

External Debt and Exchange Rate Overshooting: The Case of Selected East Asian Countries*

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Abstract:

The accumulations of foreign debts had indeed been at a rapid phase, particularly during the last few years leading to the outbreak of the 1997 financial crises in the four most severely effected economies, namely Indonesia, the Philippines, Thailand and Korea. Interestingly, during the same period, the rates of overshooting of these East Asian currencies have, in general, increased significantly. The objective of this paper is to evaluate whether the rapid accumulation of external debts, especially starting around 1995 and 1996, has contributed to the overshooting of the East Asian countries' currencies starting late 1997.

Key Words: External Debt, East Asian Countries, Exchange Rate and Overshooting.

JEL Classifications: F31, F34, F41.

1. Introduction

The adverse consequences of exchange rate volatilities on various parts of the domestic economy have now been well documented in numerous research works. In particular, a rise in exchange-rate volatilities has been found to have negative consequences on the trade sector (i.e. exports and imports) of the local economy (McKenzie (1999), Chou (2000), Rahmatsyah, Rajaguru and Siregar (2002) and Siregar and Rajan (2004)). A similar message was conveyed in a recent paper of Calvo and Reinhart (2002). They show that the monetary authority needs to intervene and manage the fluctuation of the local currency in order to achieve its desire level of inflation target.

Due to its widespread economic implication, evaluating causes and determinants of exchange rate volatilities have accordingly remained one of the key research agenda for both academics and policy makers. Several attempts have been made recently to particularly examine the role of external debt/borrowing in explaining the fluctuations of the local currency.

For instance, Corsetti et al. (1999) and Kawai (2002) have argued that external borrowings, particularly by private commercial banks and firms are among the key factors responsible for the severity of the East Asian financial and currency crises during the late 1990s. Providing a more in-depth look at the features of currency crises, Cavallo, et.al. (2002) develop a model that suggests the size of foreign currency denominated debt of a country contributes to the occurrences of exchange rate overshooting, sudden stop of capital flows and output drop in the domestic economy. Cavallo (2005) further argues that the exposure to foreign currency liabilities magnify the cost of exchange rate depreciation. Likewise, Devereux and Lane (2001) underline the need "to extend the list of variables important for understanding bilateral exchange rate volatility beyond those suggested by optimal currency area theory" (pp.27). Their study

shows that for developing countries, in particular, volatility in their bilateral exchange rates is strongly and negatively affected by the stock of external debt.

However, hardly any of the above studies investigate the country-by-country case of the 1997 financial crisis-affected East Asian economies. Most of them have instead conducted cross-country analyses to generate a number of general lessons from both developed and developing group of economies. Given the cross-country empirical approach, it is therefore impossible to draw inferences for each individual economy, and conduct comparative analyses between them.

The objective of this paper is to try to understand further the possible role of external/foreign debt in explaining the fluctuations of the local currencies of selected East Asian economies, namely, Indonesia, the Philippines, Thailand and South Korea during the period of pre- and post-1997 East Asian financial and currency crisis. Looking at two key categories of the external debts of these countries gathered from the BIS debt database, namely, debt securities and total claims on commercial banks located in the domestic market, the accumulations of foreign debts since the early 1990s had indeed been at a rapid phase, particularly during the last few years leading to the outbreak of the 1997 financial crises, and continued to be high several years after 1997 (Figures 1-4).

During the same period, we also find episodes of significant nominal and real exchange rate overshooting (and undershooting) of these four East Asian currencies (the Indonesian rupiah, the Philippines peso, the Thai baht and the Korean won). We define overshooting (undershooting) of the exchange rate when the spot (or the short-run) exchange rate of a currency depreciates or appreciates against its trading partner's currency at a percentage rate significantly more (less) than that of the long-run "equilibrium" exchange rate. Given the lack of official data on the long-run equilibrium rate for most of the East Asian countries, we first have to estimate these rates before

generating the incidence and magnitude of the overshooting. Our empirics show that the severity of the overshooting and undershooting of these East Asian currencies has been found to increase during the few years before and after the outbreak of the 1997 financial crisis (Figures 6b, 6d, 7b, 7d, 8b, 8d, 9b and 9d).

Our paper hopes to extend early literatures by particularly addressing the following set of questions for the previously listed four East Asian currencies. *Have the rapid accumulation of external debts contributed to the overshooting of the East Asian countries' currencies in late 1990s and early 2000s? Have the rise in the average external debt share of GDP, especially starting 1995 and 1996, contributed to the more severe overshooting of the local currencies especially in late 1997 and early 1998 when compared to the rates reported during the pre-1997 financial crisis period? Which type of external liability, i.e. the debt security or the claims on bank, to be more responsible for the high overshooting in these economies?*

After providing background analyses on the trends of external debts and evidences of over and undershooting of these four economies in the next section of the paper, we adopt and extend the basic overshooting model of Dornbusch (1976 and 1976b) in section 3. The reduced form of the model suggests that indeed the higher is the external debt the more severe is the overshooting. Data and empirical testing are presented in section 4. The findings for each of the four economies will also be discussed in that section. Brief concluding remarks end the paper.

2. Trends and Analysis

2.1 External Debts of Selected East Asian Countries

Dictated by the availability of the data, this study considers two major components of the external debt of the four East Asian economies according to BIS database, namely the total claims on banks and the total debt securities issued abroad

by the individual countries (both as a share of GDP) (Figures 1-4). The total claims on banks here are total bank's liabilities to their foreign creditors. The debt securities include money market instruments, bonds, and notes issued in international markets by both public and private sector borrowers. From 1994 to 1996, the total GDP shares of both categories of external debts for the four East Asian economies were rather moderate, ranging between 30 to 50 percent. Within the period of less than two years, all four economies had rapidly accumulated external debt, reaching as low as 80 percent of GDP for Thailand and as high as 140 percent of GDP for the Philippines.

The rapid increase in the claims on banks located in these four economies in mid-1990s reflected the strong and predominantly bank related capital inflows in the region. With the sudden stop of capital/investment flows and the collapse of key industries at the early stages of the 1997 financial crises, a large number of commercial banks experienced a rise in the proportion of the bad loans and eventually were no longer able to service their foreign currency denominated borrowings. From fairly stable levels in the early 1990s in the cases of Korea, Indonesia, and Thailand, a sharp noticeable increase in total claims on banks were reported especially between late 1997 to early 1999. Similarly, we have also seen a rise in the issuance of public/government debt securities during the crisis and the post-1997 period to finance the restructuring of the collapse banks and non-bank financial institutions in all of the four major East Asian economies.

Looking at Figures (1-4), few contrasting trends are worth highlighting. Looking at the case of Indonesia, the country has accumulated claims on bank at a relatively more rapid rate than that of the debt securities starting mid 1996 to at early 1999. The total claims on bank and the debt securities were around 20 percent and 10 percent of the GDP in early 1997, respectively. By the second semester of 1998, the total claims on

bank share of GDP were close to 90 percent, more than doubled the amount of the debt securities.

In contrast, Korea and Thailand had amassed debt securities at a substantially much higher rate relative to the reported rate for claims on bank during the same period. During the first quarter 1997, Thailand had accumulated almost an equal percentage share of GDP of these two categories of external debt at a rate slightly above 20 percent. By late 1997, the debt securities share of GDP was about 10 percent higher than the rate of the claims on banks. A similar trend can also be reported for the case of Korea. By the second quarter of 1996, the two types of external debts in Korea were about the same size (moderately over 20 percent of the GDP). By the last quarter of 1998, the debt securities share of GDP was more than 15 percent higher than that of the claims on banks.

Among the four countries examined in this paper, the Philippines has the long standing record of issuing debt securities on the international market since early 1997. The rate of accumulation of external debt in the form of debt securities grew from around 30 percent of the GDP in the second quarter 1997 to over 100 percent of GDP by the end of 2003. In contrast, the claims on bank were reported at around the same size as the debt securities in the second quarter 1997. It rose to about 80 percent of the GDP at the beginning of 1999, and gradually declining to around 40 percent of GDP at the last quarter of 2003.

Towards the end of the 1990s to the start of the present decade, there is an observed declining trend in these two categories of external debts for Indonesia and Korea, with the exception of the Philippines that had greatly relied on the debt securities. In general, however, the external debt share of the domestic GDP of these countries remains quite substantial and has in average been significantly higher than the pre-1997 level.

2.2 Overshooting and Undershooting

As briefly mentioned before, overshooting (undershooting) occurs when the short-run exchange rate depreciates or appreciates more (less) than the long-run equilibrium exchange rate. For our analyses, we examine the overshooting incidences for both the nominal effective exchange rates (NEER) and the real effective exchange rates (REER) of the local currencies of the four East Asian economies against the countries' top five trading partners' currencies. Since the long-run exchange rates are not officially available, we have to construct our own estimates. The steps taken to generate the long run and the spot rates for the NEER and the REER will be discussed in more detail at the later part of the paper. The frequency and the severity of the overshooting and undershooting of these economies are shown in Figures (6b, 6d, 7b, 7d, 8b, 8d, 9b and 9d).

Sharp contrasting evidences are reported for the pre- and post-1997 financial crisis periods. In general, the pre-crisis was a period of stability. The NEER of the Korean won experienced almost no overshooting and undershooting. The Thailand baht had at the most only around 5 percent of overshooting and undershooting of the NEER. The Philippines peso and the Indonesian rupiah, on the other hand, had experienced double-digit rates of overshooting and undershooting as high as 14 percent and 10 percent, respectively.

The post-1997 crisis period witnessed much more volatilities in both NEER and REER of these four major East Asian currencies. The Indonesian rupiah and the Korean won experienced overshooting of the NEER by as much as 70 percent and 80 percent, respectively. The Philippines peso, on the other hand, reported the most modest overshooting at only around 15 percent. Relatively similar analyses can be drawn from

the trends of the REER for the pre- and post-1997 crisis periods, except that, in general, the rates are more moderate than the rates observed for NEER.

In addition to the magnitude, the frequency of the overshooting and undershooting incidences is another critical fact worth highlighting, particularly for the period immediately after the outbreak of the 1997 financial crisis. Based on a simple step of observing the sequential periods of overshooting and undershooting at the minimum rate of 20 percent, the rupiah had undoubtedly experienced the longest sequential episodes of severe overshooting (and undershooting). Immediately after the initial meltdowns of the currencies in the third quarter of 1997, the rupiah continued to experience substantial over- and undershooting in all quarters of 1998, plus two additional quarters in mid to late 1999, with the quarterly average of over 30 percent. The Korean won and the Thai baht, on the other hand, had gone through only two quarters at the most of soaring overshooting and undershooting of more than 20 percent. The Philippines, on the other hand, had reported a series of overshooting period, which is followed immediately by an undershooting episode. However, the average magnitude was less than 10 percent per quarter. The relatively higher frequencies and larger magnitudes of overshooting (and undershooting) of the NEER and REER seem to suggest that the 1997 East Asian financial crisis had undoubtedly affected the Indonesian rupiah most severely.

3. Theoretical Framework

To capture theoretically the possible exchange rate overshooting (or undershooting) implication of a rise (or fall) on the external debt, we adopt and modify the basic framework of the Dornbusch (1976) model. The basic structures of the model are presented in the following sub-sections.

3.1. Goods Market

Price reaction function is a simple Phillips Curve (Equation 1) without inflation expectations.¹ Here, we assume a stationary economy with no continuing inflation. Note: all key variables in this section are in log-form, unless it is otherwise noted.

$$\dot{p} = \rho (y^d - y) \quad (1)$$

\dot{p} is domestic inflation ---or change in price over time. Note that price is sticky in the short-run. y^d is the aggregate demand for the goods in the domestic economy. y is the aggregate supply of goods locally(exogenously determined). ρ is a positive coefficient ($\rho > 0$).

Equation (2) posits that the aggregate demand for the goods positively depends on the real exchange rate ($e - p$) (assuming foreign price equals to one (i.e. its log equals to zero)), income (aggregate supply) and government expenditure.

$$y^d = b_0(e - p) + b_1y + g \quad (2)$$

p is the domestic price level. e is the nominal exchange rate (a rise implies a depreciation of local currency). g is the total government expenditure. b_0 and b_1 are positive coefficients. The demand for goods in the market is driven by the fluctuation of the real exchange rate (nominal exchange rate and domestic price), the supply of the goods, and the level of government expenditure.

3.2. Money Market

The demand for money in the local economy is captured by the following equation (Equation (3)).

$$m^d = p + \bar{f}y - \bar{l}i \quad (3)$$

¹ This is the same Phillips curve equation adopted by Dornbusch (1976).

m^d represents the domestic demand for money. i is the domestic interest rate.

α denotes the income-elasticity of money demand, and $\beta > 0$. ($\beta > 0$) is the interest-elasticity of money demand. Higher interest rate raises the opportunity cost of holding money, and therefore reduces the demand for money. An increase in the output, on the other hand, generates a rise in the transactions demand for money. Finally, the nominal demand for money is positively proportional to the price level. As in the case of previous equations, all of these variables are in log-form.

The money market equilibrium condition ensures that the demand for money is fully met by the supply.

$$m^s = m^d = m \quad (4)$$

Where: m^s is the log of domestic money supply, and m is the log of domestic money stock.

3.3. International Asset Market

One of the key equations of the Dornbusch overshooting model is the uncovered interest parity condition. At its basic form, the condition simply claims that the interest rate (i) on domestic bond must equal the interest rate of foreign bond (i^*), plus the expected rate of depreciation of the exchange rate ($E(\dot{\$})$). Obstfeld and Rogoff (1998) have however shown that the risk premium can potentially be quite large. Given their empirical finding, we modify the basic Dornbusch (1976) model by employing the risk premium adjusted interest rate parity condition (Equation (5)).

$$i = i^* + E(\dot{\$}) + RP \quad (5)$$

The expected rate of nominal depreciation ($E(\dot{\epsilon})$) is presented as the spread between \bar{e} (the long-run equilibrium nominal exchange rate) and e (the spot nominal exchange rate).

$$E(\dot{\epsilon}) = q(\bar{e} - e) \quad (5b)$$

Where: q is a positive coefficient parameter. If \bar{e} is larger (smaller) than e , then $E(\dot{\epsilon})$ is going to be positive (negative), implying that there will be market expectation for the local currency to depreciate (appreciate). In the long-run, e is expected to converge to \bar{e} .

RP is the risk premium variable, where it is assumed to be positively influenced by the size of the external debt (F^*) of the country.

$$RP = a_0 F^* \quad (5c)$$

Note: a_0 is a positive coefficient parameter. Hence, the rise in the external debt will increase the risk premium.

3.4. External Debt and Exchange Rate Overshooting

One of the basic findings of the overshooting model of Dornbusch (1976) claims that under the presence of short-run price rigidity, a rise in monetary aggregates such as the money supply can easily lead to an overshooting of the nominal exchange rate in the short-run. This study extends the original model by looking at the possibility of the overshooting of the exchange rate in the short-run when the economy experiences a rise in its external debt position.

To address this pertinent question, we will derive both the short-run and long-run equilibrium conditions of the price and nominal exchange rate. From the money market

and asset market equations (3 - 5c), we can derive the following short-run nominal exchange rate equation.

$$e = \left(\frac{1}{lq} \right) [m - p - fy + l i^* + l q \bar{e} + l a_0 F^*] \quad (6)$$

Note in Equation 6, for the sake of simplicity we assume the money market equilibrium condition (Equation 4). This assumption does not change any theoretical findings in this section.

Substituting equation 2 to equation 1, and set $\dot{p} = 0$, the short-run equilibrium equation for the price of the goods market (Equation (7)) can easily be derived.

$$p = e + \frac{g}{b_0} - \frac{(1 - b_1)}{b_0} y \quad (7)$$

Next, the long-run equilibrium for the price and nominal exchange rate will also be set. In the long-run, the spot nominal exchange rate is expected to converge to the long-run nominal equilibrium rate ($e = \bar{e}$). Hence from the money market and asset market equations (3 – 5c), the long-run price level (\bar{p}) is:

$$\bar{p} = m - fy + l (i^* + a_0 F^*) \quad (8)$$

Note from Equation (7), we can also easily derive the long-run price equation from the goods market (Equation 9) by setting up ($y^d = y$) and ($e = \bar{e}$).

$$\bar{p} = \bar{e} + \frac{g}{b_0} - \frac{(1 - b_1)}{b_0} y \quad (9)$$

In the long-run, the price levels from both the goods market and the assets market are equal. Setting the price equations (#8 and #9) equal to each other, we can generate the long-run equilibrium nominal exchange rate (\bar{e}) in the market.

$$\bar{e} = m + l [i^* + a_0 F^*] + \left[\frac{1 - b_1}{b_0} - f \right] y - \frac{g}{b_0} \quad (10)$$

Now, we can examine the impact of a rise in the external/foreign debt position on the short- and long-run nominal exchange rate by going back to Equation 6 and taking the partial derivative with respect to F^* .

$$\frac{\partial e}{\partial F^*} = \frac{\partial \bar{e}}{\partial F^*} + \frac{a_0}{q} \quad (11)$$

From equation (10), we can also generate the impact of the changes in (F^*) on the long-run equilibrium exchange rate (\bar{e}) :

$$\frac{\partial \bar{e}}{\partial F^*} = -1 a_0 > 0. \quad (12)$$

Since we know that $\frac{a_0}{q} > 0$, therefore we can also confirm that a rise in F^* will

theoretically generate an overshooting of the nominal exchange rate in the short-run, i.e.

$$\left(\frac{\partial e}{\partial F^*} > \frac{\partial \bar{e}}{\partial F^*} \right) \quad (13)$$

We can graphically illustrate the overshooting impact of a rise in the external debt (Figure 5). By solving for the price level from the money and asset market equation (#6), the MS curve can easily be derived. It has a negative slope of $(-1/q)$. From the goods market equation (#7), we get the positively slope of IS curve.

Let us now assume that the local economy is at the initial equilibrium condition of point (A), where price level is at \bar{p} , and exchange rate is at \bar{e} . The rise in the external debt position will increase the risk premium (Equation 5c). Given the rigidity in price in the short-run, one percentage rise in (F^*) will depreciate the local currency at the

$\left(\frac{a_0}{q} \right)$ percentage rate (Equation 6). The MS curve shifts to MS(1). The economy arrives

at point (B) in the short-run, where the price is still at \bar{p} , but the exchange rate has

depreciated to $e(1)$. In the long-run, price will adjust and absorb some of the impact of the increase in the (F^*) , as indicated in (Equation 8). At the long-run equilibrium point (C), the level of price is at $\bar{p}(1)$ and the exchange rate appreciates from its short-run level of $e(1)$ and settles at $e(2)$. In summary, the rise in (F^*) causes the exchange rate to overshoot. From the figure, we could also conclude that the larger is the increase in (F^*) (shown by the size of the shift in the MS curve), the greater the magnitude of the overshooting $(e(1) - e(2))$.

4. Empirics

The main objective of this section is to empirically test the theoretical finding of the previous section on the four East Asian currencies, namely the rupiah, peso, baht and won for the period of the early 1990s to 2004. First we need to estimate the size of overshooting experienced by these currencies. To do so, we first need to construct the long-run nominal and real effective equilibrium exchange rates. Testing on the unit-root properties of the relevant series will then be conducted before we proceed to the autoregressive distributed lag regressions to test for the exchange rate overshooting implication of the external debts on the currencies of the four East Asian economies.

4.1. Long-Run Equilibrium Exchange Rate

The main relationship to be examined is the presence of any overshooting impact of the change in the external debt on the short-run nominal exchange rate $\left(\frac{\partial e}{\partial F^*}\right)$ relative to that of the long-run equilibrium nominal exchange rate $\left(\frac{\partial \bar{e}}{\partial F^*}\right)$ (as shown in Equation 13). There are two empirical issues that we face immediately here. The first

one is on the nominal exchange rate. Second, is on the long-run equilibrium exchange rate (\bar{e}). Given the lack of official data and the forward rate in most of these East Asian currencies during the most part of the observation period, we will have to first estimate (\bar{e}).

With regards to the former, given the fact that most currencies of the countries included have arguably been pegged to the US dollar, we will adopt the nominal effective exchange rate (NEER) index instead.² The nominal effective exchange rate is constructed as the trade weighted sum of the nominal exchange rate of the local currency against the top five trading partner countries.³ These top five trading partners make up more than 75 percent of total trade of the home country. The spot NEER is generated by the following equation.

$$NEER = \sum_{i=1} v_i NEX_i \quad (14)$$

where: $NEER$ is the domestic nominal effective exchange rate. v_i is the trade weight assigned to each bilateral nominal exchange rate of domestic currency against the trading partner (i) currency (NEX_i). The weight is trade-weighted, calculated as the percentage share ratio of the trade of each partner country (i) with the domestic economy. The rise in NEX and NEER implies a depreciation of the local currency.

Next, we need to generate the long-run nominal effective exchange rate. To do so, we will generate the Purchasing Power Parity rate of (\bar{e}), captured by the following equation.

$$\bar{e} = \sum_{i=1} v_i \left[\frac{p}{p_i} \right] \quad (15)$$

² Frankel and Wei (1994) and McKinnon (2000).

³ Each country has a different list of top trading partners. But the US and Japan are listed among the top five trading partners for all of these economies.

where: p is the price level of home country. p_i is the price of the trading partner country (i). The price level for the relevant countries is the consumer price index. A rise in (\bar{e}) implies depreciation in the long-run nominal effective exchange rate of the local currency. Note the figures for the spot NEER and the PPP rate are shown in Figures (6,7, 8 and 9).

In addition, apart from using the nominal effective exchange rate case, a number of studies have also examined the overshooting evidence using the real effective exchange rate (REER) (refer to Rogoff (2002) and Cavallo, et.al (2002)). Given the rigidity of the price level in the short-run, both the real and nominal exchange rate have to move in proportion in response to the initial change in the foreign/external debt. Hence, the general theoretical finding for the nominal exchange rate (Equations 11 and 13) is also applicable for the real exchange rate case (see Rogoff (2002)).

The spot REER of the local currency is the trade-weighted sum of the real exchange rate of the local currency against that of the top five trading partners' currencies (Equation 16).

$$REER = \sum_{i=1} \nu_i REX_i \quad (16)$$

where:

$$REX_i = NEX_i * \frac{P}{P_i} \quad (16a)$$

Note: REX_i (NEX_i) is the real (nominal) exchange rate of home currency against the currency of the trading partner country (i). A rise in REX_i (NEX_i) implies a depreciation of real (nominal) exchange rate of the local currency. ν is the trade weight as, likewise,

discussed in Equations (14 and 15). As in the case of the PPP nominal effective exchange rate, we employ the consumer price index for the price variables (P_i and P).

The long-run equilibrium ($REER$), on the other hand, will be estimated by adopting the NATREX approach (MacDonald and Stein (1999) and Stein and Paladino (1997 and 1999)). The model considers a set of economic fundamental variables that have been found to be theoretically determining the long-run fluctuation of the real effective exchange rate of a currency.⁴ Those variables are terms of trade (TOT), productivity ($PROD$), and real government spending ($RGOV$). Note, since we are looking at the period of quarter 1, 1990 to quarter 4, 2003 (except for Korea where we have data starting at an earlier period of quarter 1, 1985), a crisis dummy ($Cdummy$) variable is also included in the model. This variable takes a value of 0 before the major devaluation of the local currency in mid to early 1997, and a value of 1 for the post devaluation period. In short, the following estimation model is considered:

$$LnREER_t = a + b_0 LnTOT_t + b_1 LnRGOV_t + b_2 LnPROD_t + b_3 Cdummy_t + e_t \quad (17)$$

Note: Ln denotes the log-normal form.

We expect the estimated coefficients for the three key explanatory variables to be negative. An improvement in the terms of trade (TOT) will cause a capital inflow into the tradable sector, creating a real appreciation, thus $b_0 < 0$. Note the terms of trade variable is constructed as the ratio of the unit value of export over the unit value of import of the economy.

The roles of social consumption and regime change have also been found to be important fundamental determinants of the exchange rate (Stein and Paladino (1999)).

⁴ For further discussions on NATREX, refer to MacDonald and Stein (1999) and Stein and Paladino (1997 and 1999).

The social consumption is the sum of private and government expenditure. However, as also shown by Stein and Paladino (1999) for their three European countries (i.e. France, Germany and Italy), we find that the fluctuations in the government expenditures have contributed more to the overall changes in the social consumption. The GDP shares of the private consumptions of these four economies are found to be stationary series at its levels, while the GDP shares of the government expenditures are tested to be non-stationary at its levels.⁵ Hence to capture the impact of the social consumption behavior on the real exchange rate, we only consider the real government expenditure (*RGOV*). Furthermore the change in *RGOV* captures the changes in the fiscal policy regime of the country. An expansionary fiscal policy appreciates the real exchange rate in the short-run. However as the current account worsens, the real exchange rate will depreciate in the long run. In short, $(b_1 < 0)$ for the short-run case and $(b_1 > 0)$ for the long run.

An increase in productivity (*PROD*) is expected to improve the current account position and the improvement can be sustained even in the long run, i.e. $(b_2 < 0)$. Due to the lack of data to proxy the productivity rate, we employ GDP per capita series. The advantage of using untrended GDP per capita series, is that we are also able to capture the possible consequences of the output cycle on the movements of the real (effective) exchange rate (Mills and Pentecost, 2001; and Stockman, 1998).

To ensure that there is a potentially long-run relation (or cointegration relationship) among the variables in Equation 17. We test the commonly used ADF and the KPSS unit-root testing on all the relevant variables for each country case. The results show that all of these variables are integrated of order (1) at its levels.⁶ Based on

⁵ Based on the 5 percent critical value of the ADF and the KPSS unit-root testing.

⁶ The unit-root test results for the NATREX variables are not reported in the paper, but they can be made available upon request to the authors.

the cointegration results, we can confirm that there is one cointegration relationship for each of those currencies (Tables 1-5). Using the coefficient estimates for $(b'_0, b'_1, b'_2, \text{ and } b'_3)$, we then generate the NATREX long-run equilibrium real effective exchange rate.

$$\ln NATREX_t = \alpha + b'_0 \ln TOT_t + b'_1 \ln RGOV_t + b'_2 \ln PROD_t + b'_3 Cdummy \quad (18)$$

In general, the coefficient estimates are significant and have theoretically consistent signs, with the exception of the variable (*PROD*) for the case of rupiah and won, and for the variable (*TOT*) for the case of peso. Both the REER and the NATREX rates for the four currencies are posted in Figures (6c, 7c, 8c and 9c). These figures suggest that the four East Asian currencies were overvalued ($NATREX > REER$) a few years before the outbreak of the 1997 financial crises. The Thai baht was the most overvalued currency averaging around 11 percent per quarter between quarter 1, 1995 to quarter 1, 1997. The won, on the other hand, was only moderately overvalued at around 3 percent between quarter 1, 1996 to quarter 1, 1997. Based on the test results, the rupiah and the peso were also overvalued at a quarterly average of around 5-6 percent between quarter 1, 1995 to quarter 1, 1997.⁷

4.2. Overshooting Tests

Based on equation (11), we estimate the size of the real and nominal effective exchange rate overshooting by taking the difference between $(\Delta e_t - \Delta \bar{e}_t)$. where:

⁷ Due to the substantial depreciation of the rupiah at the third quarter of 1997, Figures 6a and 6c are not able to capture clearly the overvalued rupiah during the years of 1995 and 1996.

Δe_t and $\Delta \bar{e}_t$ are the quarterly percentage changes in the spot and the long-run equilibrium exchange rate of the local currency, respectively. $\Delta e_t - \Delta \bar{e}_t > 0$ is for the case of overshooting, whereas, reciprocally, $\Delta e_t - \Delta \bar{e}_t < 0$ is for the case of undershooting.

As elaborated previously in section two of the paper, two categories of external debts are included in the testing: (1) total external debt claims on the commercial banks in the local economy, and (2) total external debt securities issued by local institutions. Both series were gathered from the Bank for International Settlement (BIS) database.

The Auto Regressive Distributed Lag (ARDL) testing will be adopted here. We also apply the General to Specific approach of Henry (1976) to each of the ARDL testing, where only those explanatory variables with significant coefficient estimates will be included in the final regressions. To address the possible structural break due to the 1997 financial crises in East Asia, we introduce the crisis dummy ($Cdummy$) to the ARDL regression. The dummy equals to zero for the period before the outbreak of the financial crisis in 1997 and equals to one otherwise. The following ARDL overshooting regression is tested for both exchange rates (NEER and REER) and the two categories of external debts.

$$\Delta e_t - \Delta \bar{e}_t = b_0 + b_1(\Delta e_t - \Delta \bar{e}_t)_{t-1} + \sum_{i=0}^2 \gamma_i \Delta DebtSec_{t-i} + \sum_{i=0}^2 \rho_i \Delta TotBnkClm_{t-i} + m Cdummy_t + e_t \quad (19)$$

where: ($\Delta DebtSec$) and ($\Delta TotBnkClm$) are the percentage changes in the total GDP share of external debt securities and the total GDP share of total external debt claims on the commercial banks. γ and ρ are coefficient estimate parameters and they are both

theoretically expected to be positive, that is, a rise in the external debt will lead to an exchange rate overshooting. m is expected to be positive, as the incidence of overshooting should be more rampant during the crisis period. e_t is the error term. Note, we add $(\Delta e_t - \Delta \bar{e}_t)_{t-1}$ to capture the adjustment factor where the rate of overshooting (or undershooting) at $(t-1)$ may contribute to the incidence of overshooting (or undershooting) at period (t) . The coefficient parameter (b_1) can either be positive or negative.

The observation period for each country is dictated by the availability of the external debt data. At the most we have data from quarter 1, 1990 to quarter 4, 2003. To ensure an adequate degree of freedom, two quarters lag are considered for the ARDL test.⁸ Before we proceed to the actual ARDL testing, the unit-root properties of the relevant variables are to be examined first.

4.3 Unit Root Testing

It is well known that the data generating process for most macroeconomic time series are characterised by unit roots, which puts the use of standard econometric methods under question. Therefore, it is important to analyse the time series properties of the data in order to avoid spurious results. To ensure the robustness of the test results, two most commonly used unit-root tests are applied here, namely the Augmented Dickey-Fuller (ADF) and the KPSS unit root tests on the relevant variables $((\Delta e_t - \Delta \bar{e}_t), (\Delta DebSec)$ and $(\Delta TotBnkClm))$. As opposed to the ADF tests for which the test statistic is constructed under the null hypothesis that the series is non-stationary,

⁸ As also shown in Tables (2-5), in general we do not find the estimate coefficients of the explanatory variables at any higher lags (beyond two quarters) to be significant.

Kwiatkowski, et al., 1992 (KPSS) propose their test procedure in which the null hypothesis is stationary.

Both the ADF and the KPSS unit-root testing confirm that all of the relevant variables (the nominal and real effective exchange rate overshooting rates $(\Delta e_t - \Delta \bar{e}_t)$, and the changes in the external debts ($\Delta DebSec$) and ($\Delta TotBnkClm$)) are stationary series $I(0)$. For the sake of brevity, the test results are not reported in the paper.⁹

4.4 Analyses on Test Results

The ARDL test results are posted in Tables (2-5). Two main findings are worth highlighting. First, the coefficient estimates for the parameters (γ and r) are both reported to be positive and significant for all the testing conducted, except for the REER of the peso. Thus, this implies that the higher is the accumulation of the rate of external debts, the more severe is the overshooting of the NEER and the REER of the local currencies in these four countries. In short, the empirical results present conclusive evidences that the rapid accumulations in one or both groups of external debts prior to the outbreak of the 1997 financial crisis in these four economies have significantly contributed to the incidences of overshooting using both the NEER and the REER of the four local currencies.

Second, the test results also suggest that the overshooting of the Indonesian rupiah has been driven largely by the accumulations of the claims on banks. In contrast, the role of debt securities is more significant for the cases of peso, baht and won. These findings are arguably consistent with the stylized facts presented in Section 2.1 of the paper. The growth rates on the claims on bank for Indonesia were significantly higher

⁹ However they can be made available upon request to the authors.

than the rates for debt securities. The opposite trends occurred for the cases of the Philippines, Korea and Thailand, where the buildup rates of the debt securities were significantly higher than the rates for the claims on banks.

Few more detail analyses should also be discussed here. The two main findings are in general very robust. The test results for the NEER and REER are, in general, consistent with each other. The diagnostic statistics, including the R^2 statistics adjusted for degrees of freedom, the Durbin-Watson (DW), the F-statistics (and its probability), and the Engle's ARCH test for heteroscedasticity, are presented for each regression. The F-statistics indicate that the probability is at least 95 percent that one or more of the independent variables are non-zero. The Durbin-Watson statistics indicate that the serial correlations are not a problem in any of the regression results. In addition, the ARCH results conclude the absence of heteroscedasticity in general, with a possible exception in the case of the NEER of the baht. Finally, the R-squares range from around 60 percent for Indonesia to about 30 percent for the case of peso.

5. Brief Concluding Remarks

As a number of these East Asian economies shift to adopt inflation targeting as the main anchor of their monetary policy, the ability to manage the volatilities of the exchange rate will largely influence the capacity of the monetary authority in achieving its inflation target. Understanding factors influencing the fluctuations of the local currency is therefore imperative, especially given the more volatile foreign exchange markets in the region after the outbreak of the 1997 financial crisis.

Having generated the PPP and NATREX rates, our study has successfully reported the significant presence of exchange rate overshooting (and undershooting) of the four key East Asian currencies since the early 1990s, despite the lack of official data on the long-run equilibrium NEER and REER. The results have also shown that the

currency has unquestionably become more volatile, as demonstrated by the high frequency and persistence in the overshooting (and undershooting) of the East Asia regional currencies. Based on the frequencies of the overshooting (and undershooting) of the NEER and REER, the rupiah and peso were more severely affected than the baht and the won.

To provide more insights to the overshooting phenomena, our study examines the potential role of external debt in explaining the incidences of exchange rate overshooting of those four East Asian currencies. The empirical results have shown that the accumulation of external debts in these economies have indeed been partly responsible for the increasing incidence and severity of exchange rate overshooting of the local currency. What is even more important is that the empirics have also suggested that the role of external debts associated with the banking sector has been largely responsible for the exchange rate overshooting of the rupiah, arguably, the most severely crisis effected East Asian currency. In contrast, the role of debt securities has been found to be more significant in explaining the exchange rate overshooting of the peso, the won and the baht.

Despite the two contrasting results, we can confidently conclude that managing and reducing the high GDP share of the external debt should be placed among the foremost strategic objectives of the macroeconomic policy agenda of these countries. The ability to reduce the size of external debts, thus easing the exchange rate overshooting implication of the size of the debt on the local currency, will certainly create greater flexibility in the budgetary management of fiscal policy. And, while, at the same time, should improve the capacity of the monetary authority to manage the fluctuations of the domestic price level and meet its inflation target.

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Table 1: The Johansen Cointegration Test Results

Indonesia: REER-CPI

Eigenvalue	Likelihood Ratio	5% Critical Value
0.4794	77.02*	68.52
0.3414	43.72	47.21
0.2119	22.43	29.68
0.1347	10.27	15.41
0.0552	2.89	3.76

* There is 1 cointegrating equation at 5% Critical Value.

$$LnREER_t = -4.048 + 0.056LnPROD_t - 1.814LnTOT_t - 0.328LnRGOVT_t - 0.365Dummy$$

Std error: (0.1539)** (0.3605)** (0.1148)** (0.2018)*

** Significant at 5% and * Significant at 10%.
Sample Observations= 1990:1-2003:4; and Number of Lags = 4

The Philippines: REER-CPI

Eigenvalue	Likelihood Ratio	5% Critical Value
0.5598	78.88*	68.52
0.2624	37.86	47.21
0.2072	22.64	29.68
0.1639	11.04	15.41
0.0407	2.08	3.76

* There is 1 cointegrating equation at 5% Critical Value.

$$LnREER_t = 8.141 - 0.257LnPROD_t + 1.348LnTOT_t - 0.586LnRGOVT_t + 0.498Dummy$$

Std error: (0.0714)** (0.3351)** (0.1108)** (0.0367)**

** Significant at 5% and * Significant at 10%.
Sample Observations= 1990:1-2003:4; and Number of Lags = 1

Table 1: The Johansen Cointegration Test Results (cont'd)

Thailand: REER-CPI

Eigenvalue	Likelihood Ratio	5% Critical Value
0.5177	78.51*	68.52
0.4109	39.14	47.21
0.1095	10.55	29.68
0.0743	4.29	15.41
0.0022	0.12	3.76

* There is 1 cointegrating equation at 5% Critical Value.

$$LnREER_t = 4.014 - 0.647LnPROD_t - 0.875LnTOT_t + 1.733LnRGOVT_t + 0.174Dummy$$

Std error (0.2073)** (0.3878)** (0.5786)** (0.0885)**

** Significant at 5% and * Significant at 10%.
Sample Observations= 1990:1-2003:4; and Number of Lags = 1

Korea: REER-CPI

Eigenvalue	Likelihood Ratio	5% Critical Value
0.4897	87.49*	68.52
0.2067	39.72	47.21
0.1555	23.28	29.68
0.0864	11.29	15.41
0.0662	4.87	3.76

* There is 1 cointegrating equation at 5% Critical Value.

$$LnREER_t = -5.423 + 0.205LnPROD_t - 1.034LnTOT_t - 0.835LnRGOVT_t - 0.083Dummy$$

Std error: (0.0196)** (0.1411)** (0.1149)** (0.0386)**

** Significant at 5% and * Significant at 10%.
Sample Observations= 1985:1-2004:2; and Number of Lags = 6

Table 2: Test Results for *NEER* and *REER* of Rupiah

<u>Nominal Effective Exchange Rate (NEER)</u>	
$\Delta NEER_t - \Delta PPP_t = 0.187 \cdot \text{DebSec}_t + 0.622 \cdot \text{TotBnkCIm}_t$	
$(0.101)^* \qquad (0.105)^{**}$	
$R^2 = 0.67. \quad DW = 2.16. \quad \text{Prob}(F\text{-stat}) = 0.000. \quad \text{ARCH}(\text{Prob}) = 0.41$	
<u>Real Effective Exchange Rate (REER)</u>	
$\Delta REER_t - \Delta NATREX_t = 0.510(\Delta REER_t - \Delta NATREX_t)_{t-1} + 0.621 \cdot \text{TotBnkCIm}_t +$	
$- 0.554 \cdot \text{TotBnkCIm}_{t-1}$	
$(0.127)^{**} \qquad (0.094)^{**}$	
$(0.126)^{**}$	
$R^2 = 0.65. \quad DW = 2.16. \quad \text{Prob}(F\text{-stat}) = 0.000. \quad \text{ARCH}(\text{Prob}) = 0.25$	

* Significant at 10 percent. ** Significant at 5 percent. DW: Durbin-Watson.

Table 3: Test Results for *NEER* and *REER* of Peso

<u>Nominal Effective Exchange Rate (NEER)</u>	
$\Delta NEER_t - \Delta PPP_t = 0.036 \text{Cdummy}_t + 0.144 \cdot \text{DebtSec}_{t-1} +$	
$0.125 \cdot \text{DebtSec}_{t-2} + 0.191 \cdot \text{TotBnkCIm}_t - 0.034$	
$(0.018)^{**} \qquad (0.067)^{**}$	
$(0.059)^* \qquad (0.067)^{**}$	
$R^2 = 0.33. \quad DW = 2.185. \quad \text{Prob}(F\text{-Stat}) = 0.008. \quad \text{ARCH}(\text{Prob}) = 0.62$	
<u>Real Effective Exchange Rate (REER)</u>	
$\Delta REER_t - \Delta NATREX_t = 0.576(\Delta REER_t - \Delta NATREX_t)_{t-1}$	
$(0.119)^*$	
$R^2 = 0.332. \quad DW = 1.789. \quad \text{ARCH}(\text{Prob}) = 0.65$	

* Significant at 10 percent. ** Significant at 5 percent. DW: Durbin-Watson.

Table 4: Test Results for NEER and REER of Baht

<u>Nominal Effective Exchange Rate (NEER)</u>	
$\Delta NEER_t - \Delta PPP_t$	$= -0.054 + 0.411 \cdot DebtSec_t + 0.191 \cdot TotBnkCIm_t +$ (0.017)** (0.092)** (0.073)*
$0.050CrisisDummy_t$	 (0.020)**
$R^2 = 0.578. \quad DW = 1.950. \quad Prob(F-Stat) = 0.0000. \quad ARCH(Prob) = 0.08$	
<u>Real Effective Exchange Rate (REER)</u>	
$\Delta REER_t - \Delta NATREX_t$	$= -0.053 + 0.445 \cdot DebtSec_t + 0.131 \cdot DebtSec_{t-1} +$ (0.018)** (0.100)** (0.080)*
$0.179 \cdot TotBnkCIm_t + 0.050Cdummy_t$	 (0.077)** (0.022)**
$R^2 = 0.59. \quad DW = 2.14. \quad Prob(F-stat) = 0.000. \quad ARCH(Prob) = 0.14$	

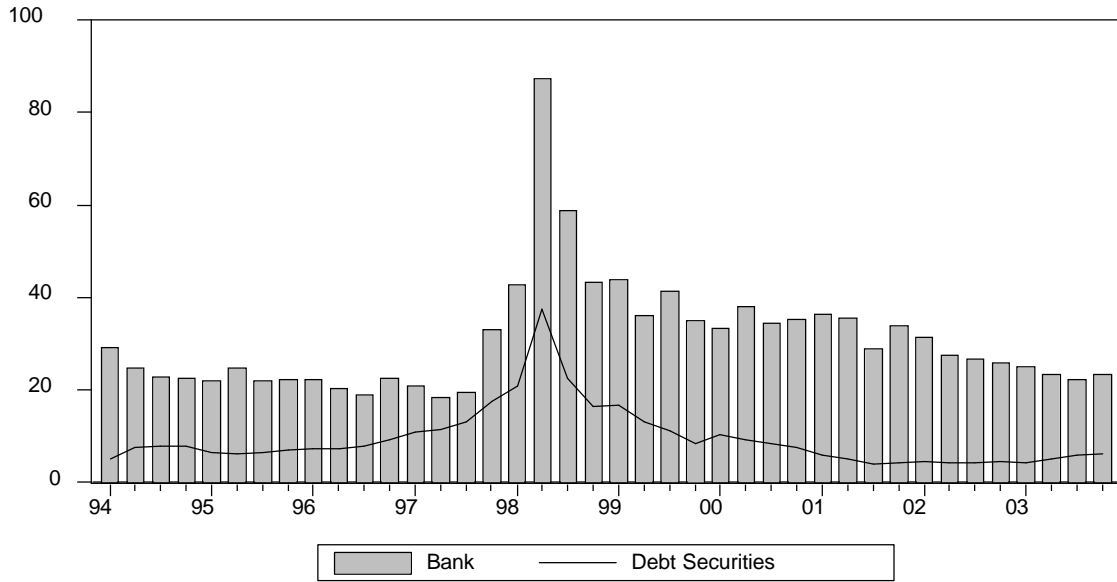
* Significant at 10 percent. ** Significant at 5 percent. DW: Durbin-Watson.

Table 5: Test Results for NEER and REER of Won

<u>Nominal Effective Exchange Rate (NEER)</u>	
$\Delta NEER_t - \Delta PPP_t$	$= 0.503 \cdot DebtSec_t$ (0.094)**
$R^2 = 0.40. \quad DW = 2.47. \quad ARCH(Prob) = 0.28$	
<u>Real Effective Exchange Rate (REER)</u>	
$\Delta REER_t - \Delta NATREX_t$	$= -0.064 + 0.239 \cdot DebtSec_{t-1} + 0.339 \cdot DebtSec_{t-2}$ (0.028)** (0.114)** (0.115)**
$+ 0.072CrisisDummy_t$	 (0.034)**
$R^2 = 0.24. \quad DW = 2.31. \quad Prob(F-stat) = 0.000. \quad ARCH(Prob) = 0.94$	

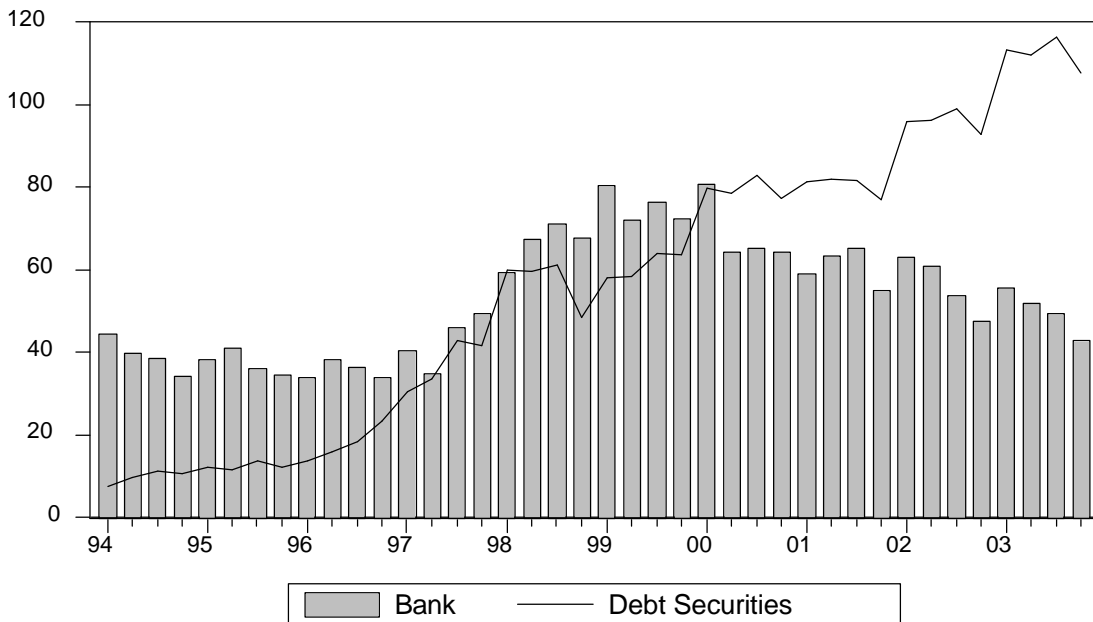
* Significant at 10 percent. ** Significant at 5 percent. DW: Durbin-Watson.

Figure 1: External Debts of Indonesia



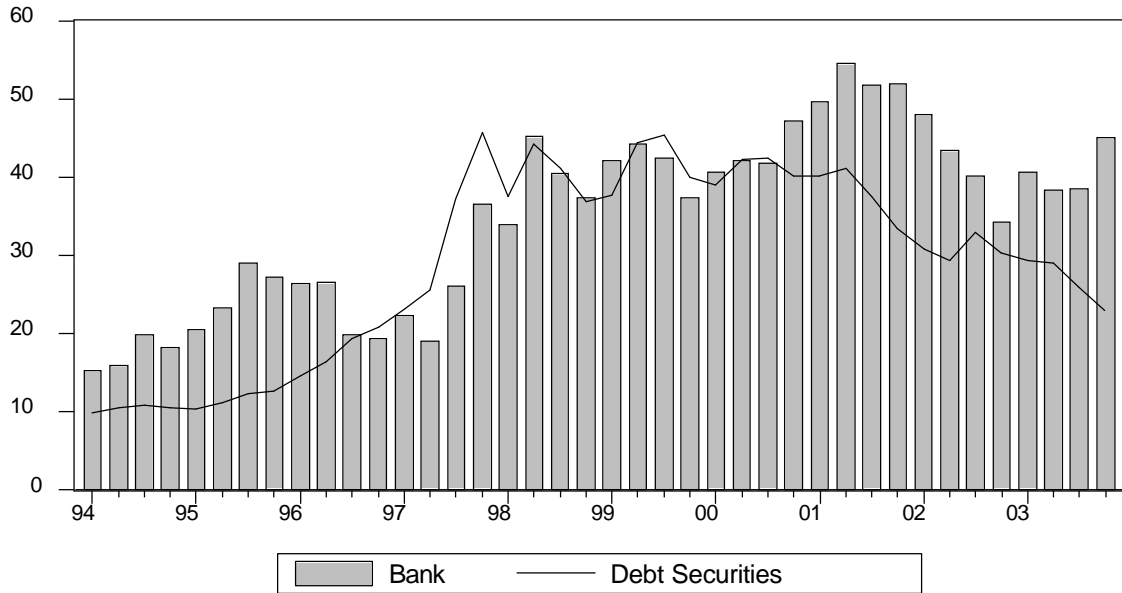
Bank: Total Claim on Bank over GDP (in %).
 Debt Securities: Total Debt Securities issued abroad over GDP (in %).
 Source: Bank for International Settlement

Figure 2: External Debts of The Philippines



Bank: Total Claim on Bank over GDP (in %).
 Debt Securities: Total Debt Securities issued abroad over GDP (in %).
 Source: Bank for International Settlement

Figure 3: External Debts of Thailand

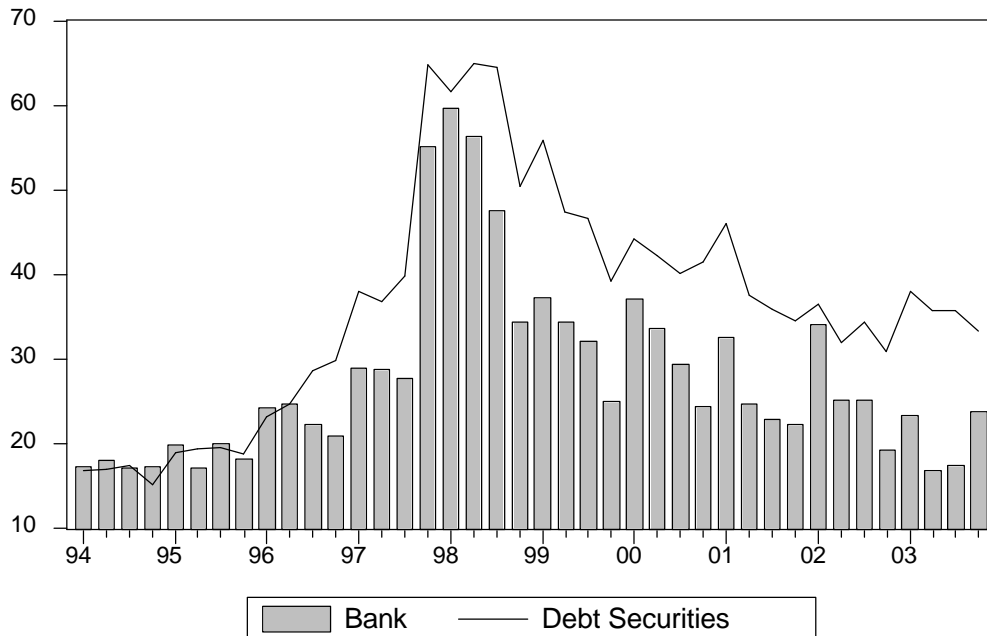


Bank: Total Claim on Bank over GDP (in %).

Debt Securities: Total Debt Securities issued abroad over GDP (in %).

Source: Bank for International Settlement

Figure 4: External Debts of Korea

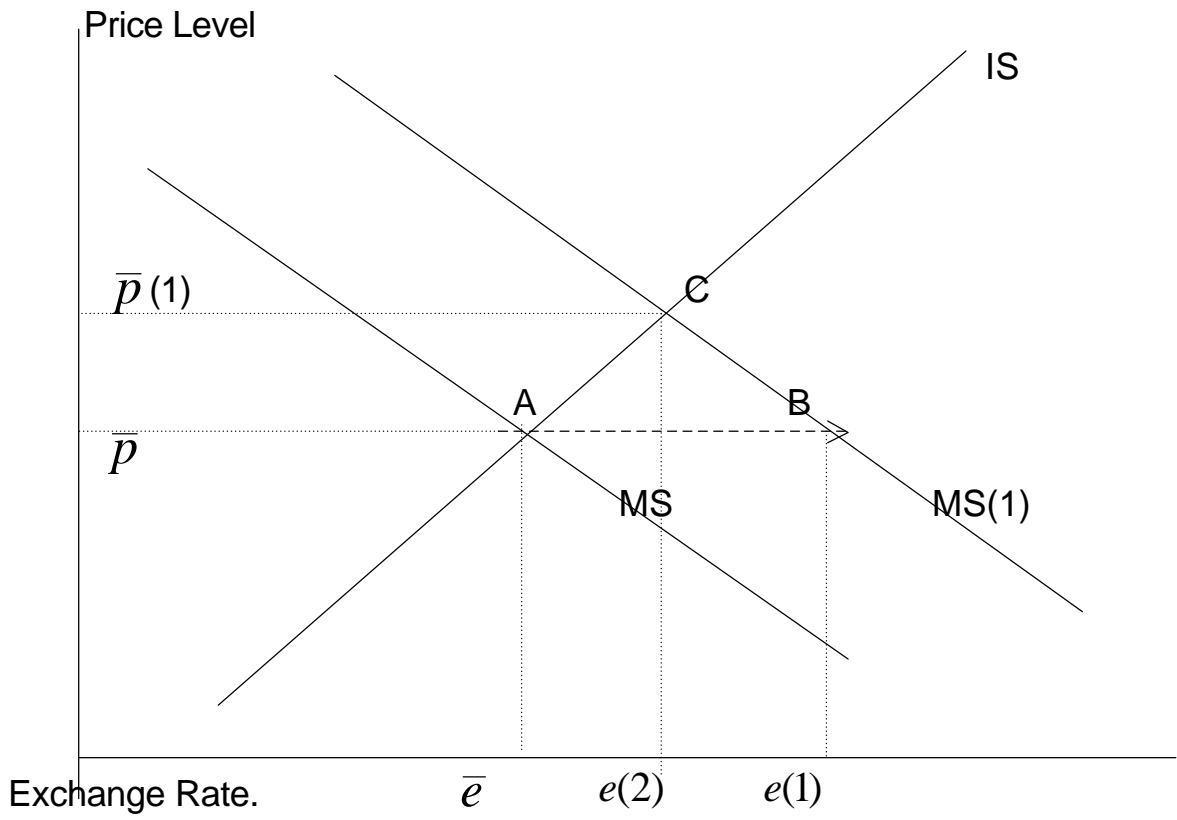


Bank: Total Claim on Bank over GDP (in %).

Debt Securities: Total Debt Securities issued abroad over GDP (in %).

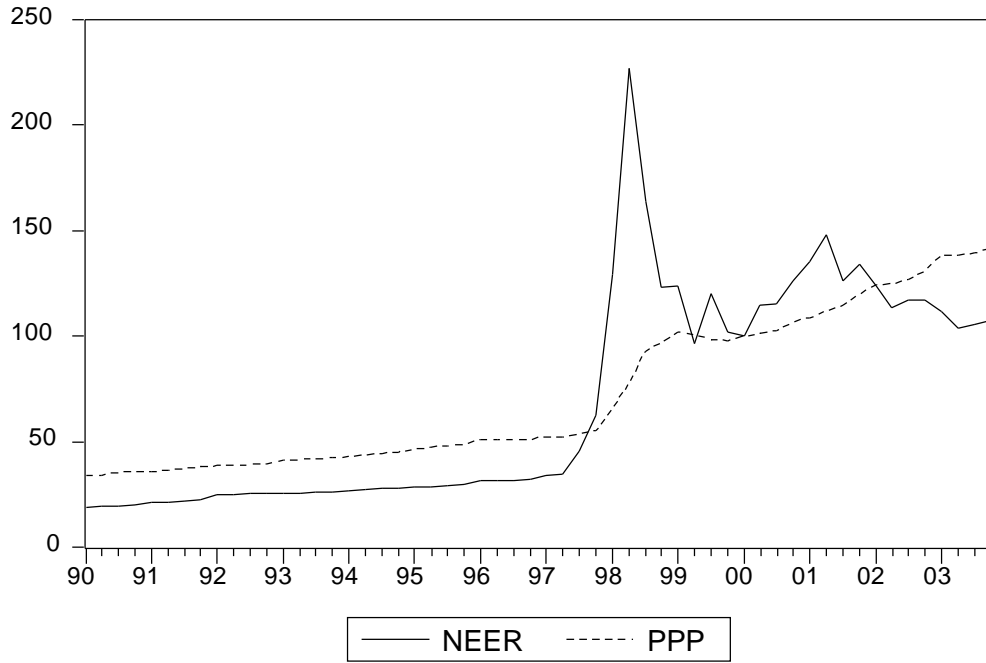
Source: Bank for International Settlement

Figure 5: External Debt and Overshooting



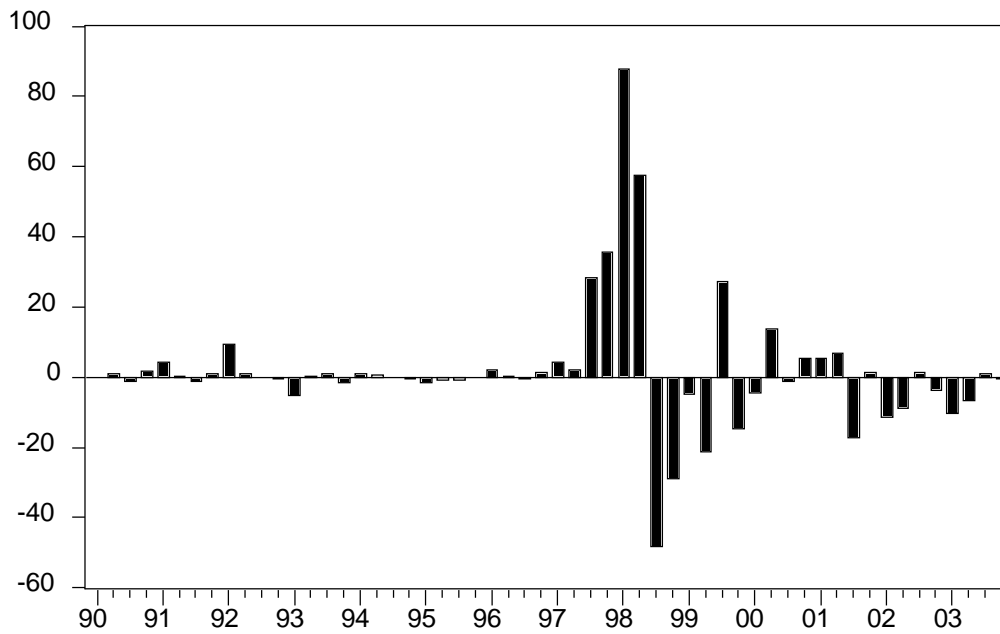
Note: A rise in (e) implies a depreciation of the local currency.

Figure 6: PPP Rates and NEER for Indonesia
(Quarter 1, 2000 = 100)



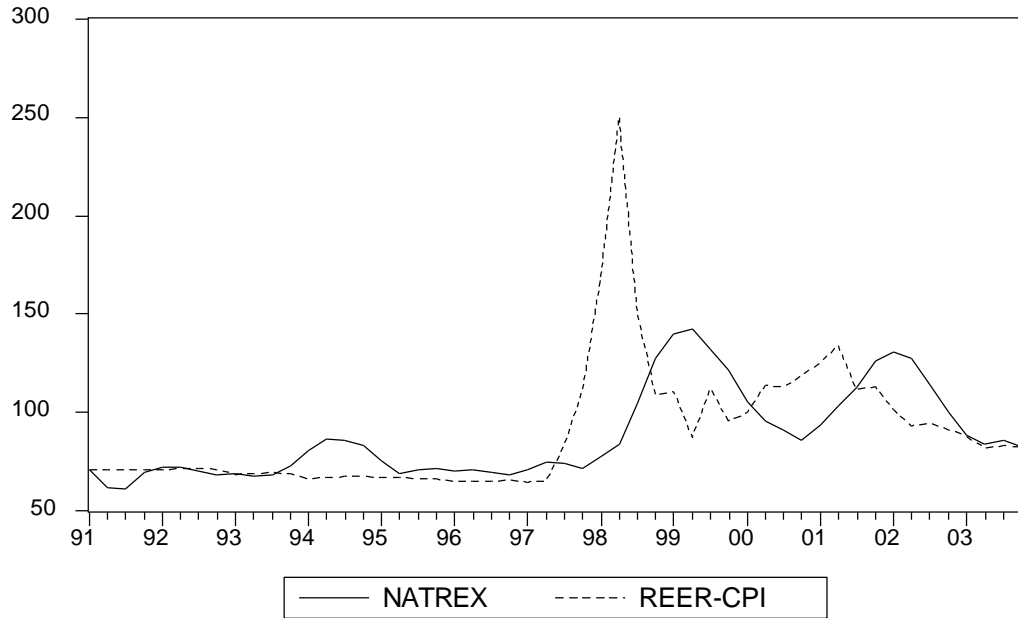
Source: Authors' own calculation

Figure 6b: Overshooting NEER for Indonesia
(in percentage)



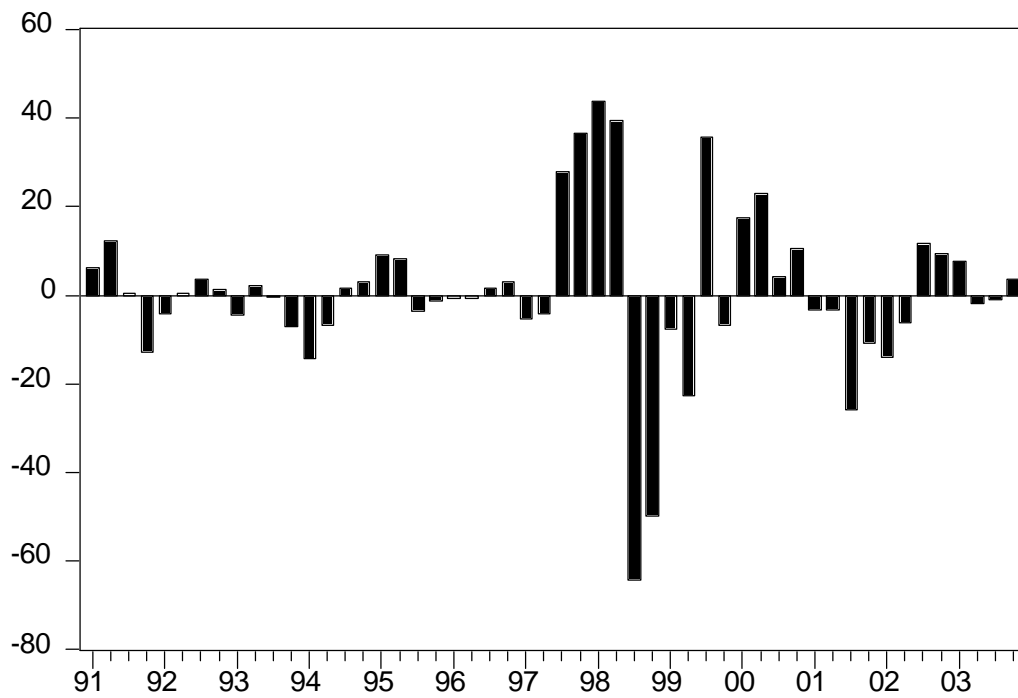
Source: Authors' own calculation

Figure 6c: REER (CPI) and NATREX for Indonesia
(Quarter 1, 2000 = 100)



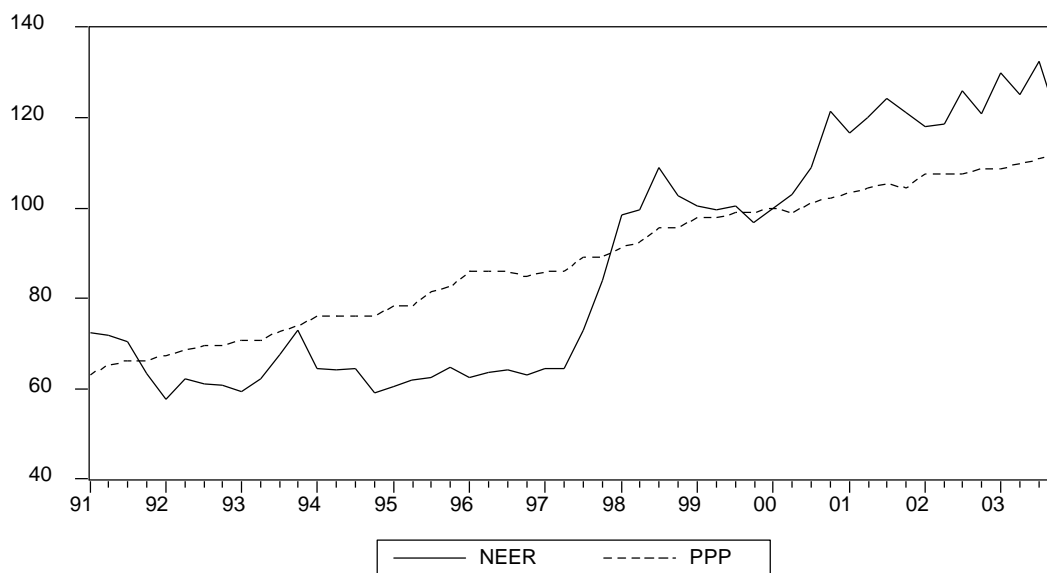
Source: Authors' own calculation

Figure 6d: Overshooting REER for Indonesia
(in percentage)



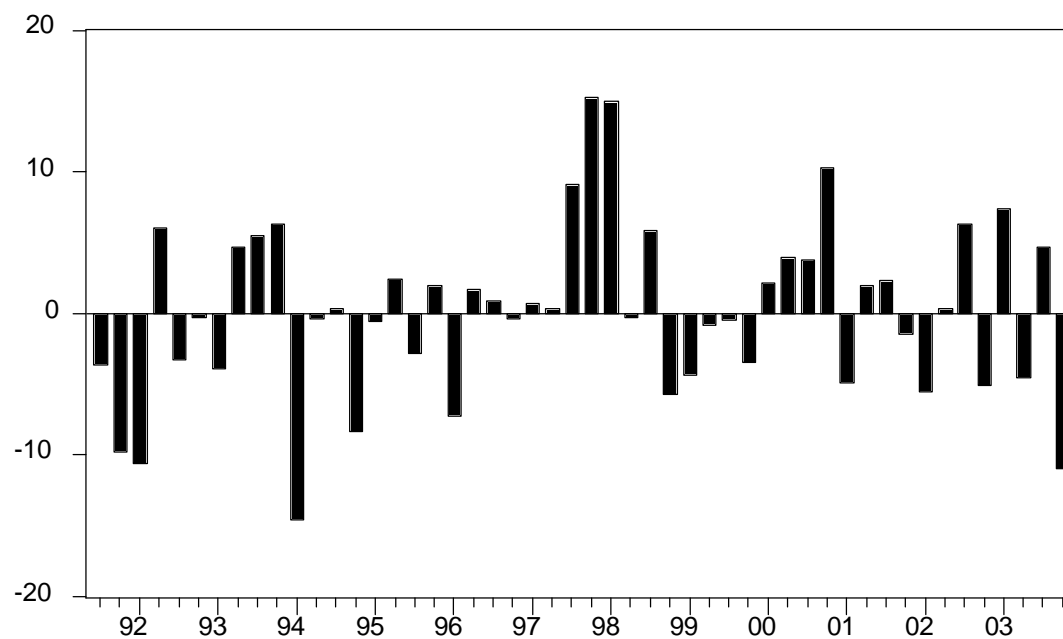
Source: Authors' own calculation

Figure 7: NEER of the Peso



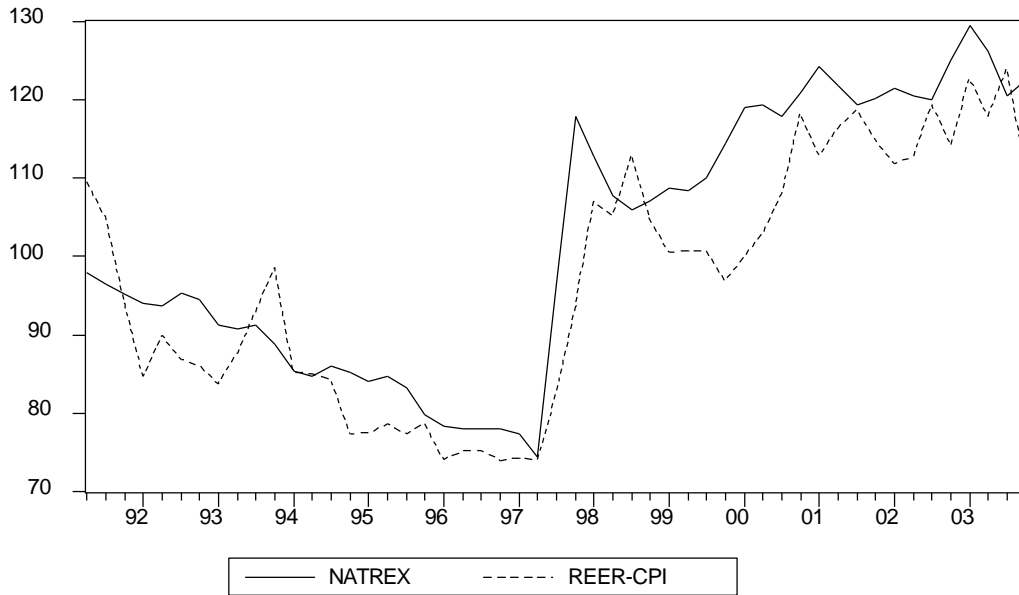
Source: Authors' own calculation

Figure 7b: Overshooting NEER for the Philippines
(in percentage)



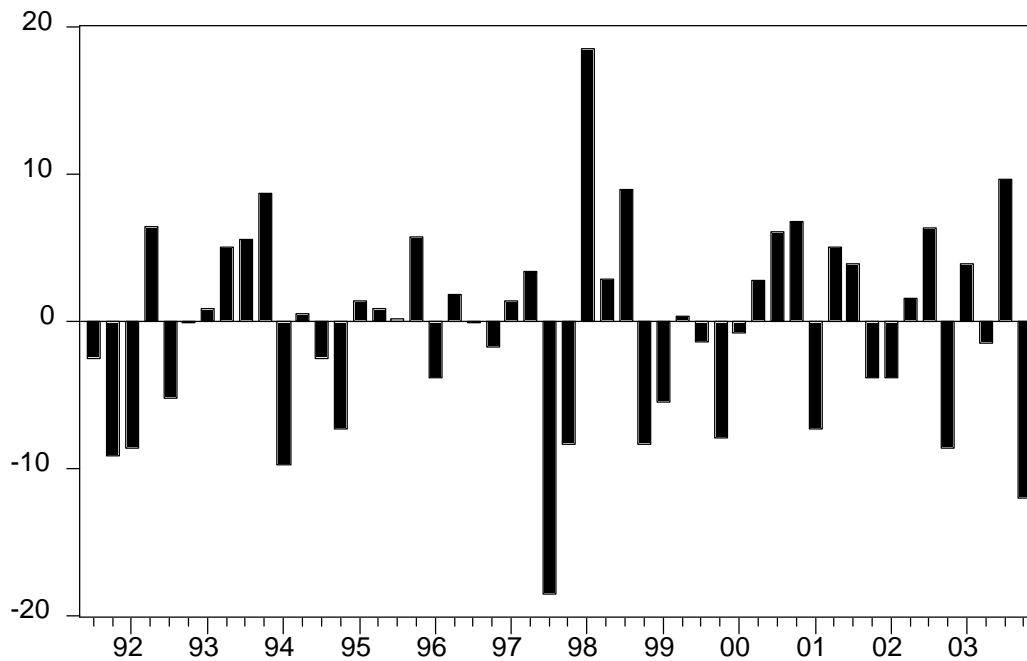
Source: Authors' own calculation

Figure 7c: REER (CPI) and NATREX for the Peso



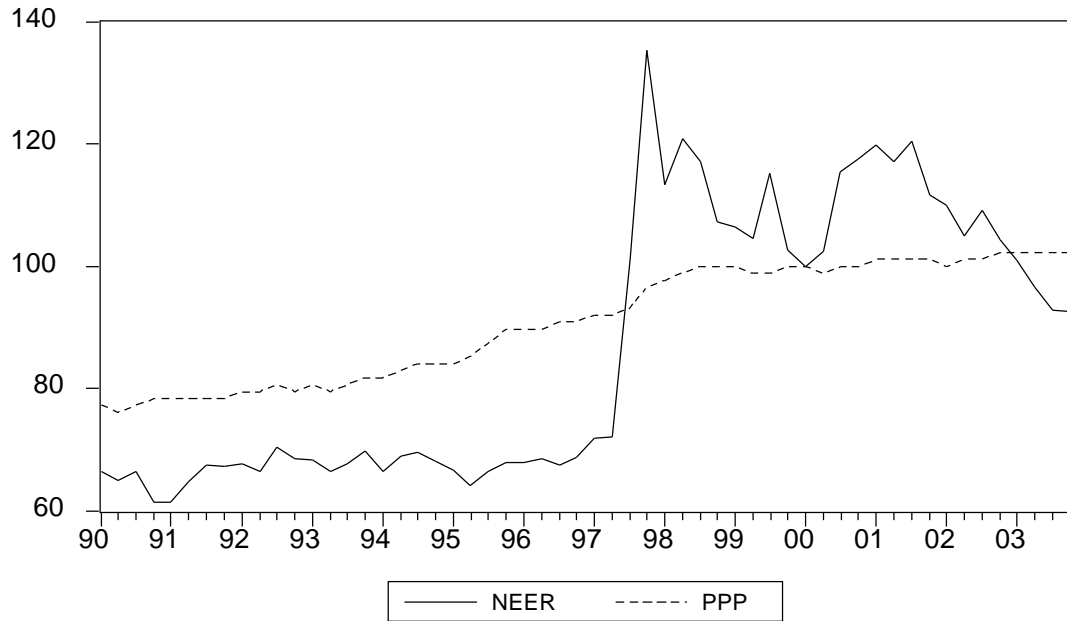
Source: Authors' own calculation

**Figure 7d: Overshooting REER (CPI) for the Philippines
(in percentage)**



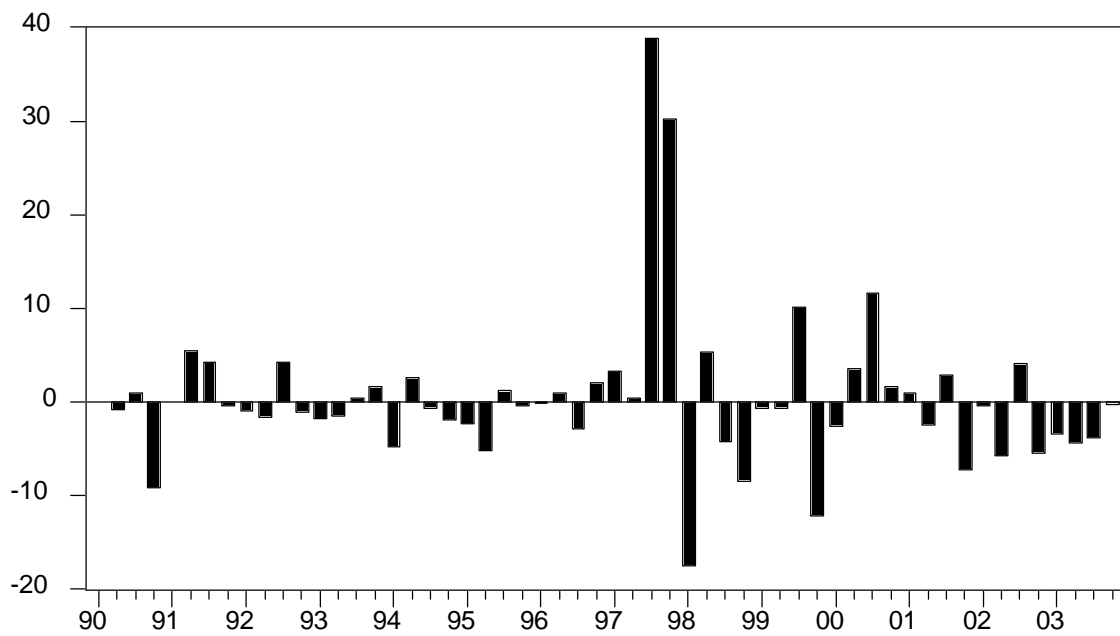
Source: Authors' own calculation

Figure 8: NEER of Thailand Baht
(Quarter 1, 2000 = 100)



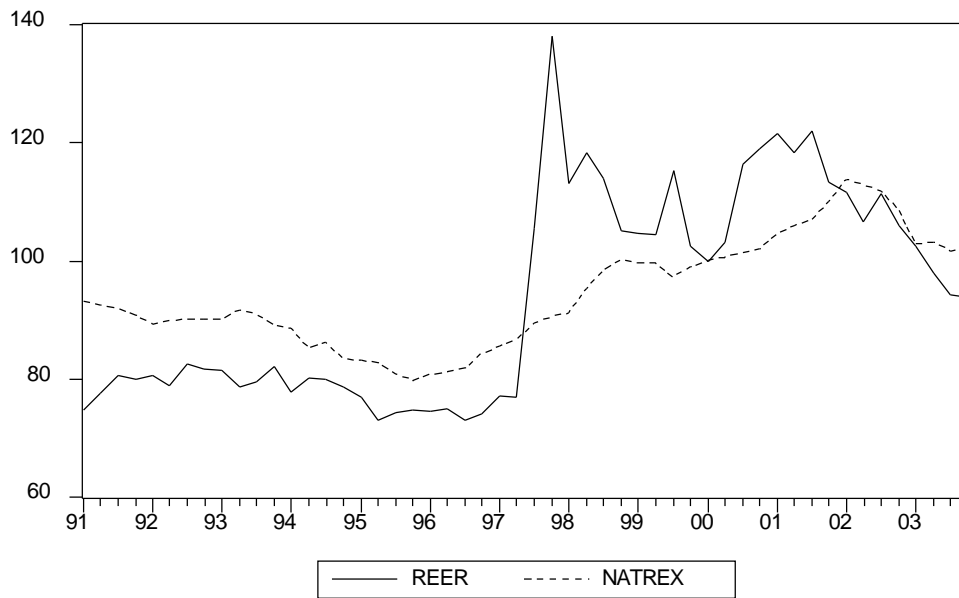
Source: Authors' own calculation

Figure 8b: Overshooting NEER for Thailand
(in percentage)



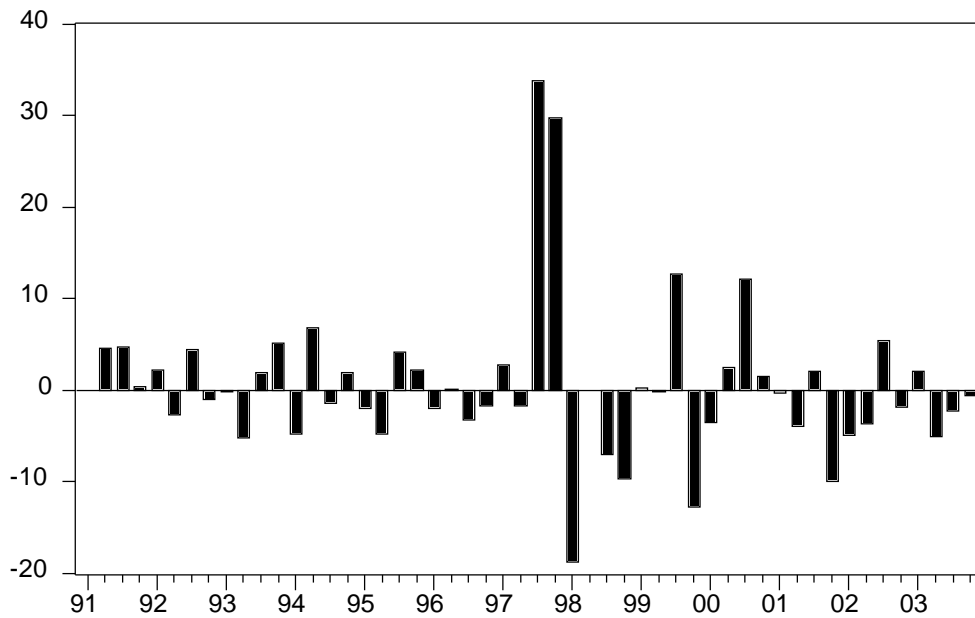
Source: Authors' own calculation

Figure 8c: REER (CPI) and NATREX of Thailand Baht



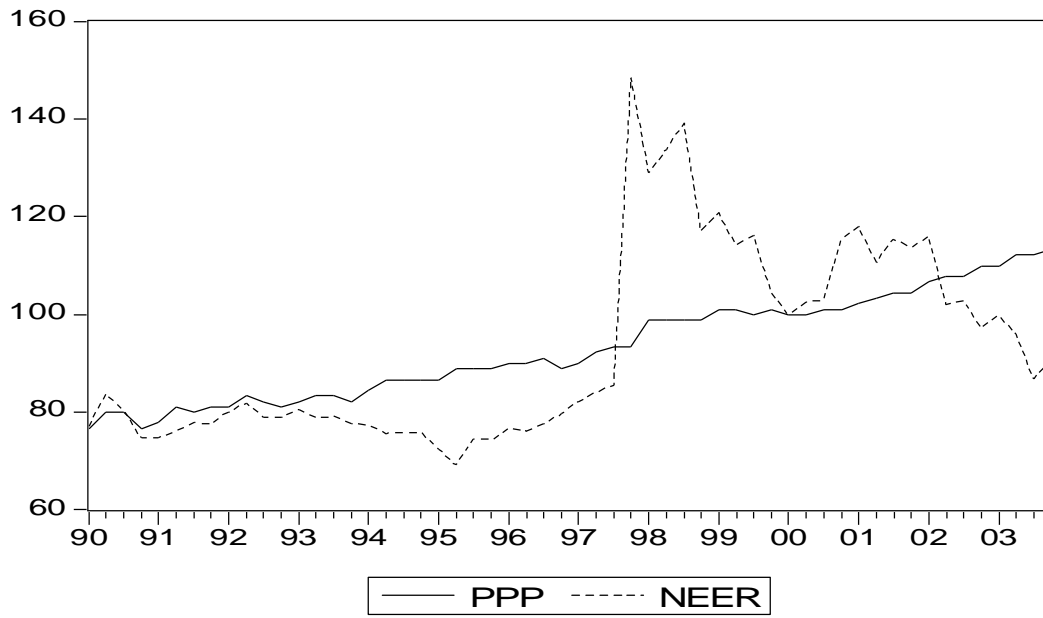
Source: Authors' own calculation

**Figure 8d: Overshooting REER for Thailand
(in percentage)**



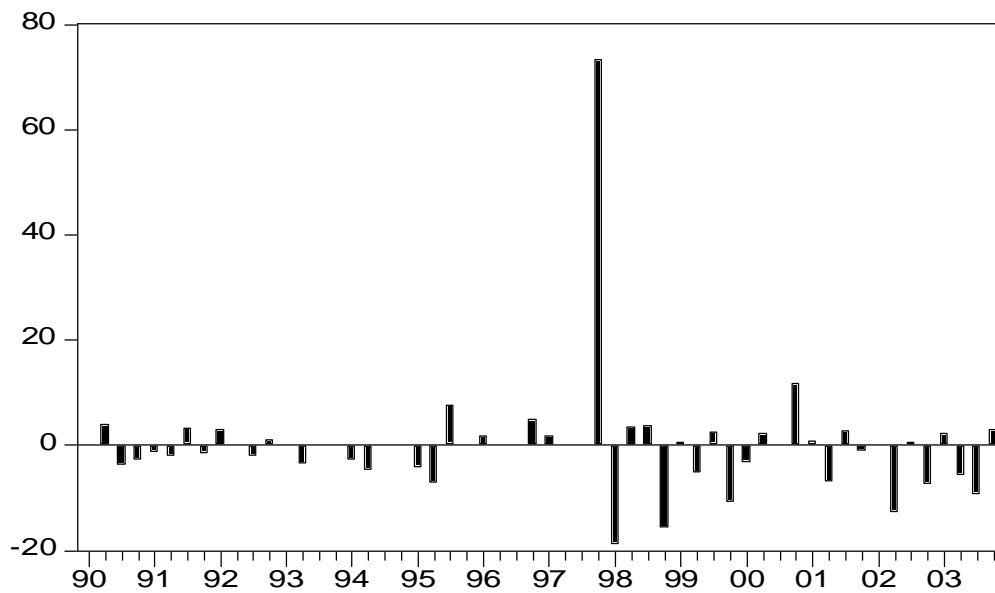
Source: Authors' own calculation

Figure 9: NEER of Korean Won



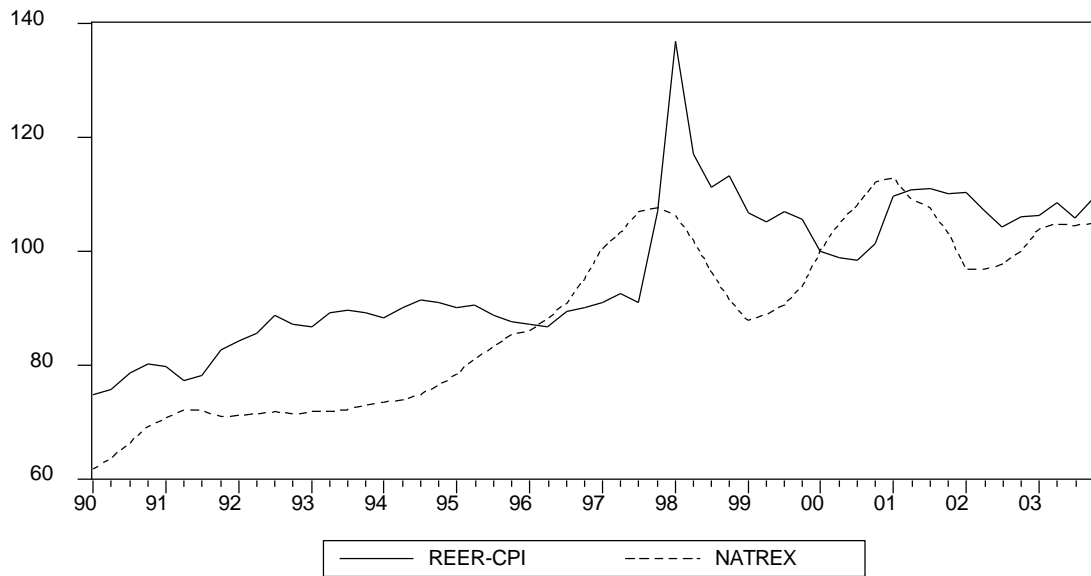
Source: Authors' own calculation

Figure 9b: Overshooting NEER of Korean Won
(in percentage)



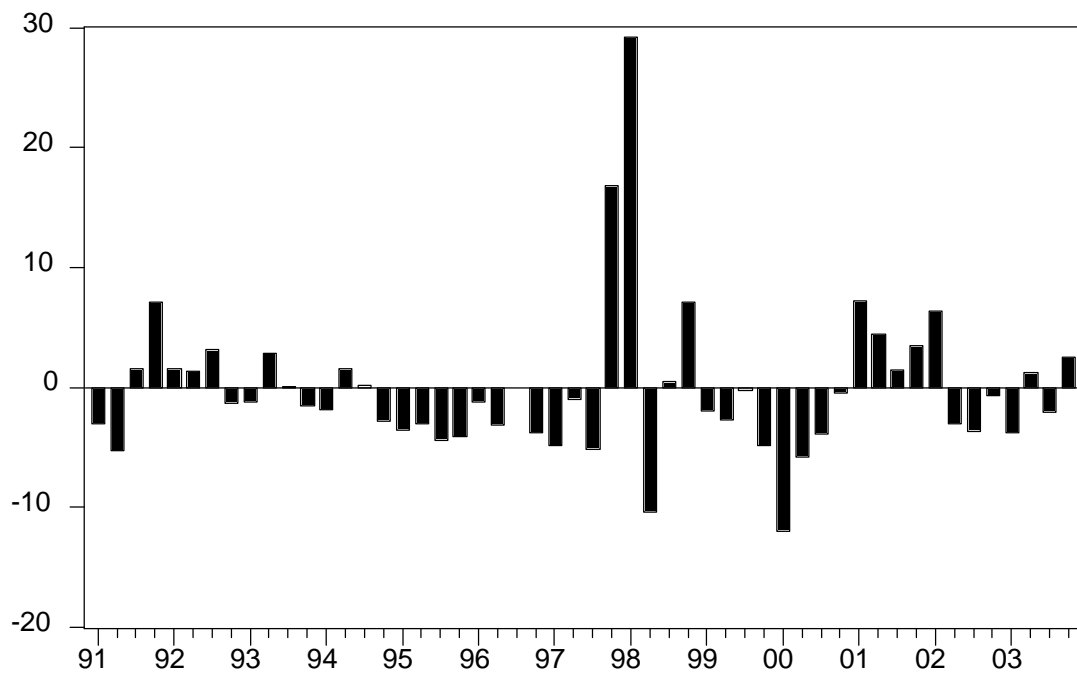
Source: Authors' own calculation

Figure 9c: REER (CPI) and NATREX of Korean Won



Source: Authors' own calculation

Figure 9d: Overshooting REER of Korean Won
(in percentage)



Source: Authors' own calculation