Exchane Rate Dynamics under Financial Market Frictions- Exchange rate regime, capital market openness and monetary policy -Electoral cycle of exchange rate in Korea : The Trilemma in Korea

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- EXCHANGE RATE DYNAMICS UNDER FINANCIAL MARKET FRICTIONS
- EXCHANGE RATE REGIME, CAPITAL MARKET OPENNESS AND MONETARY POLICY: THE TRILEMMA IN KOREA
- ELECTORAL CYCLE OF EXCHANGE RATE IN KOREA

PHILOSOPHIÆ DOCTOR (PH.D.) IN BUSINESS ADMINISTRATION

FROM ESSEC BUSINESS SCHOOL

and

DOCTEUR EN SCIENCES DE ECONOMIE
DE L'ECOLE DOCTORALE
« ECONOMIE, MANAGEMENT, MATHEMATIQUES DE CERGY »

FROM UNIVERSITE DE CERGY PONTOISE

Presented and defended publicly on December 3, 2012 by

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Acknowledgements

It has been a long journey. Sometimes it was tough but it was joyful.

I believe that it would not have been possible to complete my thesis without the great help and support of my supervisor professor Cristina Terra. Her excellent guidance makes the journey valuable.

I would like to thank my juries Mr. Michael Brei, Ms. Karine Gente and Mr. André Fourçans. Especially, I appreciate professor André Fourçans who admitted me in the PhD course.

I dedicate my works to my husband Kook-hee LEE and my son Jae-In.

Hyunjoo RYOU

Contents

Chapter 1

Exchange Rate Dynamics under Financial Market Frictions

Abstract

This paper extends Dornbusch's overshooting model by proposing "*generalized interest parity condition*", which assumes sluggish adjustment on the asset market. The exchange rate model under the generalized interest parity condition is able to reproduce the *delayed overshooting* of nominal exchange rates and the hump-shaped response to monetary shocks of both nominal and real exchange rates.

Keywords: Exchange rates; Interest rate parity; Overshooting; Purchasing power parity puzzle; Forward premium puzzle; Monetary policy

JEL classification: E52; F31; F41; F47

1.1 Introduction

Dornbusch (1976), one of the most influential papers in international macroeconomics, presents the first model to incorporate sticky prices in an open macroeconomics model with rational expectations. According to the model, the real exchange rate should depreciate after a monetary expansion, returning to its equilibrium value over time. As for the nominal exchange rate, its initial depreciation should overshoot its long-run value, so that we would observe a nominal appreciation over the equilibrium path toward its long-run value. The model, thereby, explains the excess volatility of nominal exchange rates.

On the one hand, empirical studies have found patterns conflicting with Dornbusch's predictions. According to these findings, the peak response of exchange rates to a monetary shock occurs with a delay of several months, so the both nominal and real exchange rates present a hump-shaped pattern after monetary shocks (Eichenbaum and Evans, 1995; Cheung and Lai, 2000; Kim and Roubini, 2000; Faust and Rogers, 2003; Kim, 2005; Steinsson, 2008; Scholl and Uhlig, 2008; Kalyvitis and Skotida, 2010). This result is referred in the literature as *delayed overshooting*.

On the other hand, Dornbusch's model relies on the uncovered interest parity (UIP) condition, which states that interest rate differentials across countries should be equal to expected currency depreciation. In reality, however, interest rate differentials are poor predictors of exchange rate behavior, which constitutes the *forward premium puzzle* (for a survey, see Lewis, 1995).

Actually, most theoretical analyses in international macroeconomics assumes the validity of UIP, despite the overwhelming empirical evidence against it. Assumptions do not need to be literally true, but there is a problem when an unrealistic assumption hides mechanisms that are essential to the understanding of the issue at question. By allowing for departures from UIP in the Dornbusch model, we are able to generate the delayed overshooting found in the data. More specifically, we propose a *generalized interest parity condition*, according to which excess returns in asset markets adjust sluggishly to shocks. As a result, nominal exchange rates have a delayed peak response to monetary shocks, while the response dynamics of the real exchange rate also present a hump-shaped initial response followed by a prolonged convergence period.

A number of papers have proposed theoretical explanations for the delayed overshooting. Landry (2009) incorporates a state-dependent pricing rule in an otherwise standard new open macroeconomics model to obtain a delayed exchange rate overshooting. On a different line, Andersen and Beier (2005) and Gourinchas and Tornell (2004) assume imperfect information on whether the monetary shocks are permanent or transitory. They generate not only delayed exchange rate overshooting but also ex-post departures from UIP due to persistent forecast errors. In Bacchetta and Wincoop (2010) these empirical regularities are explained by infrequent foreign currency portfolio decisions. However, none of these papers are able to explain real exchange rate movements.

Our focus is to understand the interaction between real exchange rates and excess returns in the assets market, following a monetary shock. To this end, we propose a simple model with no micro-foundations for the sluggish adjustment neither of prices nor of excess return on assets. The new open macroeconomics models offer micro-foundations for price rigidities (Lane, 2001, offers an early survey of this literature, following the seminal paper of Obstfeld and Rogoff, 1995), while either imperfect information on the nature of the shocks, as in Andersen and Beier (2005) and Gourinchas and Tornell (2004), or infrequent portfolio decisions, as in Bacchetta and Wincoop (2010), could be underlying explanations for departures from the UIP. We then keep the simplification spirit of Dornbusch's model to better understand the intuition behind the role of excess returns of assets on exchange rate paths.

For the rest part of the paper, in section 2, we present some stylized facts to motivate this study. In section 3, we introduce the new assumption of sluggish adjustment on the asset market, captured by the *generalized interest parity* condition, and incorporate it to the Dornbusch (1976) framework. Section 4 analyzes the effects of monetary shocks and describes the empirical predictions of the model. In section 5, we present some empirical evidence for the model. Finally, section 6 concludes the paper.

1.2 Stylized Facts

We start by presenting some stylized facts to motivate our theoretical investigation. We look, in turn, at the pattern of departures from purchasing power parity and from interest rate parity conditions.

1.2.1 Purchasing power parity

There is a vast empirical literature documenting the behavior of real exchange rate (RER) over time (see Froot and Rogoff, 1995, Rogoff, 1996, Sarno and Taylor, 2002, and Taylor and Taylor, 2004). On the one hand, real exchange rates tend to converge to purchasing power parity (PPP) at very low speeds. On the other hand, short run deviations from PPP is large and volatile. As Rogoff (1996) points out, these two characteristics of RER are hard to reconcile. Usual explanations for RER changes cannot account for both of them simultaneously.

One explanation relies on nominal shocks in an economy with sticky prices. Price rigidity would prevent prices from adjusting instantaneously to nominal shocks, so that RERs would absorb the shocks. The effect would die out with the gradual adjustment of prices. The problem with this explanation is that it does not account for the low speed of convergences to PPP. Price stickiness would have to be more long lasting than the time required for sources of rigidity such as menu cost, imperfect information or fixed wage contracts.

Alternatively, *equilibrium* RERs may change as a response to real shocks to the economy, such as terms of trade shocks or changes in international interest rates. In this case RER changes could have a longer lasting effect. However, in order to explain the high RER volatility in the short run, real shocks would have to be unrealistically frequent and large.

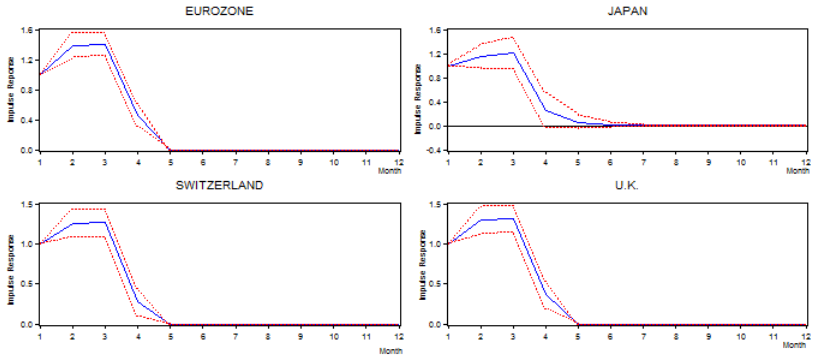
Cheung and Lai (2000) compute the adjustment dynamics of the real exchange rates through impulse response analysis of four European countries, including France, Germany, Italy and U.K., vis-à-vis the U.S. for the period from April 1973 to December 1996. They find that the impulse responses of real exchange rates have similar patterns: (i) they are all hump-shaped; (ii) the shock amplification period lasts for 1 to 3 months only; and (iii) the adjustment occurs afterwards, and it takes more than one year. In addition, they point out that the initial amplification of shock response, albeit it is over a very short time, is related to the half-life estimation. The large amplified initial response can produce a long half-life estimation and generate the slow adjustment even when PPP deviations are corrected at a relatively fast speed.

They point out that this non-monotonic response of the real exchange rates is not consistent with monotonic price-adjustment behavior in Dornbusch-type sticky-price models.

1.2.2 Interest rate parity

It is a well-known stylized fact that there exist large deviations from uncovered interest parity (Hodrick, 1987; Froot and Thaler, 1990; Lewis, 1995). Some researches report that monetary policy shocks generate deviations from the UIP that are several times larger than the resulting interest rate differential (Eichenbaum, 1995; Cushman and Zha, 1997; Kim and Roubini, 2000). In other words, excess returns are larger than interest rate differentials. Excess returns ER_{t+1}, defined as the difference between the expected return on domestic assets and on foreign assets, can be written as:

Figure 1.1: Adjustment dynamics of excess return.



$$ER_{t+1} \equiv e_{t+1} - e_t - (i_t - i_t^*) \tag{1.1}$$

where e_t is the nominal exchange rate in period t, and i_t and i_t^* are the domestic and foreign interest rates, respectively.

We compute impulse response functions on excess return, following the procedure of Cheung and Lai (2000) for the RER. Figure 1.1 presents the impulse responses on excess return of four currencies, including those of Eurozone, Japan , Switzerland and the United Kingdom, vis-à-vis the US. We use monthly data of average exchange rates and 3-month short term interest rates, for the period from January 2001 to December 2010.[1] All four excess return data are found to be stationary.

In Figure 1.1, we identify the following features: (i) impulse responses are all hump-shaped; (ii) the response to shocks amplifies over the first three months; and (iii) they damp out for 15 to 20 months. In fact, we analyze all the OECD member countries and obtain the same results. Surprisingly, the pattern of impulse responses shown in Figure 1.1 is very similar to the RER adjustment dynamics reported by Cheung and Lai (2000).

1.3 Theoretical Framework

We follow the structure of Dornbusch (1976) model, adding to it an alternative assumption to the UIP. More specifically, in our model economy there is

[1]For Japan we have a slightly shorter period, from July 20002 to December 2010.

sluggish adjustment both in the goods and in the asset markets. We start with the description of the asset market, and then describe the goods market, the money market and, finally the equilibrium.

1.3.1 The Asset Market

Most international macroeconomics models assumes free capital mobility, perfect substitutability between domestic and foreign assets, and no information problem or other sources of frictions in international financial markets. In such an environment, domestic and foreign assets should yield the same return at all times, that is, the UIP is valid and excess return in equation (1.1) equals zero. Empirical studies indicate that, although departures from UIP are common, excess returns do tend to be zero in the long run. We capture this empirical result by assuming a sluggish adjustment of excess returns. More specifically, we assume that excess return adjusts slowly towards the parity condition according to the following transition path:

$$ER_{t+1} = \lambda ER_t, \tag{1.2}$$

where a portion λ, $\lambda \in [0,1]$, of current excess returns persists in the following period. Note that excess returns after k periods will be $\lambda^k ER_t$, so it will tend to be zero in the long run .

A larger λ means a more sluggish adjustment towards UIP. $(1-\lambda)$ can then be interpreted as the adjustment speed of excess return. We do not offer here micro-foundations for this slow adjustment of excess return. Possible explanations could be related to imperfect information on whether shocks are temporary or permanent, as suggested by Andersen and Beier (2005) and Gourinchas and Tornell (2004), or infrequent portfolio decisions, as shown in Bacchetta and Wincoop (2010).

We define $\tilde{e}_t$ as the exchange rate level that would yield the UIP valid, and we call it IPER (interest rate parity exchange rate):

$$\tilde{e}_t \equiv e_{t-1} + \left(i_{t-1} - i^*_{t-1}\right). \tag{1.3}$$

Note that the gap between the actual exchange rate and the IPER, $e_t - \tilde{e}_t$, correspond to the excess return in equation (1.1). Hence, equation (1.2) can be rewritten as:

$$e_{t+1} - \tilde{e}_{t+1} = \lambda\left(e_t - \tilde{e}_t\right), \tag{1.4}$$

or, substituting $\tilde{e}_{t+1}$ is the equation above by definition (1.3), we get:

$$e_{t+1} - e_t = \lambda \left(e_t - \tilde{e}_t\right) + \left(i_t - i_t^*\right) \tag{1.5}$$

We term equation (1.5) the *generalized interest parity* (GIP) condition, which allows for sluggish adjustment of excess return. Compared to the traditional UIP condition, the GIP condition has the additional term $\lambda(e_t - \tilde{e}_t)$, which captures the persistent component of past excess returns. The UIP can be seen as a special case of GIP, where $\lambda = 0$.

Note that, according to (1.4), we have that $\underset{k\to\infty}{lim} \left(e_{t+k} - \tilde{e}_{t+k}\right) = \underset{k\to\infty}{lim} \lambda^k \left(e_t - \tilde{e}_t\right) = 0$, that is, in the long run equation (1.5) boils down to the traditional interest parity condition. In the short run, however, there is some persistence of excess returns.

1.3.2 The Goods Market

Following Dornbusch (1976), we assume that there is slack capacity in the economy so that its activity level is demand determined. Aggregate demand for domestic output, y_t^d, is assumed to be an increasing function of the real exchange rate, q_t, and it is equal to its "natural" rate, $\bar{y}$, when the RER is at its equilibrium level, $\bar{q}$. That is:

$$y_t^d = \bar{y} + \delta \left(q_t - \bar{q}\right), \ \delta > 0. \tag{1.6}$$

where the real exchange rate is defined as:

$$q_t \equiv e_t + p_t^* - p_t, \tag{1.7}$$

where p_t and p_t^* are domestic and foreign prices, respectively. p_t^* is assumed to be constant.

If prices were fully flexible, the RER would be at its equilibrium level at all times, $q_t = \bar{q}$, and, consequently, output would remain at its natural level. However, we assume that prices are sticky in the short-run. We follow the price adjustment rule suggested by Mussa (1982), according to which price adjusts under the influence of following two forces. On the one hand, it adjusts to gradually eliminate the excess demand, and, on the other hand, it responds to changes in its own equilibrium path, as in:

$$p_{t+1} - p_t = \varphi \left(y_t^d - \bar{y}\right) + \left(\tilde{p}_{t+1} - \tilde{p}_t\right), \tag{1.8}$$

where $\tilde{p}_t$ represents the price level compatible with the long run equilibrium both in goods and in asset market, given the state of the economy at time t. In terms of our model, this means the price level that renders the RER equal to its equilibrium level $\bar{q}$, given the IPER, that is, the nominal exchange rate compatible with the UIP. Hence:

$$\tilde{p}_t \equiv \tilde{e}_t + p_t^* - \bar{q}. \tag{1.9}$$

By substituting the definition of equilibrium prices, equation (1.9), with the price adjustment, equation (1.8), and using the aggregate demand, equation (1.6), we get the price adjustment path:

$$p_{t+1} - p_t = \varphi\delta\left(q_t - \bar{q}\right) + \tilde{e}_{t+1} - \tilde{e}_t. \tag{1.10}$$

Note that in a model with no frictions in the asset market the second term of the price adjustment path (1.10), the change in IPER, would be simply the nominal exchange rate devaluation, since, in that case, the actual nominal exchange rate is the one consistent with UIP. Here, this is not necessarily the case. An excess return caused by a shock in the economy will persist over time, so that the nominal exchange rate will no longer be the one that yields UIP.

By subtracting the term $(e_{t+1} - e_t)$ from both sides of equation (1.10), using equation (1.4) and the RER definition in equation (1.7), we get the equilibrium path for the RER:

$$q_{t+1} - q_t = -\varphi\delta\left(q_t - \bar{q}\right) - (1 - \lambda)\left(e_t - \tilde{e}_t\right) \tag{1.11}$$

Under UIP, we have that $q_{t+1} - q_t = -\varphi\delta(q_t - \bar{q})$, and shocks to RER should damp out monotonically over time, given that $\varphi\delta < 1$. Nevertheless, as we have seen in the previous section, empirical findings unveil non-monotonic dynamic responses of the RER (Cheung and Lai, 2000). The adjustment term $(1 - \lambda)\left(e_t - \tilde{e}_t\right)$ in equation (1.11), which does not exist if we assume the UIP condition, is a possible answer to such non-monotonic responses. Hence, the sluggish adjustment on the asset market is reflected on the RER path. According to this term, a positive excess return on foreign assets, that is, an actual nominal exchange rate more devalued than the IPER, would cause an appreciation of the RER. This means that sluggish adjustment on the asset market increases the short-term volatility and the adjustment time of the RER.

1.3.3 The Money Market

Money market equilibrium requires that money demand equals its supply. As usually seen in the literature, we assume that money demand is a negative function of interest rates and positive function of real income. The equilibrium condition in the money market is then given by:

$$m_t - p_t = -\eta i_t + \phi y_t \tag{1.12}$$

where m_t represents nominal money supply Substituting the interest rate for the GIP condition, equation (1.5), and using the aggregate demand, equation (1.6), to substitute for real income, equation (1.12) can be rewritten as:

$$m_t - e_t + q_t = -\eta \left[e_{t+1} - e_t - \lambda \left(e_t - \tilde{e}_t \right) \right] + \phi\delta \left(q_t - \bar{q} \right)$$

where international prices and interest rates are assumed constant for simplicity. Furthermore, units are chosen so that $p^* = i^* = \overline{y} = 0$. Finally, rewriting the equation above we get the following equation:

$$e_{t+1} - e_t = \frac{e_t}{\eta} + \lambda \left(e_t - \tilde{e}_t \right) - \frac{\left(1 - \phi\delta \right) q_t}{\eta} - \frac{\phi\delta\bar{q} + m_t}{\eta} \tag{1.13}$$

Note that equation (1.13) includes a new term $\lambda(e_t - \tilde{e}_t)$. Hence, in our model the sluggish adjustment of excess return on the asset market is reflected on the paths of both nominal and real exchange rates, in equations (1.13) and (1.11), respectively.

1.3.4 Equilibrium

We have a system of two first-order difference equations, for q and for e in equations (1.11) and (1.13), respectively, and the convergence path of excess return in equation (1.4).

The economy is in a steady state when nominal and real exchange rates are stationary, which means that, when $q_{t+1} - q_t = e_{t+1} - e_t = 0$. From equation (1.11), we then have the following equation:

$$q_t = \bar{q} - \frac{1 - \lambda}{\varphi\delta} \left(e_t - \tilde{e}_t \right), \tag{1.14}$$

and from equation (1.13), we get

$$e_t = \frac{1 - \phi\delta}{1 + \eta\lambda} q_t + \frac{1}{1 + \eta\lambda} \left(\phi\delta\bar{q} + m_t \right) + \frac{\eta\lambda}{1 + \eta\lambda} \tilde{e}_t. \tag{1.15}$$

Figure 1.2: Exchange rates dynamics

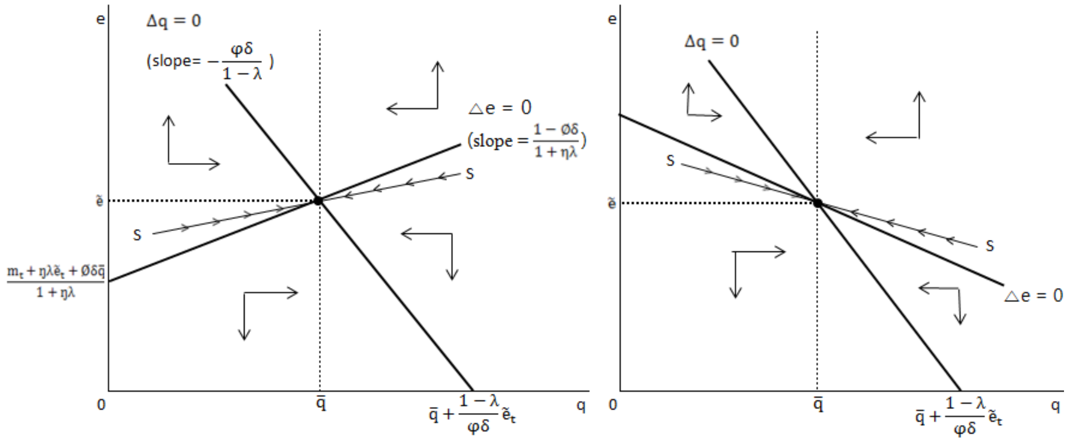


Figure 2.1 Exchange rate dynamics : øδ < 1

Figure 2.2 Exchange rate dynamics : øδ > 1

Finally, the nominal exchange rate must equal the IPER in a steady state, so that excess return is zero:

$$e_t = \tilde{e}_t. \tag{1.16}$$

Combining equations (1.14), (1.15) and (1.16), we have that, in steady state:

$$\bar{e} = \bar{m} + \bar{q},$$
$$\tilde{e} = \bar{e} \text{ and}$$
$$\bar{p} = \bar{m}.$$

Figures 2.1 and 2.2 depict the system dynamics, based on equations (1.11) and (1.13). The locus for stationary RER, defined in equation (1.14), is represented by the downward sloping $\triangle q = 0$ schedule in both figures. As for the nominal exchange rate, the line that connects the point in which it is stationary may be either upward or downward sloping, depending on the sign $1 - \phi\delta$, as indicated in equation (1.15). Figure 2.1 represents the case where $\phi\delta < 1$, which defines the upward-sloping line $\triangle e = 0$, whereas the opposite case is in Figure 2.2. In both schedules, the $\triangle e = 0$ line intercepts the vertical axis at $e = \frac{1}{1+\eta\lambda}(\phi\delta\bar{q} + m_t + \eta\lambda\tilde{e}_t)$.

Note that the $\triangle q = 0$ and $\triangle e = 0$ schedules are drawn for a given value of $\tilde{e}_t$, which is not necessarily its long-run equilibrium value $\tilde{e} = \bar{e} = \bar{m} + \bar{q}$. Hence, these schedules shift as $\tilde{e}_t$ approaches its equilibrium value. The steady state point lies at the intersection of the $\triangle q = 0$ and $\triangle e = 0$ lines for $\tilde{e} = \bar{m} + \bar{q}$.

Higher persistence of excess returns λ (see equation (1.2)) induces a steeper $\triangle q = 0$ schedule and a flatter $\triangle e = 0$ one. Note that in the case of no persistence of excess returns, i.e. for $\lambda = 0$, the $\triangle e = 0$ schedule would coincide with the one from the original Dornbusch model. The $\triangle q = 0$ schedule, on its turn, would be vertical, since the IPER and the actual nominal exchange rates would be equal at all times, $\tilde{e} = e$. Hence, the RER path would also coincide with the one in Dornbusch model.

1.4 Monetary Shocks

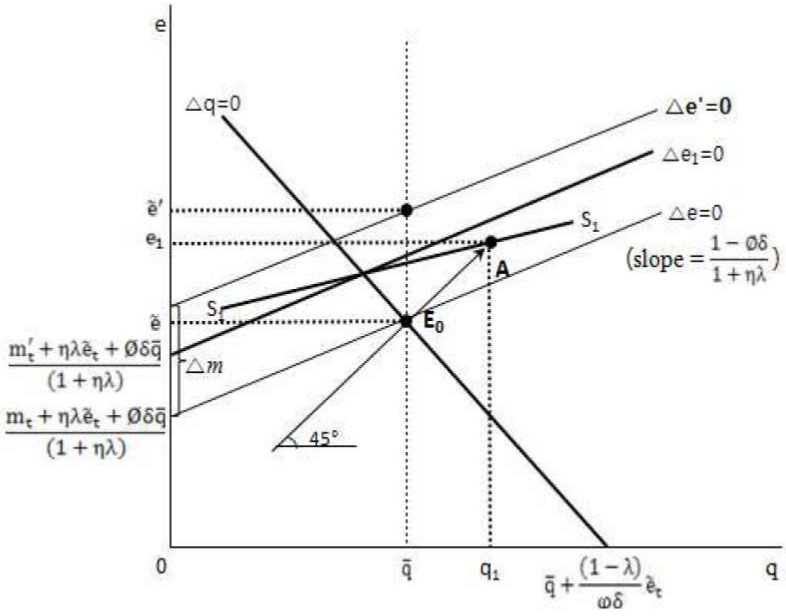
In this section, we investigate the adjustment dynamics of exchange rates in response to monetary shocks. As we have seen in the previous section, in our model the sluggish adjustment of excess returns plays a key role in both nominal and real exchange rate dynamics. Although the long-run steady state equilibrium is exactly the same as Dornbusch (1976) model, the short-term dynamics is fairly different. To help with intuition, we start with a graphical description of the effect of a monetary shock. We then show the dynamics through a numerical simulation of the model. We separate the analysis for the two possible cases for the slope of the $\triangle e = 0$ schedule: $\phi\delta < 1$ or $\phi\delta > 1$. Note that $\phi\delta$ measures the indirect impact of the RER on money demand, through its impact on output.

1.4.1 Exchange rate overshooting case: $\phi\delta < 1$

In Figure 1.3, the initial point E_0 is the original steady state where $\bar{e} = \bar{q} + \bar{m}$ and $\tilde{e} = \bar{e}$. The $\triangle e = 0$ schedule is upward sloping given that $\phi\delta < 1$. This assumption means that money demand is not too responsive to output (low ϕ) and aggregate demand is not very sensitive to RER changes (low δ). In Dornbusch's model, this corresponds to the case in which he finds an overshooting of exchange rate in response to monetary shocks.

Suppose that an unanticipated expansionary monetary shock hits the economy, so that the money supply jumps once and for all to $\bar{m}'$, and we define $\triangle m \equiv \bar{m}' - \bar{m} > 0$. Immediately, the $\triangle e = 0$ schedule shifts upward to $\triangle e_1 = 0$, consistent with the new money supply. From equation (1.15), we note that the upward-shift of the $\triangle e = 0$ schedule, given by $\frac{\triangle m}{1+\eta\lambda}$, is smaller

Figure 1.3: Monetary shock: initial response ($\phi\delta < 1$)

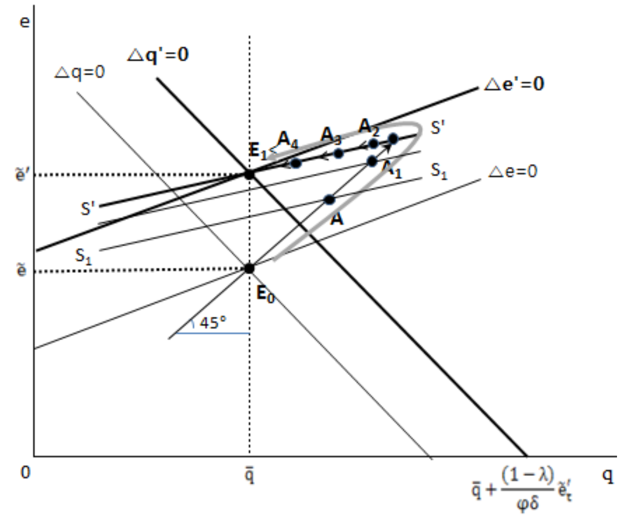


than the monetary shock $\triangle m$, as shown in Figure 1.3. The higher the persistence rate of excess returns λ, the smaller the initial shift of this curve is.

Meanwhile, the $\triangle q = 0$ schedule does not shift immediately, since $\tilde{e}_t$ has been determined at time $t-1$ and the money supply has no direct effect on that schedule. Thus the real and nominal exchange rates jumps to the point A in Figure 1.3, which is on the 45° arrow at the intersection of the new saddle path S_1S_1. Note that this is not the actual path towards the new long-run equilibrium. This saddle path is the one corresponding to the exchange rates dynamics for a given value of the IPER $\tilde{e}_t$, which also adjusts along the path to the new equilibrium. Hence, the position of the two stationary curves shifts over time, as well as the saddle path, as the nominal exchange rate approaches the IPER. It is neither possible to have a closed solution for the dynamics, nor to make a proper graphical analysis. The analysis we make here is based on the simulation results we present below, just to build some intuition about the problem.

Figure 1.4 shows the next steps in the adjustment dynamics towards the long run equilibrium. The nominal exchange rate devaluation from $\bar{e}$ to e_1

Figure 1.4: Monetary shock: adjustment dynamics ($\phi\delta < 1$)



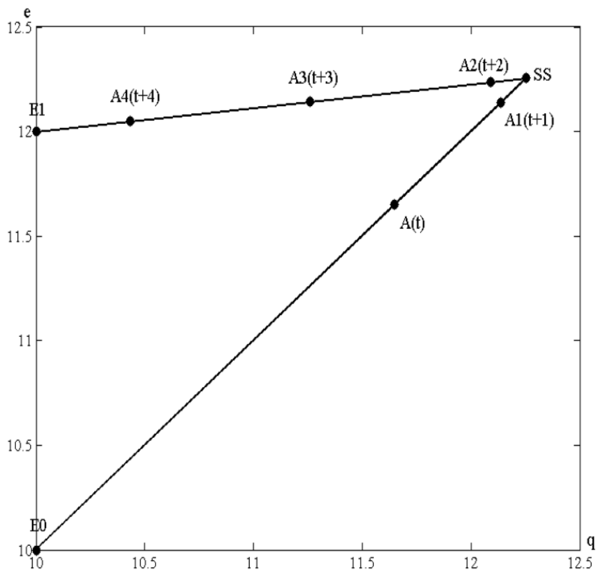
causes a devaluation of the IPER for the next period (see equation (1.3)). Both the $\triangle e = 0$ and the $\triangle q = 0$ schedules shift upwards in proportion to $\tilde{e}_t$, causing further devaluation of the real and nominal exchange rates. The upward shift continues during the asset market adjustment. Note that there is a delayed overshooting of the nominal exchange rate: the initial exchange rate devaluation is lower that the final devaluation in the long-run, but the devaluation continues to surpass its long-run value. The upward-shifting stops when it reaches the saddle path $S'S'$, in which the IPER is equal to its long-run steady state value, which is, $\tilde{e} = \bar{m}' + \bar{q}$. The devaluation then stops and the exchange rate appreciates to converge to the new steady state E_1 along the saddle path $S'S'$.

Figure 1.5 presents a numerical simulation of the model. The parameters used for the simulation are presented in Table 1.1. As we see in the figure, in response to an expansionary monetary shock on the initial steady state $E0$, the exchange rate jumps immediately to $A(t)$, which is lower than its long-run steady state level. It then continues to increase to $A1(t+1)$ along the 45^{o} line. Eventually the nominal exchange rate overshoots its long run value. Note this delay in the peak response to the shock, which is compatible with the empirical findings in the literature.. After reaching the saddle path SS, it starts to appreciate to converge on new steady state, and finally arrives at $E1$. From the initial point $E0$ to the new steady state $E1$, the adjustment time

Table 1.1: Parameter values for $\phi\delta < 1$

	Parameter	Value
Persistence of excess return	λ	0.7
Real exchange rate elasticity of domestic output	ϕ	0.8
Income elasticity of money demand	δ	1.0
Interest elasticity of money demand	η	0.5
Price adjustment to the excess demand	φ	0.8

Figure 1.5: Simulation: expansionary shock ($\phi\delta < 1$)

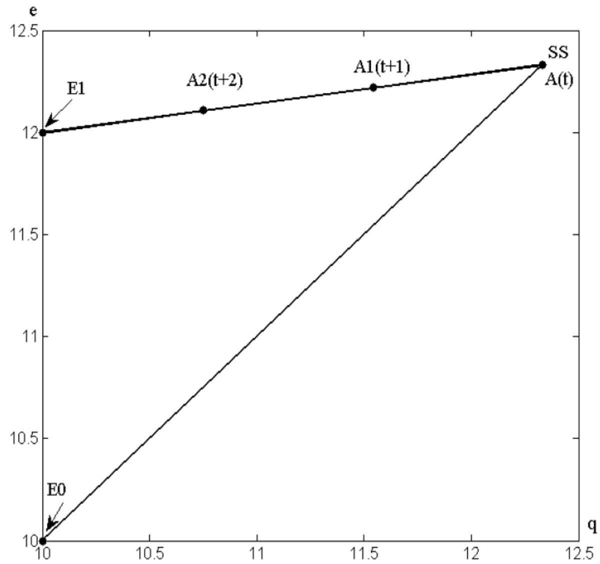


takes five periods in this simulation.

The RER, on its turn, has an initial depreciation at the moment of the shock, and then it continues depreciating during the adjustment period in the asset market. Here, also, there is a delay in the peak response to the monetary shock. After the adjustment in the asset market, the RER begins to appreciate and subsequently returns to its long term equilibrium value $\bar{q}$.

For the sake of comparison, we present the simulation for Dornbusch model in Figure 1.6. All the conditions are the same as those of Figure 1.5, except for the persistence rate λ which is set to zero to be consistent with the UIP assumption. In response to the expansionary shock in money supply, the exchange rate immediately jumps up to the new saddle path $A(t)$, with an

Figure 1.6: Simulation Dornbusch model: expansionary shock ($\phi\delta < 1$)



immediate overshooting. It then starts appreciating along the saddle path to converge to its long-run steady state value, and finally reaches the new steady state $E1$. From the initial point$E0$ to the steady state$E1$, the economy takes three periods.

1.4.2 Exchange rate undershooting case: $\phi\delta > 1$

Figure 1.7 describes the effect of an expansionary monetary shock under the assumption that $\phi\delta > 1$, which means an amplified impact of RER on money demand. In the original Dornbusch model with no frictions in the asset market, there was undershooting of the exchange rate in this case.

The $\triangle e = 0$ schedule is downward sloping and its slope is steeper than the saddle path. When an expansionary monetary shock hits the economy, the exchange rate, which was initially in steady state E_0, jumps up to A immediately but does not reach the new saddle path $S'S'$ due to the sluggish adjustment on the asset market. It continues depreciating until reaching the saddle path $S'S'$, in which the exchange rate is equal to the IPER, i.e. $e = \tilde{e}$. At that point, the RER is still more appreciated in comparison to the new steady state level, that is, there is no overshooting. The upward shifting of both the $\triangle e = 0$ and $\triangle q = 0$ schedules stop and the exchange rate converges to the new steady state

Figure 1.7: Monetary shock: adjustment dynamics ($\phi\delta > 1$)

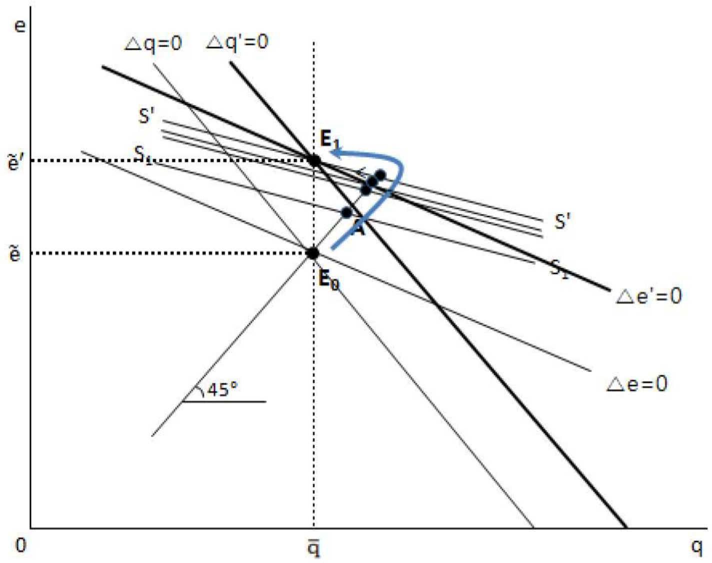


Table 1.2: Parameter values for $\phi\delta > 1$

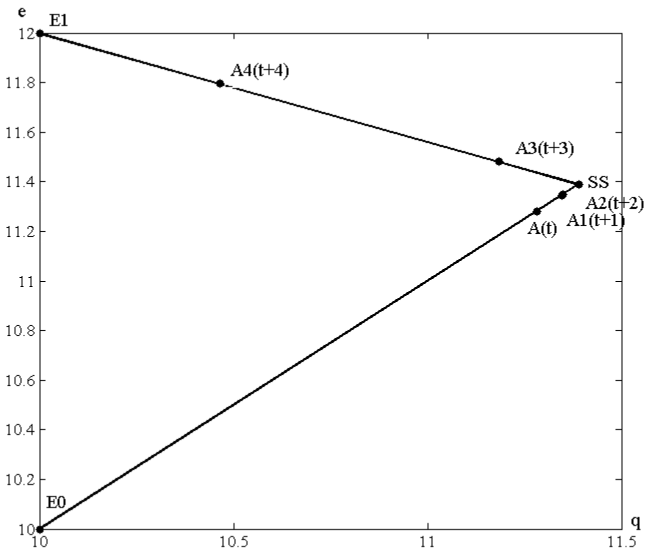
	Parameter	Value
Persistence of excess return	λ	0.6
Real exchange rate elasticity of domestic output	ϕ	1.3
Income elasticity of money demand	δ	1.2
Interest elasticity of money demand	η	0.2
Price adjustment to the excess demand	φ	0.8

E_1 along the saddle path $S'S'$. The nominal exchange rate dynamics does not overshoot with respect to its new steady state value.

As for the RER, it follows a pattern similar to the previous case: its peak response to the monetary shock is delayed. There is an initial devaluation at the moment of the shock. The RER continues devaluing while asset market adjusts, and then it appreciates to go back to its steady state value.

Figure 1.8 presents the result of the numerical simulation of this case, for the parameter values in Table 1.2. As we can see from the figure, the nominal exchange rate dynamics depreciates monotonically towards its long-run steady state value, while the RER depreciates initially and continues to depreciate for a couple of periods, and then appreciates until reaching its long-run value.

Figure 1.8: Simulation: expansionary monetary shock ($\phi\delta > 1$)



Hence, the RER has a non-monotonic response to the monetary shock, just as in the previous case.

1.4.3 Empirical Predictions

Sections 1.4.1 and 1.4.2 describe the adjustment dynamics of exchange rates in response to monetary shocks. Here we sum up the empirical predictions from the model. For the overshooting case, i.e. $\phi\delta < 1$, we have seen that the model predicts, for both real and nominal exchange rates, (i) a delayed peak response to monetary shocks; (ii) a non-monotonic path towards the long-run equilibrium, since they have a depreciating period followed by an appreciating one. For the undershooting case, i.e. $\phi\delta > 1$, we have the same type of pattern as the one described above for the RER, that is, (i) a delayed peak and (ii) non-monotonic response to monetary shocks. As for the nominal exchange rate, its response is monotonic, with no overshooting.

Besides the predictions on real and nominal exchange rate dynamics, our model has also predictions regarding the dynamics of excess returns of foreign assets. Note that Dornbusch model has nothing to say in this respect, since it assumes UIP. Figure 1.9 presents dynamics of excess return in response to an expansionary monetary shock. The thick solid line represents the excess return for the overshooting case where $\phi\delta < 1$, whose exchange rate paths are depicted in Figure 1.5. The excess return jumps at the moment of the monetary expansion, and then it decreases continually until reaching zero at $t + 5$ when the economy reaches a new steady state. Over the whole transition path to the new equilibrium, the excess return is positive and decreases monotonically.

The thin solid line in Figure 1.9 depicts the excess return dynamics in the undershooting case where $\phi\delta > 1$, for which the exchange rate paths are in Figure 1.8. The excess return initially jumps as in the previous case, and then starts to decrease. The interesting feature of this case is that there is an *overshooting of excess return*: it decreases great that it becomes negative in the path to the new steady state. It then increases gradually back to zero when the economy reaches the steady state.

The dotted line presents the dynamics of excess return when the economy is hit by a new monetary expansion when it remained on the transition path from the previous monetary expansion, for the case with $\phi\delta > 1$. We take an out-of steady state initial point where excess return is negative. After the initial jump, excess return decreases until it becomes negative again. Time taken to reach a new steady state is considerably longer: eight periods, compared to four periods in the cases starting from a steady state point.

Overall, excess return initially jumps in response to a monetary shock and then decreases. It is always positive on the transition path in the overshooting case where $\phi\delta < 1$, whereas it becomes negative at some point for the opposite case with $\phi\delta > 1$.

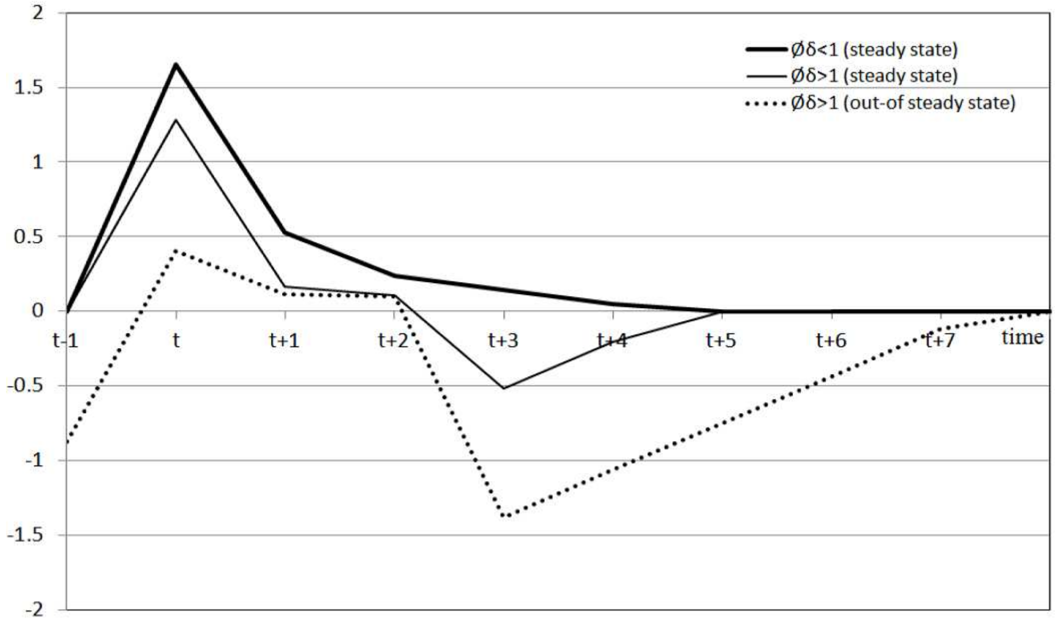
1.5 Empirical Evidence

In this section, we investigate the relation between excess returns and monetary shocks for OECD member countries. We choose OECD countries since they have open capital markets and constitute a more homogenous group of countries, whose assets should be closer substitutes compared with those from developing countries, for instance.

1.5.1 Methodology and Data

We use monthly average exchange rates, short-term interest rates (3-month) and central bank target rates for the period from January 2001 to Decem-

Figure 1.9: Excess return dynamics



ber 2010. The data set is from the OECD statistics, International Financial Statistics of the International Monetary Funds and individual central banks.[2]

We compute excess return as follows:

$$ER_{t+3} = e_{t+3} - e_t - (i_t - i_t^*), \tag{1.17}$$

where a 3-month lag for exchange rates is applied to be compatible with the 3-month interest rate used for short-term interest rate. Excess returns are computed to each country vis-à-vis the US. We have a total of eighteen individual countries plus the Eurozone. The excess return data series pass several unit root tests, so they seem free from non-stationarity issues.

We regress the excess return on monetary shocks, as in:

$$ER_t = \alpha_0 + \alpha_1 MS_t \tag{1.18}$$

where MS_t represents monetary shocks. The monetary shock is defined as the change in monetary policy over the previous three months. We capture it by

[2]For Chile, Japan and Mexico we have slightly shorter periods: 01/2001 to 06/2008 for Chile, 07/2002 to 12/2010 for Japan, and 03/2008 to 12/2010 for Mexico. Also, we use treasury bill rates for Hungary and money market rates for Turkey.

the difference between the central bank target rate at period t and the average target rate over the previous three months, that is:

$$MS_t = -\left[i_t - \frac{1}{3} \sum_{\tau=-3}^{-1} i_\tau \right].$$

Note that we change the sign of the interest rate change, so that a monetary expansion appears as a positive value for the variable MS.

In regression (1.18), a positive sign for parameter α_1 means that positive excess returns are associated to expansionary monetary shocks. Conversely, a negative sign for α_1 implies negative excess return after a monetary shock. According to our predictions in Figure 1.9, a positive estimated value for α_1 corresponds to the overshooting case of $\phi\delta < 1$, while a negative estimated value corresponds to the non-overshooting case of $\phi\delta > 1$.

1.5.2 Empirical Results

Table 1.3 presents the result of regression (1.18). We divide the countries into three groups according to the sign of the estimated coefficient of excess returns α_1, as shown in the first column of the table. For countries in group A (Australia, Canada, Eurozone, Korea, New Zealand, Norway, Sweden and UK), the estimated value of coefficient α_1, presented on the forth column of the table, is found to be positive and significant. The coefficient is negative for countries in group B (Chile, Denmark, Hungary, Iceland and Japan). Finally, excess returns are not significantly correlated to monetary shocks for countries in group C (Czech Republic, Israel, Mexico, Poland, Switzerland and Turkey).

According to our analytical prediction in the previous section, countries in group A should be in the overshooting case $\phi\delta < 1$, whereas those in Group B should be in the non-overshooting case$\phi\delta > 1$. Ideally, we would like to check both the income elasticity of money demand ϕ and the RER elasticity of domestic output δ to check if this is actually the case. However, accurate estimates of RER elasticity of output are not available. We do find in the literature estimates of income elasticity of money demand, and we report them in the last column of Table 1.3.[3] We observe that the income elasticity of

[3] Brouwer and Subbaraman, 1993; Atta-Mensah, 2004; Greiber and Setzer, 2007; Yoo, 1994; Cassino and Misich, 1997; Eitrheim, 1998; Lybeck, 1975; Fisher, Hudson and Pradhan, 1993; Bahmani, 2010; Butter and Dijken, 1997; Dritsakis, 2011; Cornelius, 1990; Fujiki, Hsiao and Shen, 2002; Komárek and Melecký, 2001; Offenbacher and Kamel, 2007; Arrau

Table 1.3: Estimation results: Excess Returns

(Monthly data, Jan 2001~Dec 2010, OLS estimation)

Group	Country	α_0	α_1	R^2	Ø
A	Australia	-0.045 ***	11.510 ***	0.323	1.056
		(-8.31)	(7.50)		
	Canada	-0.017 ***	6.023 ***	0.207	1.181
		(-4.50)	(5.55)		
	EU	-0.016 ***	5.076 **	0.039	1.070
		(-3.18)	(2.19)		
	Korea	-0.021 ***	14.981 ***	0.227	1.130
		(-4.32)	(5.89)		
	New Zealand	-0.053 ***	7.665 ***	0.230	0.537
		(-9.75)	(5.94)		
	Norway	-0.029 ***	2.978 **	0.037	0.821
		(-4.85)	(2.13)		
	Sweden	-0.009	2.837 **	0.050	0.990
		(-1.54)	(2.49)		
	UK	-0.024 ***	8.190 ***	0.352	0.930
		(-6.06)	(8.00)		
B	Chile	-0.021 ***	-2.802 ***	0.145	2.130
		(-4.15)	(-4.38)		
	Denmark	-0.012 **	-3.458 **	0.043	1.560
		(-2.45)	(-2.30)		
	Hungary	-0.065 ***	-2.460 ***	0.062	1.764
		(-9.17)	(-2.80)		
	Iceland	-0.066 ***	-3.844 ***	0.175	1.774
		(-8.67)	(-5.00)		
	Japan	0.009 *	-36.230 ***	0.179	1.750
		(1.88)	(-4.67)		
C	Czech Republic	-0.024 ***	3.242	0.014	0.710
		(-3.76)	(1.27)		
	Israel	-0.022 ***	0.718	0.012	1.125
		(-5.20)	(1.17)		
	Mexico	-0.033 **	-3.628	0.045	4.079
		(-2.13)	(1.20)		
	Poland	-0.050 ***	-1.034	0.005	2.142
		(-5.77)	(-0.74)		
	Switzerland	0.000	-0.854	0.003	1.495
		(-0.04)	(-0.56)		
	Turkey	-0.258 ***	0.210	0.000	1.000
		(-6.88)	(0.10)		

Note : *t*-statistics in parenthesis. *significant at 90%,**significant at 95%,***significant at 99%
Ø income elasticity of money demand

Source: OECD. IMF. Central banks

money demand ϕ of Group A countries is all smaller than those of Group B countries. Moreover, reported income elasticity of money demand ϕ of Group B countries is all over the 1.5.

As for group C countries, with estimates of α_1 not significantly different from zero, we can find some interesting features. Czech Republic, Israel and Turkey have positive estimates for α_1 (although not statistically significant) and they also have small value of ϕ, just as Group A countries. Conversely, Mexico, Poland and Turkey have negative estimates of α_1, and they present higher values of ϕ, just as Group B countries. We conjecture that Group C countries may have similar patterns as those of groups A and B. One possible explanation for the non-significant coefficient can be that the central bank in these countries intervene on the exchange rate markets, with sterilized interventions on foreign exchange markets.

For a closer look at the data, we divided the periods into those with no change in monetary policy, those under expansionary monetary shocks and those under contractionary monetary policy. We then computed the average excess return across these different periods, as reported in Table 1.4. The average excess return when there is no change in monetary policy, presented in column A of the figure, can be considered as the average risk premium for the country, compared to the US. Column B presents average excess return under expansionary monetary shocks, while the difference between these average excess returns and the ones in normal times is presented in column (B-A). We can see from the table that, when hit by an expansionary monetary shock, countries in group A tend to have higher excess returns while those in group B countries tend to be lower. For monetary contractions, presented in columns C and (C-A), the results are exactly the opposite: group A countries have lower excess returns and group B countries higher ones during monetary contraction. These averages are consistent with the estimation results in Table 1.3.

In summary, the empirical results for the OECD member countries are consistent with our predictions. The hard empirical puzzle in international finance, the so-called *the forward premium puzzle* can be explained by our theoretical framework.

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and Gregorio, 1993; Bahmani-Oskooeea, Kutanb and Xic, 2013(submitted); Fischer, 2006; Saatçioğlu and Korap, 2007

Table 1.4: Average excess returns across periods

(Monthly data, Jan. 2001 ~ Dec. 2010)

Group	Country	Monetary policy change							Frequency	
		Average		No change	Expansionary		Contractionary		Expan-sionary	Contrac-tionary
				A	B	(B-A)	C	(C-A)		
A	Australia	-0.042	***	-0.047	0.025	(0.072)	-0.070	(-0.023)	20	36
	Canada	-0.012	***	-0.018	0.017	(0.035)	-0.027	(-0.009)	24	18
	EU	-0.013	***	-0.016	0.038	(0.054)	-	-	7	0
	Korea	-0.017	***	-0.024	0.071	(0.095)	-0.022	(0.001)	9	6
	New Zealand	-0.049	***	-0.056	0.013	(0.069)	-0.067	(-0.011)	15	19
	Norway	-0.027	***	-0.028	-0.023	(0.005)	-0.026	(0.002)	18	20
	Sweden	-0.008		-0.010	0.019	(0.029)	-0.015	(-0.005)	9	9
	UK	-0.016	***	-0.023	0.027	(0.050)	-0.037	(-0.015)	19	10
B	Chile	-0.022	***	-0.016	-0.041	(-0.024)	-0.015	(0.002)	31	42
	Denmark	-0.014	***	-0.014	-0.027	(-0.013)	0.011	(0.026)	24	12
	Hungary	-0.068	***	-0.066	-0.075	(-0.009)	-0.058	(0.008)	40	16
	Iceland	-0.070	***	-0.070	-0.111	(-0.041)	-0.019	(0.051)	25	21
	Japan	0.009	*	0.010	-0.087	(-0.097)	0.056	(0.046)	2	2
C	Czech Republic	-0.022	***	-0.024	-0.019	(0.004)	-0.011	(0.013)	20	11
	Israel	-0.021	***	-0.025	-0.026	(-0.001)	-0.011	(0.014)	47	36
	Mexico	-0.040	***	-0.029	-0.055	(-0.026)	-0.085	(-0.056)	7	3
	Poland	-0.047	***	-0.049	-0.043	(0.006)	-0.050	(-0.002)	30	10
	Switzerland	-0.001	***	-0.003	0.000	(0.003)	0.020	(0.023)	10	10
	Turkey	-0.257	***	-0.262	-0.219	(0.043)	-0.155	(0.107)	12	1

Source: OECD, IMF, Central banks
Note : *significant at 90%,**significant at 95%,***significant at 99%

1.6 Conclusion

We depart from the new assumption of the asset market and extend Dornbusch's overshooting exchange model. By applying a more relaxed and realistic condition, which is "*generalized interest parity condition*" instead of the uncovered interest parity (UIP), we can reproduce empirical regularities. In addition, we are able to explain some crucial puzzles in international macroeconomics.

Our exchange rate model provides plausible reasons for *delayed overshooting* in response to monetary shocks by plugging into sluggish adjustment on the interest parity. Whether overshooting or undershooting, the peak of response is delayed during the sluggish adjustment on the asset market. Our model also explains purchasing power parity puzzle and non-monotonic response behavior of exchange rates are present.

It should be emphasized that we do more than just verify the empirical results, but also identify the major sources of those puzzles.

The empirical results of the OECD member countries finely fit our theoretical predictions and provide crucial clues for difficult puzzles that many economists struggle with. Particularly, income elasticity of money demand and real exchange rate elasticity of domestic output are very closely related to the exchange rate dynamics in response to monetary shocks.

Our new assumption of the sluggish adjustment on the asset market is materialized on the "*generalized interest parity condition*". Under the new assumption, we can fill in the lack of standard exchange rate model. On the basis of this new theoretical framework, we hope to develop a more elaborate model with well-equipped empirical techniques for the short-term dynamics.

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Chapter 2

Exchange Rate Regime, Capital Market Openness and Monetary Policy: The Trilemma in Korea

Abstract

This paper tests the *trilemma* proposition by performing an empirical study of Korea. Korea has distinct periods of all combinations of exchange rate regime and capital market openness in trilemma: the pegged exchange rate regime under capital controls, the pegged exchange rate regime under free capital mobility, and the floating exchange rate regime under free capital mobility. We check whether monetary autonomy existed in each of the three different combinations. Our finding is that monetary autonomy existed during the periods of capital controls and those under the floating exchange rate regime. Meanwhile, monetary autonomy was limited during the periods under the pegged exchange rate regime and free capital mobility. In addition, we identify that before the financial crisis the government pursued autonomic monetary policy under the pegged exchange rate regime and free capital mobility, thereby defying the trilemma.

Keywords: Trilemma; Exchange rate regime; Capital market openness; Monetary policy

JEL classification: E33; F41; F42

2.1 Introduction

The choice of a exchange rate stability with no monetary autonomy or of independent monetary policy with highly volatile exchange rate is painful, but this seems unavoidable under free capital mobility. If a domestic interest rate deviates from the global one, capital flows increase in open capital markets, thus the fixed exchange rate regime cannot stand ultimately. This means that it is impossible to simultaneously obtain the following three: (i) exchange rate stability; (ii) monetary autonomy; and (iii) free capital mobility. This is the so-called *trilemma* or impossible trinity.

Instead of a severe corner solution, some countries prefer an intermediate solution which is a managed floating exchange rate regime using the international reserves as a buffer, thereby keeping a certain degree of monetary autonomy. Jansen (2008) insists that intermediate exchange rate regimes may permit a modest degree of monetary autonomy, presenting an empirical case of the guilder-mark target zone in the pre-EMU periods. It is related to the so-called "*fear of floating*" (Calvo and Reinhart, 2002) literature, arguing that the countries announcing a floating exchange rate regime do not allow their exchange rates to float. More recently, Levy-Yeyati and Sturzenegger (2007) argue that in developing countries most interventions on exchange rate have been aimed to limit appreciations rather than depreciations, which is motivated by protection for domestic industries. These arguments reflect unwillingness to accept the corner solution.

Shambaugh (2004) and Obstfeld, Taylor and Shambaugh (2004) examine the validity of the trilemma from global and historical perspectives. They find that the degree of monetary autonomy under the floating exchange rate regime is slightly higher than that under the pegged regime, but the difference is not very big.[1]

This study focuses on testing the validity of the trilemma in *Korea*. Korea has some features appropriate for the empirical study of the trilemma. First, Korea's economy is a small open economy as the theory suggests. Second, there are three distinct periods in Korea in terms of the combination of exchange rate regimes and capital controls. During the first period, from September 1976 to December 1991, we observed a pegged exchange rate regime under closed financial markets. Capital controls were removed in January 1992. Since then until October 1997, the exchange rate remained pegged, and then started to float from November 1997. Korea has therefore complete combinations of the exchange rate regime and the open capital markets in the trilemma.

Most empirical studies (Hausmann, Gavin, Pagés-Serra and Stein, 1999; Frankel, Schmukler and Serven, 2004; Calvo, 2006; Chin and Ito, 2008; Obstfeld, Shambaugh and Taylor, 2010; Huayu, 2009; Aizenman, Chin and Ito, 2010) related with trilemma focus on macroeconomic performances depending on the policy choice among exchange rate regimes and capital market openness rather than the validity of the trilemma itself. For instance, many empirical studies are interested in the relationship between exchange rate regime choice and macroeconomic performances or the influence of capital controls and exchange rate regime on a financial crisis.

Ouyang, Rajan and Willett (2008) point out that Asian countries, and Korea in particular, have accumulated huge international reserves since the financial crisis in 1997, and due to this accumulation, there has been a high degree of effective sterilization monetary policy despite substantial capital mobility. This implies that the trilemma is still an important issue on the recent international financial scene.

[1]Shambaugh (2004) presents that the correlation coefficient of pegged and nonpegged countries is 0.46 *versus* 0.27 at a statistically significant level.

For the rest part of the paper, Section 2 outlines the methodology used to examine the monetary autonomy according to exchange rate regimes. Section 3 presents how to identify the three elements of the trilemma. Section 4 provides the empirical results of the validity of the trilemma in Korea. Section 5 comments on implication for the financial crisis in the trilemma terms. Lastly, section 6 presents our concluding remarks.

2.2 Methodology

We investigate how to test monetary autonomy under different combinations of the exchange rate regimes and capital mobility. To identify the monetary autonomy, we begin with uncovered interest parity (UIP) condition. This implies that the expected depreciation rate equals interest differentials between two countries, if there exist free capital mobility and perfect asset substitutability. The condition is represented as follows:

$$E_t(e_{t+1}) - e_t = i_t - i_t^*$$

where, i_t is the domestic nominal interest rate, i_t^* is the foreign interest rate and e_t is the log of the nominal exchange rate. We can rewrite this as follows:

$$i_t = i_t^* + E_t(e_{t+1} - e_t) \tag{2.1}$$

It should be noted that the domestic interest rates reflect monetary policy ultimately. First, equation (2.1) is invalid under the capital controls. Thus there is no '*a prior*' relation between domestic and international interest rates, and there exists monetary autonomy. Second, under free capital mobility with a pegged exchange rate regime, changes in monetary policy that yields domestic interest rate deviating from the international interest rate will be replaced by $E_t(e_{t+1} - e_t) = 0$. This means that there is no monetary autonomy. Third, under free capital mobility with a floating exchange rate regime, on the other hand, the expected change in the exchange rate can differ from the spot exchange rate, and therefore the domestic interest rate can then deviate from the base interest rate. This is the trilemma proposition; the economy cannot achieve open capital markets, monetary autonomy and fixed exchange rates simultaneously. This is because under free capital mobility, the fixed exchange rate regime induces no monetary autonomy, while the floating exchange rate regime allows it.

Monetary autonomy can be tested by the following equation (Shambaugh 2004):

$$i_t = c + \beta i_t^* + \varepsilon_t \tag{2.2}$$

In equation (2.2), if there is no monetary autonomy, the domestic interest rate should follow the foreign interest rate, and the coefficient β should therefore be equal to one. If perfect monetary autonomy is ensured, on the other hand, the coefficient β would become zero.

If the data are non-stationary, however, the regression (2.2) has the possibility of spurious regression. In the case of non-stationary time series data, the proper approach would be to difference the data as follows:

$$\triangle i_t = \alpha + \beta \triangle i_t^* + \mu_t \tag{2.3}$$

Through the regression (2.3), we can identify the correlation between the domestic and foreign interest rates and avoid the risk of spurious regression. By taking first differences, however, we lose the information about the long-run relationship between these two variables.

Therefore, as an alternative, we consider an error correction model (ECM), that use variables both in level and first differences. ECM identifies the short-run disequilibrium and the long-run equilibrium adjustment between two variables. Our ECM model is

$$\triangle i_t = \alpha + \beta' \triangle i_t^* + \theta(c + i_{t-1} - \gamma i_{t-1}^*) + \mu_t \tag{2.4}$$

where, γ captures the levels relationship and θ, the speed of adjustment parameter toward long-run relationship. The larger absolute value of θ implies, the faster adjustment to the long-run relationship.

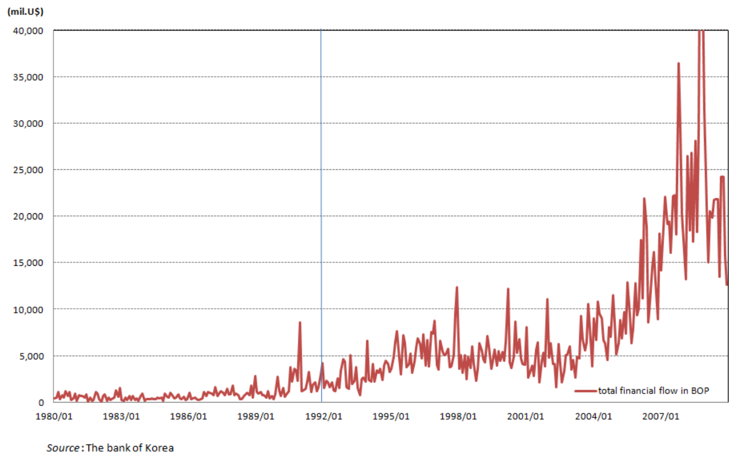
In general, the error correction model in (2.4) can be used when the data have unit roots and the two interest rates are cointegrated. If the data, although non-stationary, are not found to be cointegrated, applying the ECM may be problematic. In that case, Shin, and Smith (PSS, 2001) provide the tables of different critical values to check whether ECM can be applied. By checking the statistical significance of θ with the critical value of PSS, we decide to apply equation (2.4).

2.3 Identifying the Trilemma components

Capital Market Openness

Since the Foreign Exchange Management Acts was enacted in 1961, the Korean government strictly regulated foreign currency transactions. Indirect foreign investment in the domestic stock market through the foreign investment bond (Korea Fund) was allowed in 1984. However, capital transactions are highly regulated by the government.

Figure 2.1: Capital Flows in Korea



Foreign direct investment in the domestic stock market was allowed in 1992. The so-called negative system was adopted, so that in principle, all current transactions were allowed, except for specified prohibited transactions such as money laundry. We consider that capital controls in Korea have been removed at that time. In Figure 2.1, however, capital flows started to increase from 1990 onwards. This is because the Korean government increased issuance of Foreign Exchange Stabilization Fund Bond in order to keep the current account surplus under control. For this reason, we do not consider it as a sign of capital market openness. In sum, we conclude that the capital control existed until December 1991 and afterward there exists free capital mobility, as shown in Figure 2.1.

Exchange Rate Regime

Most empirical studies used the *de jure* regime reported by the IMF. It is based on the regime officially announced by the country. From 1961 until 1980, the Korean won was pegged to the U.S. dollar and foreign currency transactions were strictly regulated. From 1980 to 1990, a multiple-basket pegged exchange rate system was introduced officially, but exchange rates were tightly managed by the authorities.

In March 1990, Korea's exchange rate regime was announced as a floating within a daily band, following the adoption of the Market Average Exchange Rate System. Although the Korean won-U.S. dollar rate began to be determined on the basis of underlying demand-supply conditions in the interbank market, daily fluctuations were limited within certain bands. The currency crisis broke out in late 1997 and the Korean government signed up for the financial aid package from IMF in December 1997. The daily fluctuation band was abolished at that time.

Levy-Yeyati and Sturzenegger (2005) find out that many countries behave differently from *de jure* regime. They classify exchange rate regimes of IMF-reporting countries over the period from 1974 to 2000 according to the behavior of three classification variables: changes in the nominal exchange rate, the volatility of these changes, and the volatility of intervention. They use the changes in international reserve as an indication of the intervention.

Recently, the IMF replaces *de jure* classification by a new assessment "*De Facto classification of exchange rate regimes and monetary policy framework*", from June 1998. This means that the IMF starts to classify as "*actual*" arrangement, based on commitments detected by their monitoring, not officially announced one.

Shambaugh (2004) classifies the exchange rate regime in terms of whether the monthly exchange rate stays within ±2 percent bands over the last 12 months.[2]. This means that, if there are fluctuations over ±2 percent bands on the exchange rate during a year, the exchange rate regime is classified as a non-pegged or floating exchange rate regime. On the other hand, if the exchange

[2]Reinhart and Rogoff (2000) calculate the probability that the monthly exchange rate change remains within a +/-2 % band over a rolling 5-year period. If this probability is 80 percent or higher, then the regime is classified as a *de facto* narrow band.

rate stays within ± 2 percent bands, the exchange rate regime is classified as a pegged exchange rate regime. In addition, temporary changes for realignments to hold the pegged exchange rate regime are considered as a part of the peg period. Since exchange rate regimes are not so flexible as to change every month, this classification seems more plausible than others with pliable regime change.

Levy-Yeyati and Sturzenegger (2005) do not distinguish between sterilized and unsterilized interventions. Therefore the intensity of intervention can be underestimated when the sterilized policies are performed. In practice, it is hard to estimate the intensity of intervention with this measurement. In Korea, the interventions into the exchange rate market by using international reserves are performed frequently, and also in many cases, sterilized policy is accompanied with it. For this reason, this method may not be appropriate for the *de facto* classification of Korea and this study adopts Shambaugh's method for Korea's case.

If monthly fluctuation in the exchange rate stays within ± 2 percent band, we classify it as a pegged exchange rate regime and otherwise as a floating exchange rate regime. Although the floating system with a daily band has been announced officially in 1990, the average rate of exchange rate change remained 0.55 percent until October 1997. In fact, the *de facto* regime in Korea was a peg until then.[3]

After the financial crisis in November 1997, the exchange rate starts to move freely, as presented in Figure 2.1. Thus, we classify the periods from September 1976 to October 1997 as the pegged exchange rate regime and the periods from November 1997 to December 2009 as the floating exchange rate regime. Figure 2.2 is split in three periods, according to capital market openness and exchange

[3] Actually, there were 6 events of fluctuation over the ± 2 percent band, but those are defined temporary changes for realignments to hold the pegged exchange rate regime.

Figure 2.2: Shift of Exchange Rate of Korea

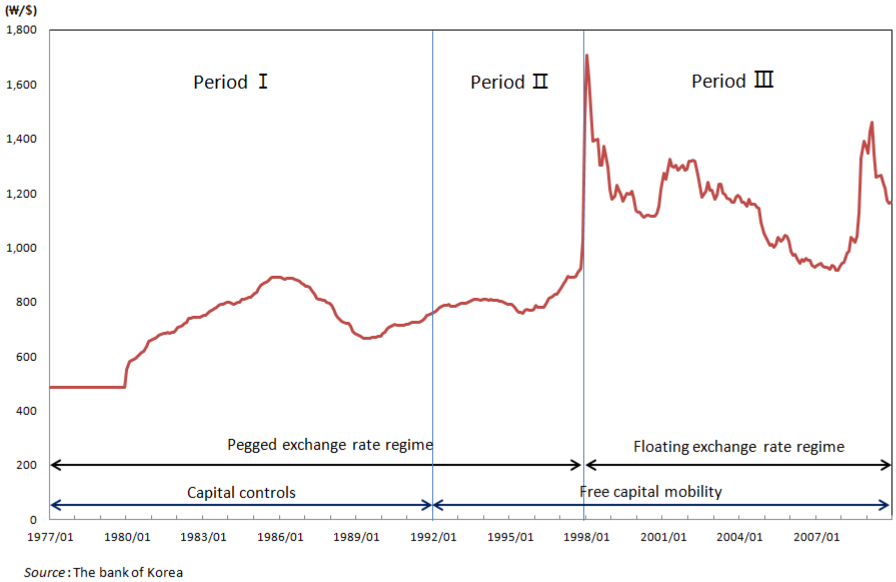


Table 2.1: Trilemma Condition in Korea

	Capital Market	Exchange Rate Regime
Period I	Closed	Peg
Period II	Open	Peg
Period III	Open	Float

rate regime: as indicated in Table 2. We should expect monetary autonomy over *Periods* I and III, and no monetary autonomy over the *Period* II.

Interest Rates

To check monetary autonomy, we need the domestic interest rate and the benchmark base rate as in equation (2.3). It is important to choose appropriate representative interest rates to get trustworthy results in regression. Since it is assumed that monetary policy has always the form of interest rate target, short-term interest rate in the money market is used as a representative interest rate in general. For Korea's case, we use the money market interest rate as a domestic interest rate. As the base rate, we use the three-month U.S. treasury bill rate, since it has been a short-term interest rate in the U.S., and the U.S. dollar is a major foreign currency in Korea.

In addition, for robustness, we provide the Monetary Stabilization Bond (MSB) rate for the domestic interest rate, although it is not a short-term interest rate. Until 1997, the central bank of Korea had issued the MSB to achieve the monetary target and it occupied a major portion of the security market. However, the portion of the MSB drastically shrank after the financial crisis in 1997, and it is thus not informative in *Period* III. For the base rate versus the MSB rate, we use average U.S. treasury bill rate.

Figure 2.3 shows the changes in Korea's money market interest rate of Korea and short-term U.S. treasury bill rate. Figure 2.4 shows MSB rate and U.S. treasury bill rates.[4]

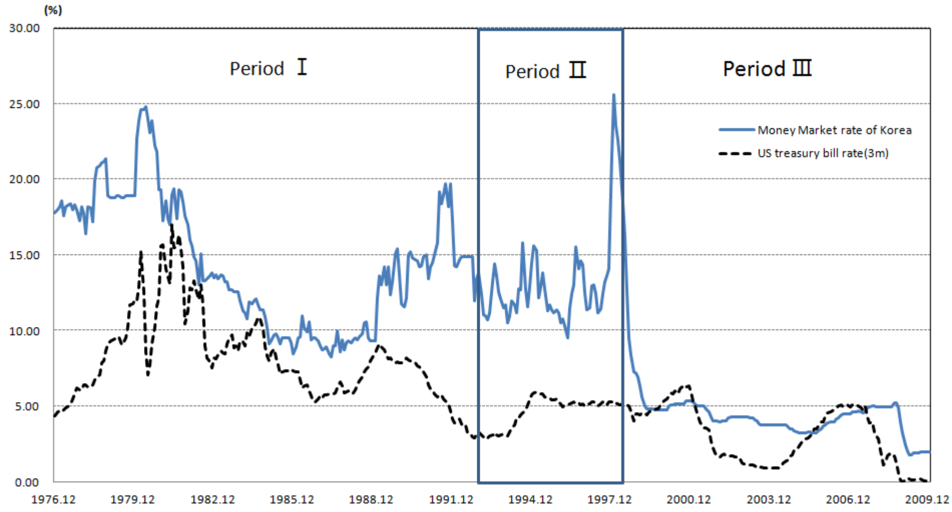
The data under study are all monthly averages. Money market rate and MSB rate in Korea are taken from the central bank of Korea. The three-month U.S. treasury bill rate and average U.S. treasury bill rate are taken from the International Financial Statistics of the IMF.

2.4 Empirical Results

Before proceeding to the regression results, we briefly look at the overview of interest rate differentials between the domestic and the base interest rates across the periods. If the trilemma is valid, monetary autonomy should be limited over *Period* II with the pegged exchange rate regime under open capital

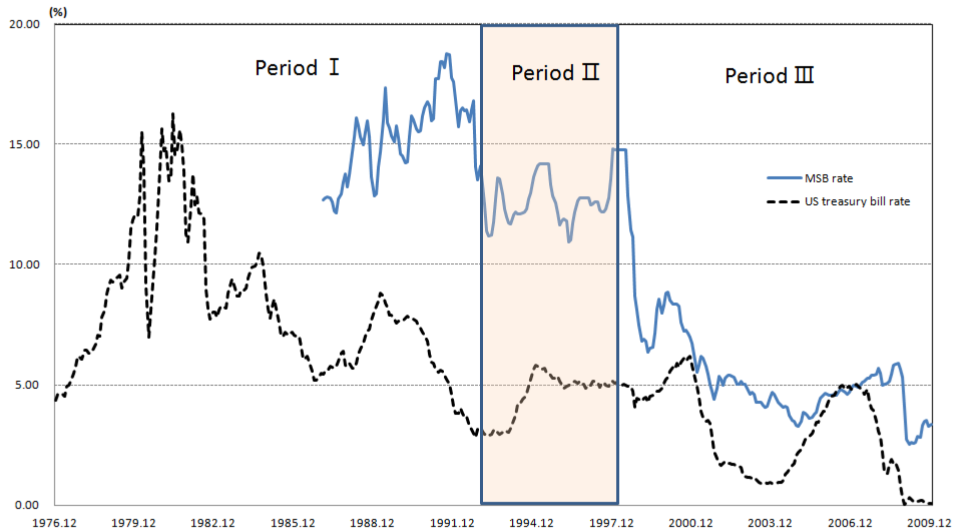
[4]Because of insufficient data, we present MSB rate from February 1987.

Figure 2.3: Domestic interest rate and base interest rate I



Source : IFS, The bank of Korea

Figure 2.4: Domestic interest rate and base interest rate II



Source : IFS, The bank of Korea

market. On the other hand, over the *period* I and III, monetary autonomy should exist.

Table 2 presents the mean and the standard deviation of interest rate differentials across periods. Over the *Period* II, the standard deviation of interest rate differentials is the lowest among the three periods, although the mean is the highest. Meanwhile, over the *Periods* I and III, the standard deviations of interest rate differentials are clearly higher than the *Period* II. If volatility of the interest rate differentials is related to the monetary autonomy, we could expect that the trilemma is valid in Korea through Table 2.

Table 2. Interest rates and differential; Money market rate *versus* Treasury bill rate

	Sample Period	Period Ⅰ	Period Ⅱ	Period Ⅲ
		Pegs under Capital Control	Pegs under Free capital mobility	Float under Free capital mobility
	(Sep. 1976~Dec. 2009)	(Sep. 1976~Dec. 1991)	(Jan. 1992~Oct. 1997)	(Nov. 1997~Dec. 2009)
$(i_t-i^*_t)$; mean	5.10	6.27	8.25	2.11
$(i_t-i^*_t)$; standard deviation	4.44	4.35	1.85	3.64
i_t; standard deviation	5.78	4.32	1.54	3.99
i^*_t; standard deviation	3.28	2.72	1.02	1.92

Source: The bank of Korea, IFS

Results

The money market rate in Korea and the short-term U.S. treasury bill rate do not pass several unit root tests: Augmented Dickey-Fuller (ADF), Phillips-Perron (PP) and Kwiatkowski–Phillips–Schmidt–Shin (KPSS). Thus the regression on level in (2.2) is not proper in Korea's case owing to the possibility of spurious regression. We apply the regression to difference equation in (2.3).

Table 3.1 presents the results of regression (2.3). In *Period* II, the estimate for β is 1.95 at a statistically significant level. In addition, the R^2 is the largest in *Period* II among the three periods. This means that the domestic interest rate follows the base interest rate. The the result thus indicates that monetary autonomy is highly limited in the period, in which the pegged exchange regime and free capital mobility are achieved.

On the other hand, in *Periods* I and III in Table 3.1 the estimate for β does not have statistically significant value. This implies that the domestic interest rate moves independently from the base rate: in other words monetary autonomy is maintained in these periods. The results are highly consistent with the prediction of the trilemma.

In addition, Table 3.2 provides the regression results of MSB rate and Treasury bill rate. In *Period* II in Table 3.2, the estimate for β is 0.97, which is very close to one, which is almost perfect coupling. As MSB issuance is drastically shrunk after the financial crisis in 1997, *period* III in Table 3.2 is not informative.

Table 3.1 Testing the Trilemma; money market rate *versus* short term treasury bill rate

	Sample Period (Sep. 1976~Dec. 2009)	Period Ⅰ Pegs under Capital Control (Sep. 1976~Dec. 1991)	Period Ⅱ Pegs under Free capital mobility (Jan. 1992~Oct. 1997)	Period Ⅲ Float under Free capital mobility (Nov. 1997~Dec. 2009)
Number of observations	400	184	70	146
α	-0.04	-0.00	-0.08	-0.07
	(0.05)	(0.07)	(0.14)	(0.08)
β	0.16	0.12	1.95**	0.21
	(0.09)	(0.09)	(0.85)	(0.31)
R^2	0.01	0.01	0.07	0.00

Note: standard error in parenthesis **significant at 95 percent
Source: The bank of Korea, IFS

Table 3.2 Testing the Trilemma; MSB rate *versus* treasury bill rate

	Sample Period	Period I	Period II	Period III
		Pegs under Capital Control	Pegs under Free capital mobility	Float under Free capital mobility
	(Feb. 1987~Dec. 2009)	(Feb. 1987~Dec. 1991)	(Jan. 1992~Oct. 1997)	(Nov. 1997~Dec. 2009)
Number of observations	275	59	70	146
α	-0.03	0.08	-0.08	-0.05
	(0.03)	(0.09)	(0.06)	(0.34)
β	0.34**	-0.16	0.97**	0.40**
	(0.15)	(0.38)	(0.39)	(0.15)
R^2	0.02	0.00	0.08	0.04

Note: standard error in parenthesis **significant at 95 percent
Source: The bank of Korea, IFS

Dynamics

We apply an error correction model (ECM) to identify the long-run equilibrium adjustment. Since cointegration relationship between two interest rates is not identified through Johansen cointegration test, we follow Pesaran, Shin, and Smith (PSS, 2001) test.

Table 4 presents the result of the error correction model in equation (2.4) across periods. The parameter θ means the adjustment speed from the deviation back to the long-run relationship. Over the *Periods* I and III, the estimate for θ does not appear statistically significant in PSS test. This implies that the long-run relationship between the domestic interest rate and the base interest rate is not identified in *Periods* I and III. This means that over the two periods monetary autonomy was retained.

On the contrary, over the *Period* II, the estimate for θ is -0.21 at a significant level. This means that the short-term deviation from the long-run relationship is being corrected about 21 percent in one month. In other words, the half-life is about 3 months in that period. When the pegged exchange rate regime and free capital mobility are achieved, the domestic interest rate cannot deviate for a long time from the long-run relationship with the base interest rate, that is, the monetary autonomy considerably constrained. The results of dynamic specification are also in accordance with the trilemma proposition.

Table 4. Adjustment Speed by PSS test

	Period Ⅰ Pegs under Capital Control (Sep. 1976~Dec. 1991)	Period Ⅱ Pegs under Free capital mobility (Jan. 1992~Oct. 1997)	Period Ⅲ Float under Free capital mobility (Nov. 1997~Dec. 2009)
observation number	184	70	146
Adjustment Speed (θ)	-0.02	-0.21**	-0.04
	(-1.04)	(-3.05)	(-2.20)

Note: *t*-statistics in parenthesis. **significant at 97.5 percent

2.5 Financial Crisis and Policy Choice of Trilemma

Financial crisis in Korea broke out in 1997. The shift to a *de facto* exchange rate regime occurred at the same time. Although the change of *de jure* exchange rate regime was announced in 1990, the fluctuation of exchange rate remains within ± 2 percent bands until 1997.

Hadiwibowo and Komatsu (2011) provide empirical results of trilemma in Indonesia around the financial crisis in 1997/1998. Before the financial crisis, the exchange rate of Indonesia remained under control, but after the financial crisis it starts to float. Before the financial crisis, the relation between the domestic and the base interest rates does not appear in the short-run, although appearing significant in the long-run relationship. After the financial crisis, the domestic interest rate moves in the opposite direction of the foreign interest rate. This means that around the financial crisis there was a change in trilemma arrangement.

Aizenman, Chinn and Ito (2010) show that the policy choice in the trilemma arrangement significantly changed around financial crises, so they called financial crisis as a structural breaks in their trilemma configuration. For example, after the crisis in 1997/1998, monetary autonomy index dropped significantly, while the exchange rates became more stable in industrialized and emerging market countries.

It should be noted that the trilemma is avoidable in the short term. Central bank can intervene in foreign exchange markets to prevent depreciation by selling foreign assets, thereby decreasing its monetary base. To neutralize the contractionary effect, the central bank could increase money supply simultaneously, so that exchange rate can be managed without impact on monetary policy autonomy. This is a sterilization policy. However, the depreciation pressure would continue, since the depreciation factors cannot be adjusted through exchange rate or interest rate. After all, the central bank has to exhaust international reserves to defend the exchange rate level as long as it does not give up monetary autonomy.

In Korea, monetary autonomy is found to be considerably restricted over the *Period* II. We gain interesting results when we dividing *Period* II into *Period* II-1 from January 1992 to October 1995 and *Period* II-2 from November 1995 to October 1997, two years prior to the financial crisis. Tables 5.1 and 5.2 present the results of two sub-periods of *Period* II. We find out a positive correlation between the domestic and base interest rates over the *Period* II-1. Over the *Period* II-2, two years prior to the financial crisis, however, there is no correlation between the domestic and base interest rates. This suggests that there are some attempts to defy the trilemma two years prior to the financial crisis: in other words macroeconomic policy makers strive to hold intermediate solution for two years.

Table 5.1 Financial Crisis and the Trilemma; money market rate *vs* short term treasury bill rate

	Period Ⅱ Pegs under Free capital mobility (Jan. 1992~Oct. 1997)	Period Ⅱ-1 (Jan. 1992~Oct. 1995)	Period Ⅱ-2 (Nov. 1995~Oct. 1997)
Number of observations	70	46	24
α	-0.08	-0.19	0.12
	(0.14)	(0.19)	(0.22)
β	1.95**	2.19**	1.35
	(0.85)	(0.99)	(1.94)
R^2	0.07	0.10	0.02

Note : standard error in parenthesis **significant at 95 percent
Source : The bank of Korea, IFS

Table 5.2 Financial Crisis and the Trilemma; MSB rate *vs* treasury bill rate

	Period Ⅱ Pegs under Free capital mobility (Jan. 1992~Oct. 1997)	Period Ⅱ-1 (Jan. 1992~Oct. 1995)	Period Ⅱ-2 (Nov. 1995~Oct. 1997)
Number of observations	70	46	24
α	-0.08	-0.14	0.02
	(0.06)	(0.09)	(0.07)
β	0.97**	1.14**	0.41
	(0.39)	(0.49)	(0.63)
R^2	0.08	0.11	0.02

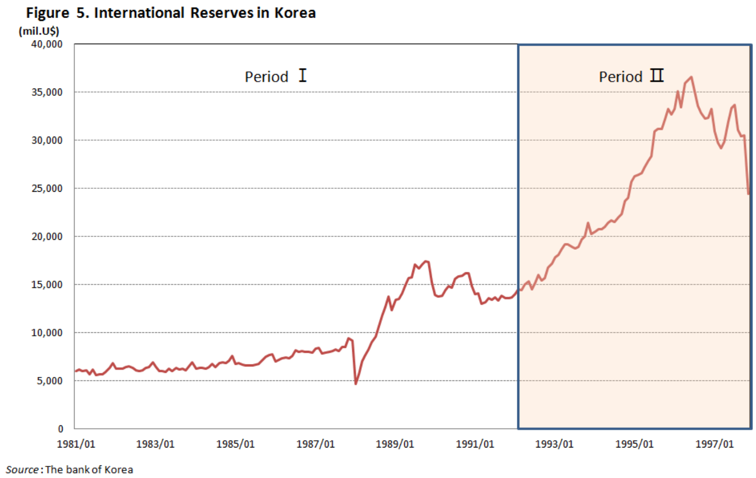
Note : standard error in parenthesis **significant at 95 percent
Source : The bank of Korea, IFS

We guess that the financial crisis in Korea is related with defying the trilemma with sterilized interventions. Korea's current account turned to a deficit in 1994 and deteriorated seriously later on. The authority increased foreign debts and payment guarantees for bonds in the foreign exchange market to defend the level of exchange rate. At the same time, the authority decreased money supply to prevent monetary expansion caused by capital inflows, which is sterilized intervention.[5] However, highly increased foreign debt, particularly short-term debt, could not be redeemed and Korea ran out of foreign reserves. After all, the financial crisis broke out in 1997.

Aizenman, Chinn and Ito (2010) claim that international reserve accumulation can relax the trade-off arising from the trilemma as a buffer in developing countries. They suggest that if a country holds a higher level of international reserves, it may be able to relax the trilemma, and may decide to pursue greater monetary independence and financial openness while maintaining exchange rate stability. We check the Korea's case to see the role of international reserves. Figure 2.5 presents that the international reserves of Korea have been maintained at a high level even before the financial crisis. In Korea's case, it is hard to say that international reserves play a key role as a buffer to relax the trade-offs in the trilemma. Regardless of how large it is, once the economy is exposed to critical risk, such as foreign debt redemption inability, international reserves may not be sufficient.

[5] The average rate of change in monetary base of Korea was -12.2 percent in 1995 and -12.5 percent in 1996. For reference, it was 14.7 percent from 1990 to 1994.

Figure 2.5: International Reserves in Korea



2.6 Concluding Remarks

This study verifies monetary autonomy in different combinations of capital market openness and exchange rate regime for Korea. The empirical results of Korea provide solid evidence supporting the trilemma that under free capital mobility the pegged exchange rate regime cannot be compatible with the monetary autonomy.

According to the results of our study of Korea, monetary autonomy has been maintained in Korea during the period from November 1997 to December 2009. It is beyond expectation that international financial market integration has increased, and monetary autonomy would therefore be limited to some extent without consideration of exchange rate regime. It is noteworthy in a sense that the choice of the floating exchange rate regime could guarantee monetary autonomy in any global situation.

Based on our empirical results, it does not seem that an intermediate solution is either feasible or desirable in the long run. In Korea, before the financial crisis, there was an attempt to choose intermediate solution, but it ends up with a financial crisis. We conjecture that deviation from the trade-offs in the trilemma framework for certain periods would be a signal of a financial crisis. As the next step, if we could identify more clearly the relationship between the easing of the trade-offs in the trilemma and macroeconomic problems, such as a financial crisis, this would give more significant lessons on policy.

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Chapter 3

Electoral Cycle of Exchange Rate in Korea

Abstract

This paper empirically investigates the real exchange rate behavior around elections in Korea. We find that the real exchange rate depreciates more before the elections but there is no clear pattern found after the elections. Interestingly, this result is the opposite of the electoral cycle found in Latin American countries. To explain this result we should consider the difference between economic backgrounds of Korea and Latin American countries.

Keywords: Exchange rate; Political Cycle; Elections

JEL classification: F31; F39

3.1 Introduction

Empirical studies of Latin American countries identify the electoral cycle of the real exchange rates (RER) (Bonomo and Terra, 1999; Frieden et al, 2001; Pascó-Font and Ghezzi, 2001; Grier and Hernández-Trillo, 2004; Stein, Streb and Ghezzi, 2005). They show that the RER tends to appreciate before elections and depreciates after elections. Theoretical models explain this finding by the incumbent governments motivation to manipulate exchange rates to improve their probability of being reelected.

To the best of my knowledge, however, there are no empirical studies on other regions, except for Latin American countries. This paper focuses on investigating whether there is an electoral cycle of the exchange rate in Korea. We do find an electoral cycle in Korea, but the pattern of the cycle is opposite of that found in Latin American countries. In Korea, the RER tends to depreciate more than average in the pre-election periods.

Two models provide theoretical explanations for the stylized facts that the RER tends to appreciate before elections and to depreciate after elections, particularly in Latin American countries. Bonomo and Terra (2005) develop a theoretical model based on the distributive effect of real exchange rate changes. The RER depreciation is favorable for exporters and import-competing domestic industries, while detrimental to the non-tradable sectors. When the non-tradable sectors have the majority of voters, the incumbent government has an incentive to appreciate the RER before the election to increase the probability of being reelected. The RER cycles result from the interplay between the electoral power of non-tradable sectors and the lobbying power of tradable sectors.

Stein, Streb and Ghezzi (2005) develop a political budget cycle model (Rogoff and Sibert, 1988; Rogoff, 1990) where devaluation acts as a tax on consumption due to a cash-in-advance constraint and the electoral cycle is the result of a signaling game between incumbent governments and rational forward-looking voters. Competent governments may signal their competency by reducing the devaluation rate in pre-election periods. Incompetent governments, on the other hand, postpone the devaluation until after-elections for the purpose of mimicking competent governments.

This study will focus on empirical evidences of the electoral cycle in Korea. We then suggest a hypothesis that can explain the electoral cycle. For the rest of the paper, Section 2 introduces briefly the economic structure and political background of Korea. Section 3 provides a quantitative analysis of the electoral cycle of the exchange rate in Korea and its results. Section 4 presents other evidences about the government behavior around elections. Lastly, Section 5 presents our concluding remarks.

3.2 The Political Economy of Korea

Political Background

In the tide of imperialism Korea was colonized by Japan in 1910. After World War II, Korea was liberated but divided into two separate countries. The Korea war occurred in 1950 and a ceasefire was signed in 1953.

Under the original constitution of South Korea the president was elected indirectly by the national assembly and Mr. Rhee was elected as president in 1948. However, Mr. Rhee changed the indirect presidential election system to the direct one in 1952. He was ousted from power in 1960 by student demonstrations protesting against his dictatorial rule and election frauds. The Democrat party seized the power afterwards.

In 1961 there occurred a coup d'etat led by Mr. Park who was elected as president in 1963. In 1972, a self-coup occurred to bring about a new constitution. It transferred the election of the president to an electoral college. In effect, the constitution converted Park's presidency into a legal dictatorship. Until his assassination in 1979, Park remained in power for nearly two decades through the dictatorial presidential political system.

After Park's death, there was a military coup again led by General Chun and military government took over power following an interim government. He was afterwards elected as president by the electoral college.

In 1987, owing to huge demonstrations throughout the country, the military government accepted direct presidential elections. There were two major candidates in the opposition side, and the ruling party won the election by a narrow margin. In 1990, the ruling party merged with second and third largest opposition parties to form a grand conservative party (the Democratic Liberal Party) and won the presidential election in 1992.

In 1997, there was a government change through the presidential election. It was the first meaningful change in the ruling party from conservative to democratic. The conservative party came back to power in 2007.

The political system of Korea is the strong presidentialism, so presidential elections are most influential. The Korean political system is multiple party system but there are two major parties; conservative and democratic parties. The electoral periods were not regular owing to frequent revisions of constitution.

Table 1. Presidential Elections in Korea

Order	Election Year	Party	Elected President	Note
1st	July 1948	Conservative	Rhee, S. M.	
2nd	August 1952	Conservative	Rhee, S. M.	
3rd	May 1956	Conservative	Rhee, S. M.	
4th	August 1960	Democratic	Yun, B. S.	
5th	October 1963	Conservative	Park, J. H.	After Military coup
6th	May 1967	Conservative	Park, J. H.	
7th	April 1971	Conservative	Park, J. H.	
8th	December 1972	Conservative	Park, J. H.	
9th	July 1978	Conservative	Park, J. H.	
10th	December 1979	Conservative	Choi, K. H.	An interim Government
11th	August 1980	Conservative	Chun, D. H.	After Military coup
12th	February 1981	Conservative	Chun, D. H.	
13th	December 1987	Conservative	Roh, T.W.	Democratization
14th	December 1992	Conservative	Kim, Y. S.	
15th	December 1997	Democratic	Kim, D. J.	
16th	December 2002	Democratic	Roh, M. H.	
17th	December 2007	Conservative	Lee, M. K.	

Source: National Election Commission of Korea

Economic History

In the 1950s, Korea ranked among the poorest countries in the world. The First 5-year Economic Development Plan started in 1962. The Korean economic development was driven under a powerful, dictatorial government. The Korean government fostered import-substitution industries and export firms. They were blessed with government support, for example low-interest rate policy loans and various forms of preferential tax treatment, such as tax exemptions and tariff rebate to exporters. This environment nurtured major companies in the tradable sector. Due to the success of the export-oriented industrialization strategy, Korea was transformed into an industrialized country within a short period of thirty years. In December 1996, Korea attained membership in the Organization for Economic Cooperation and Development (OECD).

Table 2 shows the dynamic history of the Korean economy. Per capita GNI increased dramatically from 884 U.S. dollars in the 1970s to 16,689 U.S. dollars in the 2000s and the annual growth rate rose from 6 to 9 percent until 2000. The ratio of exports and imports to GNI remained high throughout the periods. Inflation rate was very high in the 1970s and remained at a relatively high level until the 2000s. Interestingly, the share of employees in the non-tradable sector increased from 36.9 percent in the 1970s to 73.8 percent in the 2000s and exceed 50 percent in 1985 in particular.

Table 2. Key Economic Indicators in Korea

	1971~1980	1981~1990	1991~2000	2001~2010
Per capita GNI (US$)	884	3,303	9,755	16,689
Real GDP Growth (%)	9.1	9.8	6.6	4.2
Ratio of Export and Import to GNI	61.7	70.7	63.4	85.0
Ratio of Export to GNI (A)	27.5	35.1	32.2	43.6
Ratio of Import to GNI (B)	34.2	35.6	31.2	41.4
Consumer Price Increase (%)	16.5	6.4	5.1	3.2
Share of Employment in non-tradable sector (%)	36.9	49.5	64.6	73.8

Source: The Bank of Korea, Statistics Korea

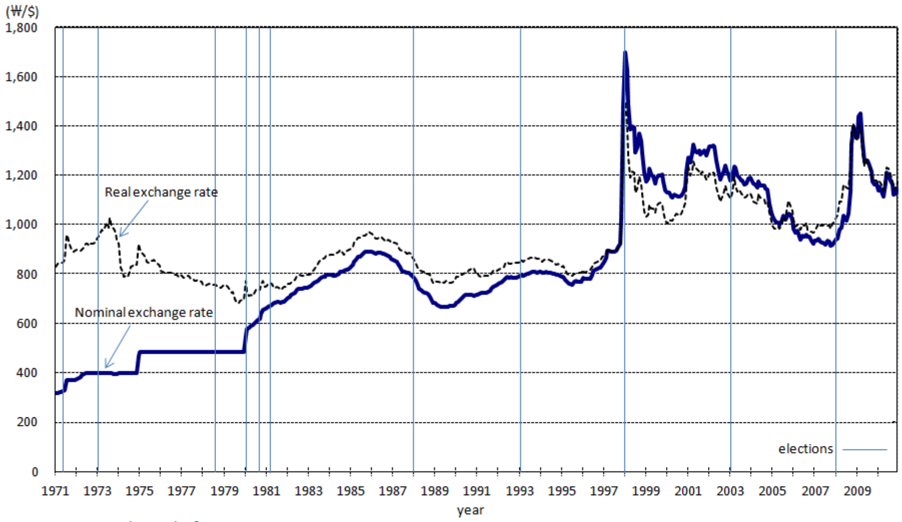
Exchange Rate Policy[1]

From 1961 until 1980, the Korean won was pegged to the U.S. dollar. From 1980 to 1990, a multiple currency basket system was introduced officially.

In March 1990, Korea's exchange rate regime was announced as a floating within a daily band, following the adoption of the Market Average Exchange

[1] *Source*: The Bank of Korea

Figure 3.1: Exchange Rates in Korea



Source : IFS, The Bank of Korea

Rate System. Although the Korean won-U.S. dollar rate began to be determined on the basis of the interbank market, daily fluctuations were highly limited within certain bands. As the currency crisis broke out in late 1997, the Korean government signed up for the financial aid package from the IMF in December 1997. The daily fluctuation band was abolished at that time.

Figure 3.1 shows a shift of Korea's nominal and real exchange rates. The vertical lines indicate the presidential election periods. The volatility of exchange rates increased throughout the periods. After the financial crisis in 1997, the real exchange rate level became higher and more volatile.

3.3 Quantitative Analysis

This section presents the empirical evidences of the electoral cycle of Korea's exchange rate. The focus of this paper is placed on the real exchange rate rather than nominal one. This is because real exchange rates are not only more directly connected with economic performances, but also less likely to be misled by other factors.

We follow the empirical models used in studies of Latin American countries (Stein, Streb and Ghezzi, 2005; Cermeño and Grier, 2010). This makes it easier for us to compare Korea's case with that of Latin American countries.

Methodology

We identify how elections affect the real exchange rate. The RER, however, is basically determined by the economic fundamentals, as well as by political factors. It should be noted that electoral cycle does not mean the change in the equilibrium RER, but presents temporary misalignment of the RER caused by political disturbances. Basically, the equilibrium level of the RER is determined by fundamental factors.

In order to identify the electoral factors more precisely, we need to control economic determinants that influence the RER. We specify an equation similar to that of Cermeño and Grier (2010) as follows:

$$\triangle ln(RER_t) = c + \alpha_{np} \triangle X_{npt} + \beta_p \triangle X_{pt} + \varepsilon_t \tag{3.1}$$

where RER is the real exchange rate, X_{np} is a vector of economic variables and X_p is a vector of political variables.

Goldfajn and Valdés (1999) present fundamental variables that affect RER depreciation: *terms of trade, size of government, openness* and *international interest rates*. As for economic variables, we use these four variables in the same fashion as follows.

Terms of trade (TOT) affect relative prices of nontradables in a small open economy. If there is a negative shock on TOT, real income and the demand for nontradables will decrease. The relative price of nontradables will thus fall and the RER will depreciate. This is the case where income effect dominates substitution effect (Diaz-Alejandro, 1982). However, if the substitution effect is strong enough, the demand for importables moves to relatively cheap nontradables intensely, the price of nontradables could rise and the RER will appreciate (Edwards, 1989). TOT is measured simply by the ratio of export prices to import prices.

Permanent expansion in the size of the government (gvt) may cause the RER appreciation if the government propensity to consume nontradables is higher than that of the private sector. If the government spends more on tradables, for example, imported military equipment, the RER will depreciate. The government size is measured by the ratio of government expenditures to GDP.

Openness ($open$) indicates how the economy is connected to the rest of the world and represents trade liberalization. The degree of openness is proxied by the ratio of exports plus imports to GDP.

International interest rate ($Tbill$) affects the RER. If the international interest rate decreases to a greater extent than domestic interest rates, increased capital inflows will induce higher expenditures, and then the RER will appreciate.

These four economic variables are associated with fundamentals in equilibrium RER from a general perspective. For the empirical study for Korea, we need to consider the financial crisis which broke out in 1997. As we see in Figure 3.1, the RER level increases. In this study, we use a dummy variable for the three-month periods before and after the financial crisis ($CRIS$).

Most importantly, we use an election variable, which is composed of pre- and post-election dummy variables. The pre-election dummy is the period of the three months before the presidential elections ($ELEb$), and the post-election dummy is the period of the three months after the presidential elections ($ELEa$). Regarding the political factors, we analyze the difference between a dictatorship ($ELEb * Dic$) and a democratic regime ($ELEb * Dem$).

Reflecting the variables mentioned above, we can rewrite the equation (3.1) as follows:

$$\begin{aligned}\triangle ln(RER_t) = c + \alpha_1 \triangle ln(TOT_t) + \alpha_2 \triangle ln(gvt_t) + \alpha_3 \triangle (open_t) + \alpha_4 \triangle (Tbill_t) \\ + \alpha_5 CRIS_t + \beta_1 ELEb_t + \beta_2 ELEa_t + \varepsilon_t \qquad (3.2)\end{aligned}$$

In the regression, we choose depreciation of the real exchange rates instead of real exchange rate levels. Cermeño and Grier (2010) argue the reasons for this: (i) most existing studies used depreciation rates, not exchange rate levels; (ii) the first differencing removes individual effects in the mean equation; and (iii) we can avoid non-stationary problem of the exchange rates data by the first differencing.

In order to specify an appropriate regression model, we implement several unit root tests: Augmented Dickey-Fuller (ADF), Phillips-Perron (PP) and Kwiatkowski–Phillips–Schmidt–Shin (KPSS). They confirm that time series data in regression (3.2) are stationary, which eliminates our concerns about spurious regression.

Data and Descriptive Statistics

We examine the RER of Korea during 40 years from January 1971 to December 2010. We use the bilateral real exchange rate that is $RER = Nominal\ exchange\ rate \times (PPI\ of\ U.S./PPI\ of\ Korea)$. The data set of monthly average exchange rates, producer price indexes (PPI) of Korea and the U.S. and TOT is taken from International Financial Statistics (IFS) released by the International Monetary Funds.

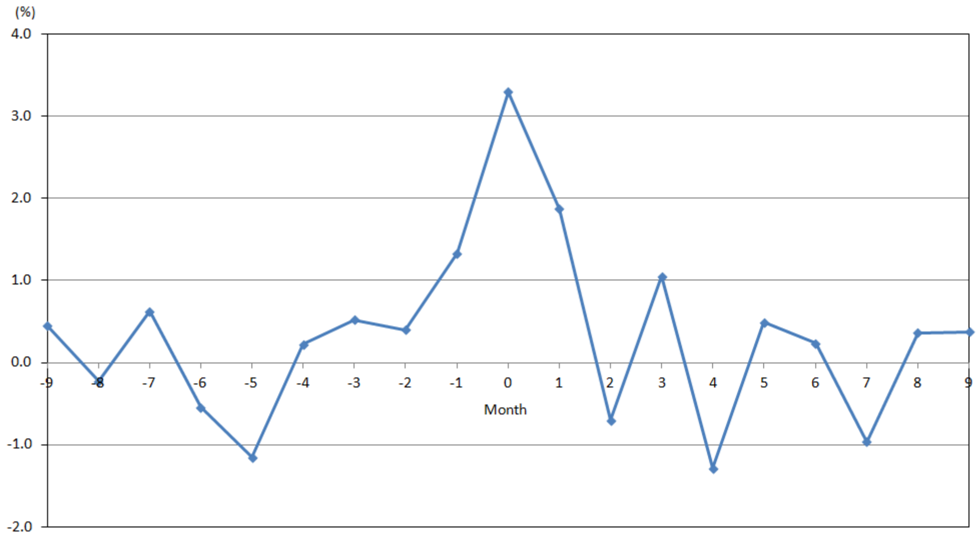
GDP, government spending, exports and imports data are obtained from the Bank of Korea. Government spending data are calculated by 3-month moving averages of the government expenditure data in the Korea National Accounts. The three-month U.S. Treasury bill rates are obtained from the website of Board of the Governors of the Federal Reserve System.

During the sample periods from January 1971 to December 2010, there were 11 presidential elections as shown in Table 1. However, the assassination of president Park in 1978 brought the country to political chaos that triggered a military coup within a short period of time. For this reason, we do not consider the three elections held in 1979, 1980 and 1981 as authentic ones. Data on the presidential elections are obtained from the National Election Commission of Korea. As for the political regime, we define the dictatorship as having ended in June 1987, when a direct presidential election was introduced due to democratization movements.

Before proceeding with the econometric analysis, it is informative to look at descriptive statistics around election periods. We observe the behavior of the RER during a 19-month period centered on elections. Figure 3.1 shows the average RER changes around elections, where month 0 corresponds to the month of the election, month -1 one month prior to election, and so on. This presents figures from nine months before the elections (-9) to nine months after the elections (+9). The RER starts to depreciate around 3-months before the election and reaches a peak in the month of the election. After the elections, the RER seems to be in convergent oscillation. It should be noted that the electoral cycle does not mean the change in the equilibrium RER, but represents temporary misalignment of the RER caused by political disturbances. Basically, the equilibrium level of the RER is determined by fundamental shocks.

Table 3 presents the volatility of RER changes around election periods. The

Figure 3.2: RER Changes around Elections



Source : IFS

means and standard deviations of the RER changes are higher around election periods compared to the whole periods. Particularly, the standard deviation more than doubled in the pre-election periods. This implies that elections amplify the volatility of the RER depreciation particularly before elections.

Table 3. Volatility of the Real Exchange Rate Changes around Elections

	Sample Period	The three months before elections	The three months after elections
Real Exchange Rate Depreciation			
mean	1.40	2.21	3.00
standard deviation	2.30	6.19	3.22

Empirical Results

Table 4 presents the results of estimation equation (3.2). The three fundamental variables except TOT, the size of government, openness and international interest rate, are not statistically significant. Interestingly, the coefficient of TOT is positive, which implies that substitution effect is stronger than income effect in Korea. As we expected, the coefficient of the financial crisis dummy is positive and highly significant.

As for the electoral determinants, in the pre-election periods, the three months before elections, the coefficient is positive at a statistically significant level, while in the post-election periods, the coefficient is positive but not statistically significant, as in the column (1). This means that the RER depreciated more in the pre-election periods but there is no clear pattern found after the election.

We examine political regimes to see more details of the electoral cycle. As in the column (2), the coefficients of the pre-election periods under both dictatorial and democratic regimes are positive, but under dictatorship the coefficient is not statistically significant. On the other hand, the coefficient of the post-election periods under dictatorship is positive at a statistically significant level, while under the democratic regime, is negative and holds weak statistical significance. Under the democratic regime, the RER depreciation is higher before the elections and lower after the elections. This means that the incumbent government chooses higher RER depreciation before the election to increase the probability of being re-elected, and after the election the RER comes back to the equilibrium level. However, under the dictatorial regime, the RER depreciation is higher in both the pre- and post-election periods. This implies that the dictatorial government is less motivated to intervene the RER before elections, since an election is not decisive in the extension of power. The columns (3) and (4) show the results of an analysis conducted with significant variables adopted.

For robustness, we test anticipated elections only. Table 5 shows the results of the analysis which take into account authentic elections excluding the three elections held in 1979, 1980 and 1981. The results are similar to that of Table 4.

In any case, the results seem reasonable. If the RER depreciation is a signaling of the incumbent government in order to increase its chance to be re-elected, it is more influential under the democratic regime in which power is determined by the election. Under the dictatorship, however, a signaling behavior may not be so important as under the democratic regime. To sum up, the electoral cycle of the RER in Korea is depreciation in pre-election periods, and this is more obvious under a democratic regime.

This result is exactly the opposite to the cycle found in Latin American countries. Existing empirical studies of Latin American countries identify the RER appreciation in the pre-election periods (Bonomo and Terra, 1999; Frieden et al, 2001; Pascó-Font and Ghezzi, 2001; Grier and Hernández-Trillo, 2004; Stein, Streb and Ghezzi, 2005).

Table 4. Dependent variable: Depreciation of Real Exchange Rate

(Monthly data, January 1971 ~December 2010, OLS estimation)

Explanatory Variables	(1)	(2)	(3)	(4)
Number of observations	479	479	479	479
Constant	-0.001	-0.001	0.000	-0.001
	(-0.79)	(-0.67)	(-0.27)	(-0.54)
Δ ln(Terms of trade)	0.188 **	0.187 **	0.196 **	0.202 **
	(2.64)	(2.64)	(2.77)	(2.87)
Δ ln(Size of government)	0.018	0.004		
	(0.61)	(0.12)		
Δ Openness	-0.012	-0.012		
	(-1.25)	(-1.31)		
Δ International interest rates	-0.136	-0.227		
	(-0.62)	(-1.01)		
Financial Crisis	0.065 ***	0.067 ***	0.067 ***	0.064 ***
	(6.42)	(6.33)	(6.69)	(6.26)
The 3 months before elections	0.010 **		0.010 **	
	(2.32)		(2.23)	
The 3 months before election under dictatorship		0.006		
		(1.12)		
The 3 months before election under democracy		0.015 **		0.016 **
		(2.30)		(2.44)
The 3 months after elections	0.006			
	(1.36)			
The 3 months after election under dictatorship		0.016 **		0.014 **
		(2.71)		(2.48)
The 3 months after election under democracy		-0.006		
		(-0.94)		
R^2	0.14	0.15	0.13	0.14

Note: *t*-statistics in parenthesis. ** denotes significance at 95 percent, *** denotes significance at 99 percent

Table 5. Dependent variable: Depreciation of Real Exchange Rate (exclude coup period)

(Monthly data, January 1971 ~ December 2010, OLS estimation)

Explanatory Variables	(1)	(2)	(3)	(4)
Number of observations	479	479	479	479
Constant	-0.001	-0.001	0.000	0.000
	(-0.50)	(-0.41)	(-0.15)	(-0.39)
Δ ln(Terms of trade)	0.181 **	0.180 **	0.191 **	0.197 **
	(2.54)	(2.54)	(2.70)	(2.80)
Δ ln(Size of government)	0.017	0.009		
	(0.58)	(0.30)		
Δ Openness	-0.012	-0.013		
	(-1.27)	(-1.34)		
Δ International interest rates	-0.063	-0.123		
	(-0.29)	(-0.56)		
Financial Crisis	0.065 ***	0.067 ***	0.067 ***	0.064 ***
	(6.34)	(6.31)	(6.57)	(6.25)
The 3 months before elections	0.011 **		0.011 **	
	(2.11)		(2.08)	
The 3 months before election under dictatorship		0.004		
		(0.53)		
The 3 months before election under democracy		0.015 **		0.016 **
		(2.24)		(2.41)
The 3 months after elections	0.004			
	(0.77)			
The 3 months after election under dictatorship		0.020 **		0.019 **
		(2.46)		(2.31)
The 3 months after election under democracy		-0.006		
		(-0.93)		
R^2	0.13	0.15	0.13	0.14

Note: *t*-statistics in parenthesis. ** denotes significance at 95 percent, *** denotes significance at 99 percent

3.4 Other Evidences

In Section 3, we identify the electoral cycle of the RER in Korea which is conflicting with the stylized facts found in Latin American countries. In this Section, we provide other evidences of the incumbent government behavior around elections, according to the RER depreciation.

Foreign Reserves

If incumbent governments have motivation to depreciate exchange rates to improve their probability of being re-elected, they need some policy instruments to intervene in the foreign exchange market. Foreign reserves may be a fast and efficacious policy instrument for doing so.

Figure 3.3 presents foreign reserves changes (year-over-year) around elections in Korea.[2] Foreign reserves increase before elections, and then sharply fall immediately after elections. It is strongly suspected that during the election periods a government attempts to intervene in the foreign exchange market by using foreign reserves. This is natural since the scale of Korea's foreign exchange market is relatively small, the foreign exchange authority, i.e. the government is a big hand in the market, and as a result government intervention in the foreign exchange market is easily monitored by market participants and the intervention has strong influence on the market in terms of not only volume itself but also of signal.[3]

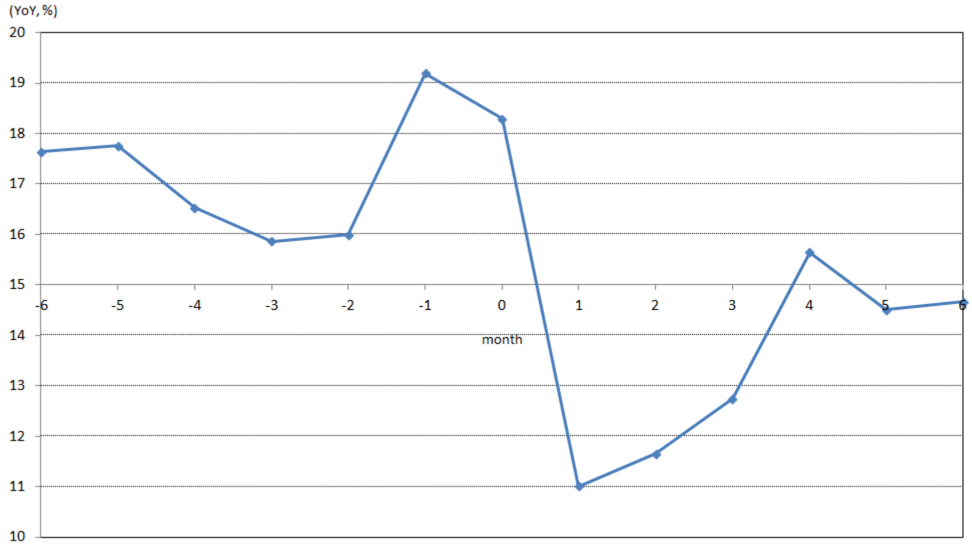
Monetary Base

Table 6 presents the correlation between monetary base change and elec-

[2] The foreign reserve amount is based on month end figures. In order to lessen the effect of outlier, we exclude the period of financial crisis in 1997.

[3] The average daily total trading volume in the foreign exchange market in Korea amounted to 8.9 billion US dollars, and the amount of Korea's foreign reserves recorded 96.2 billion dollars as of 2000.

Figure 3.3: Foreign Reserve Changes around Elections



Source : The Bank of Korea

tions. The monetary base appears to be a positive coefficient for the three months before elections and a negative one for the three months after elections. This suggests that the central bank increases money supply before elections and absorbs immediately after the elections. Monetary expansion causes the exchange rate depreciation.

Table 6. Dependent variable: Increase rate of Monetary Base

Explanatory Variables	
Constant	0.012
	(6.55) ***
The 3 months before election	0.015
	(2.12) **
The 3 months after election	-0.013
	(-1.87) **

Note : *t* -statistics in parenthesis. ** denotes significance at 95 percent; *** denotes significance at 99 percent

The increase in the monetary base affects both nominal and real exchange rates. As we are focusing on the RER cycle, we then need to check the inflation rate. As shown in Table 7, the inflation rate soars after elections, while being repressed before elections but with weak statistical significance.

Table 7. Dependent variable: Inflation

Explanatory Variables	
Constant	0.205 (13.51) ***
The 3 months before election	0.002 (0.03)
The 3 months after election	0.327 (5.79) ***

Note : *t*-statistics in parenthesis. *** denotes significance at 99 percent

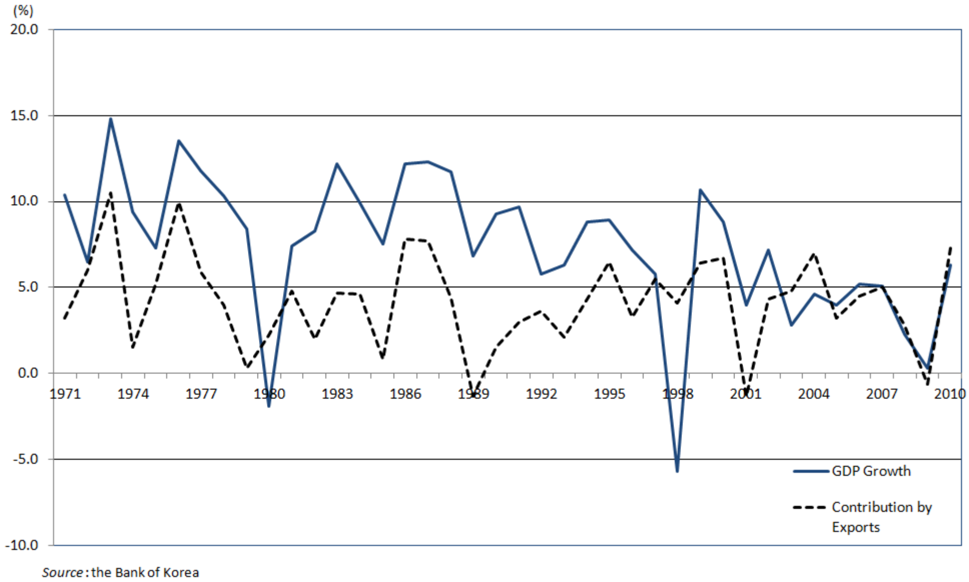
3.5 Concluding Remarks

This paper investigated the electoral cycle of the real exchange rate in Korea. We found that in the pre-election periods the RER depreciation is higher than average. The electoral cycle is exactly the opposite, compared with that of Latin American countries, in which the RER appreciate before elections.

Particularly, the electoral cycle is more intense under a democratic political regime than under a dictatorship. This means that the incumbent governments use the RER depreciation as a signal of their competency to improve the probability of being re-elected. Moreover, foreign reserves increase more before elections and decrease after elections. This implies that the government intervenes in the foreign exchange market before elections.

Existing theoretical frameworks cannot explain the empirical result of study on Korea. The majority of Korean population belong to the non-tradable sector

Figure 3.4: Contributions to Exports to GDP Growth in Korea



as in Latin American countries. Nevertheless, why does the RER depreciation appear during the pre-election periods, which is unfavorable to the non-tradable sectors? Appreciation is a signal of the incumbent government's competency. Why does the Korean government choose a depreciation before elections ? These questions need further investigation.

The peculiar electoral cycle might be explained by Korea's peculiar economic and political backgrounds. The Korean economy grew boosted by the export-oriented industrialization and the exchange rate has remained at the center of economic concerns for long. Due to high standard education, Koreans are well aware of the relationship between growth and exports in their economic structure. Figure 3.4 presents the contribution of exports to GDP growth. Fluctuations on GDP growth rate depend on the contribution of exports.

There is a social consensus in Korea that the depreciation of the RER is favorable to the population regardless of whether they work for the tradable sector or not, since they believe growth in the tradable sector spreads to the rest of their economy. The incumbent governments thus use the RER depreciation as a signal of its competency to improve the probability of being re-elected.

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