 1980년부터의 분석은 2000년부터 연구하였던 기존 논문과 차이가 컸다. 경상수지 및 자본수지에 대한 결과는 마찬가지로 변화가 거의 없었으나, 물가는 하락하고 실질 통화공급 및 실질 GDP는 증가하는 결과를 가져와 매우 큰 차이가 있었다. 이는 1997년 외환위기 이후 환율 제도의 변화가 결과에 영향을 주었을 것이다.

마지막으로 논문의 부록에는 대미 관세율 상승에 대한 변화도 다루었다. 현재 미국이 중국에게 관세율 상승으로 무역 제제를 가하고 있다는 점을 고려하여, 한국에 이와 마찬가지로 관세율

상승이 있을 경우 똑같이 원화의 평가절상이 시행될 때 어떠한 결과가 있을지 알아보았으나, 예측과 달리 관세는 환율의 상승을 조금 가져올 뿐 이외에는 아무런 유의미한 변화를 주지 않았다. 이는 대미 무역이 한국 무역에 큰 부분을 차지하지만 관세 상승이 한국 경제에 전체적인 큰 변화를 줄 정도의 영향력을 미치지 않고 있음을 알 수 있었다.