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「What is Learned from a Currency Crisis, Fear of Floating or Hollow Middle? : Identifying Exchange Rate Policy in Recent Crisis Countries」

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What is Learned from a Currency Crisis, Fear of Floating or Hollow Middle? Identifying Exchange Rate Policy in Recent Crisis Countries

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Abstract

This paper develops a new methodology to infer the de facto exchange rate regime, based on a structural VAR model with sign restrictions. The methodology is applied to data from eleven emerging markets that recently experienced a currency crisis. The main findings are: (1) to be consistent with the "Hollow Middle" hypothesis, many countries moved toward hard pegs, such as dollarization and a currency board, or more flexible exchange rate arrangements that are close to the free float in the post-crisis period; and (2) the cases where a country over-states its exchange rate flexibility (including the case of "Fear of Floating") are found in all samples, but such cases tend to be less frequently found in the post-crisis period than in the pre-crisis period.

Key Words: De Facto Exchange Rate Regime, structural VAR,
Fear of Floating, Hollow Middle, Currency Crisis
JEL Classifications: F33, E52, F31, C32

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1. Introduction

In recent years, many countries have experienced a currency crisis and economic turbulence, including Europe (1992), Mexico (1994-5), East Asia (1997), Russia (1998), and Argentina (2002). Most of these countries had highly managed exchange rate arrangements when the currency crisis occurred. As a result, there is the notion that the exchange rate arrangements adopted in each country are at least partly responsible for the currency crisis. Consequently, lively discussions on the choice of the exchange rate regime have followed.

Eichengreen (1994) suggests that highly managed exchange rate arrangements are vulnerable to international capital flows. Thus, intermediate regimes, including a soft peg, would disappear in a world with integrated capital markets. The only viable choices would be two extreme exchange rate arrangements: free float and "hard peg."[1] This view is known as the "Hollow Middle" hypothesis (Eichengreen, 1994) or the "bipolar view" (Fisher, 2001).[2]

Recent European monetary unification confirms the bi-polar view since a currency union can be regarded as a polar regime. However, experience of emerging markets is more diversified, and it does not uniformly support this bi-polar view. Although changes toward polar regimes are seemingly observed based on what each country officially states or the country's de jure classification of the exchange rate regime (for example, see Fischer, 2001), each country's official statement may be different than what the country actually does. Calvo and Reinhart (2002) find that by inferring the exchange rate policies in each country from the actual data on the exchange rate and policy instruments (that is, de facto arrangements), most countries that say they allow their exchange rate to float do not. Calvo and Reinhart (2002) conclude that there appears to be a

[1] "Hard peg" includes currency boards, dollarization, and a currency union.
[2] See also Obstfeld and Rogoff (1995) and Krueger (2000) for this view.

widespread case of "Fear of Floating."[3] This possible discrepancy between de jure and de facto exchange rate arrangements has been well represented in recent debates. For example, Mussa et al. (2000) and McKinnon (2000) argue that a few years after the Asian currency crisis, the Asian crisis countries reverted back to highly managed exchange rate arrangements (although they claimed use of a free float) and these countries raised concerns of possible repetition of the crisis.

This paper contributes to the literature on the transition of exchange rate arrangements and de facto exchange rate arrangements in two aspects. First, this paper develops a de facto measure of exchange rate arrangements by using a structural VAR (Vector Auto-Regression) model, which resolves some problems with previous methods. Second, this method is applied to eleven countries that recently experienced a currency crisis (including five Asian crisis countries), in order to shed some light on various issues concerning de facto exchange rate arrangements and the transition of exchange rate arrangements. Based on the empirical evidence, this paper infers what these countries learned about exchange rate arrangements after the experience of a severe currency crisis. Specifically, did these crisis countries move to polar regimes that were less vulnerable in integrated capital markets? Were these countries reluctant to publicly announce their highly managed exchange rate arrangements?

Following Calvo and Reinhart (2002), a number of recent studies construct de facto exchange rate regime classifications (e.g., Levy-Yeyati and Sturzenegger (2005), Reinhart and Rogoff (2002), Ghosh, Gulde, and Wolf (2003), Bubula and Ötker-Robe (2002), Hernandez and Montiel (2003), and Baig (2001)). Many previous studies, including Calvo and Reinhart (2002), often classified regimes by comparing the *unconditional* volatility of the exchange rate (changes)

[3] Levy-Yeyati and Sturzenegger (2005) also confirms "Fear of Floating" by classifying de facto exchange rate regime of each country based on the data.

and policy instruments (changes) such as foreign exchange reserves (changes) and the interest rate (changes), based on the following idea: in highly managed exchange rate arrangements, the policy authority actively stabilizes exchange rate movements by adjusting policy instruments, so that the volatility of the exchange rate would be small but the volatility of policy instruments would be large.[4]

However, such classification methods based on the *unconditional* volatility have a drawback. The policy instruments may change in the absence of the policy authority's intention to stabilize the exchange rate. For example, the interest rate may change in support of other policy objectives (i.e., stimulating output) rather than for just the purpose of stabilizing the exchange rate. Foreign exchange reserves, for instance, may change due to fluctuations in valuation, interest accrual, and passive interventions, in order to fulfill government transactions or orders. Although past studies have not excluded such changes by using *unconditional* data, these changes in policy instruments (and the resulting changes in the exchange rate) are not relevant to exchange rate stabilization and should be excluded when inferring de facto exchange rate arrangements. The problem arises from using *unconditional* data that comprises both the movements originating from shocks to the exchange rate that policy instruments react to and the movements originating from shocks to the instruments that affect the exchange rate, although only the former contains the relevant information.

To separate the two types of shocks and provide the statistics *conditional* on the exchange

[4] Calvo and Reinhart (2002) characterized various countries based on three variables (the exchange rate, reserves, and the interest rate) without providing an exact classification of countries. On the other hand, Chosh, Gulde, and Wolf (2003) and Reinhart and Rogoff (2002) provide an exact classification but the inference is based on the exchange rate only. Levy-Yeyati and Sturzenegger (2005) provide an exact classification based on two variables (the exchange rate and reserves). The current paper provides the estimated reaction function and some probability measures to infer the exchange rate policy based on three variables (the exchange rate, reserves, and the interest rate) and provide a classification.

rate shocks, this study constructs structural VAR models with sign restrictions on impulse responses by modifying Uhlig's (2005) methodology. Based on the estimated impulse responses to the former shocks, dynamic policy reaction functions are formally derived, instead of simple descriptive statistics as has been used in some past studies. Then, the sizes of the reactions of each country are compared to those of the benchmark cases by applying a Bayesian procedure, in order to infer de facto exchange rate arrangements.

The empirical results suggest that (1) the cases where a country over-states its exchange rate flexibility (including the case of "Fear of Floating") are often found, but such cases tend to be less frequently found in the post-crisis period than in the pre-crisis period (2) based on de facto classification after correcting for such cases, most countries adopted intermediate regimes in the pre-crisis period but the majority of countries adopted hard peg or free float exchange rate arrangements in the post-crisis period, supporting the "Hollow Middle" hypothesis.

The rest of the paper is organized as follows. Section 2 explains the methodology developed in this paper. Section 3 analyzes exchange rate arrangements and discusses various issues on exchange rate arrangements, based on the empirical results. Section 4 concludes with a summary of findings.

2. The Methodology

Since the model is applied to short time-span data, the most parsimonious VAR model, which includes only two variables (the exchange rate changes and changes in policy instrument), is considered. For policy instruments, we consider two types of variables, foreign exchange reserves changes and interest rate changes.

As is usual in structural VAR analysis, the structural representation is identified by imposing some restrictions on the estimated reduced form. The reduced form VAR equations for the model with foreign exchange reserves changes are:

$$(1)\quad \begin{bmatrix} \Delta E_t \\ \Delta FR_t \end{bmatrix} = \begin{bmatrix} A_{11}(L) & A_{12}(L) \\ A_{21}(L) & A_{22}(L) \end{bmatrix} \begin{bmatrix} \Delta E_{t-1} \\ \Delta FR_{t-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_{E,t} \\ \varepsilon_{FR,t} \end{bmatrix}$$

where E is the log of the exchange rate, ΔFR is the ratio of the changes in foreign exchange reserves to monetary base of the previous period, $A(L)$s are polynomials in the lag operator L, ε_E and ε_{FR} are the residuals in each equation, which is assumed to be Gaussian random variables, ε is a two by one vector of residuals, $\varepsilon = (\varepsilon_E \quad \varepsilon_{FR})'$, and var($\varepsilon$)=$\Sigma$. For simplicity of exposition, the constant term is dropped in equation (1). This study uses the log-difference or the difference of each variable (instead of log-level or level) for the following reasons. First, most past studies, such as the studies of Calvo and Reinhart (2002), Levy-Yeyati and Sturzenegger (2005), Hernandez and Montiel (2003), Baig (2001), and Reinhart and Rogoff (2003), have used the percentage changes (or difference) instead of log-level, or level. This helps make the results of this study comparable to past studies. Second, in most countries, the hypothesis of a unit root in the log of the exchange rate and the hypothesis of a unit root in the ratio of foreign exchange reserve to monetary base are not rejected at the conventional significance level based on conventional unit root tests like the ADF and PP tests. Third, there are some cases of continuously falling or rising exchange rates such as a crawling peg regime. In such cases, the log-difference of the exchange rate may be more appropriate than the log-level.

On the other hand, although some studies, such as Calvo and Reinhart's (2002), used percentage changes in foreign exchange reserves, this study uses the changes in foreign exchange reserves as a percentage of the monetary base in the previous period, as the study of Levy-Yeyati and Sturzenegger (2005), for the following reason. The level of foreign exchange reserves may change over time and with countries. For example, Asian countries that experienced a crisis accumulated a substantial amount of foreign exchange reserves after the crisis. The accumulation of foreign exchange reserves occurred much faster than the development in the countries' general economic activities or monetary environment. In that case, a 1% change in foreign exchange reserves may have smaller effects on the exchange rate in the pre-crisis period than in the post-crisis period. To correct this problem, the responses of reserve changes are calculated as a percent of the monetary base of the previous period, since the size of a monetary base may be a reasonable proxy for development in a monetary environment.

In the model, sign restrictions are imposed in order to identify two orthogonal structural shocks: the structural shocks to the exchange rate that foreign exchange reserves react to stabilize the exchange rate, and the structural shocks to foreign exchange reserves that affect the exchange rate.[5] First, a positive shock to foreign exchange reserves would lead to exchange rate depreciation (or an increase in the exchange rate); buying foreign currency, selling domestic currency, and building up foreign exchange reserves would lead to a weaker currency value, i.e., exchange rate

[5] Popular identification methods that impose zero restrictions on the contemporaneous structural parameters, (developed by Sims (1980, 1986), Bernanke (1986), and Blanchard and Watson (1986)) and that impose zero restrictions on the long run effects (developed by Blanchard and Quah (1989)) are difficult to apply in this case. Both structural shocks are likely to affect both variables contemporaneously, so that imposing zero restrictions on contemporaneous parameters is not feasible. In addition, an imposition of any long run zero restrictions does not seem to be firmly supported by theories. On the other hand, in the large-scale model that is estimated over a long sample period, the two types of shocks can be separated with short-run zero restrictions by using other variables as instruments. For example, see Kim (2003, 2005).

depreciation. Second, a positive shock to the exchange rate (or exchange rate depreciation) would lead to a decrease in foreign exchange reserves when the policy authority stabilizes the exchange rate. This is because a decrease in foreign exchange reserves would make the exchange rate appreciate to offset the initial depreciation. That is, shocks to foreign exchange reserves move the exchange rate and foreign exchange reserves in the same direction, while shocks to the exchange rate move the two variables in opposite directions. This study imposes such restrictions only on the impact responses as it is more difficult to justify the signs of the lagged responses.[6] To implement such identification, this study modifies the method developed by Uhlig (2005).[7] See the Appendix for details.

The structural form equations in VMA (Vector Moving Average) form are:

$$(2)\quad \begin{bmatrix} \Delta E_t \\ \Delta FR_t \end{bmatrix} = \begin{bmatrix} C_{11}(L) & C_{12}(L) \\ C_{21}(L) & C_{22}(L) \end{bmatrix} \begin{bmatrix} e_{E,t} \\ e_{FR,t} \end{bmatrix},$$

where $C(L)$s are polynomials in the lag operator L, e_E and e_{FR} are the structural shock to the exchange rate and the structural shocks to foreign exchange reserves, respectively, e is a two by one vector of structural shocks, $e = (e_E \;\; e_{FR})'$, var(e)=Ω, and Ω is a diagonal matrix. The sign restrictions imposed on this model are $C11\ (0) \geq 0$, $C12\ (0) \geq 0$, $C21\ (0) \leq 0$, and $C22\ (0) \geq 0$.

To infer the degree of exchange rate stabilization, the dynamic policy reaction function is calculated. This function shows the reaction of the foreign exchange reserves to the exchange rate

[6] For example, a positive foreign exchange reserve shock would depreciate the exchange rate on impact, but the foreign exchange reserve might decrease in the next period if the policy authority tries to offset the initial exchange rate depreciation.

[7] Refer to Canova and Nicolo (2002) for similar types of sign restrictions.

over time in the presence of shocks to the exchange rate. From equation (2), the impulse responses of the exchange rate and foreign exchange reserves to the shocks to the exchange rate are:

(3) $\Delta E_t(e_E) \equiv C_{11}(L)e_{E,t}$,

(4) $\Delta FR_t(e_E) \equiv C_{21}(L)e_{E,t}$.

That is, $\Delta E_t(e_E)$ and $\Delta FR_t(e_E)$ are the exchange rate and foreign exchange reserve changes in the presence of shocks to the exchange rate only. By combining (3) and (4),

(5) $\Delta FR_t(e_E) = \dfrac{C_{21}(L)}{C_{11}(L)} \Delta E_t(e_E)$.

The coefficients on $\Delta E_t(e_E)$, $\Delta E_{t-1}(e_E)$, $\Delta E_{t-2}(e_E)$,… in equation (5) show how much the percentages of the foreign exchange reserves change over time in reaction to a 1% depreciation of the exchange rate in the presence of the shocks to the exchange rate.

In the above, the dynamic policy reaction function is constructed by exploiting the impulse responses to the exchange rate shocks. This procedure is essentially equivalent to recovering the policy reaction function after controlling the simultaneity between policy instruments and the exchange rate. In this sense, past studies that used *unconditional* data can be viewed as follows. Past studies have used information from both the policy reaction function (the policy authority's reaction of policy instruments to the exchange rate, in order to stabilize the exchange rate) and the foreign exchange market equation (that shows how policy instruments affect the exchange rate), although

only the former contains the relevant information.[8]

To infer the interest rate reactions to the exchange rate, a two-variable model is constructed, which includes the log of exchange rate changes and the interest rate changes. For the interest rate, a difference form is used following past studies, although mixed evidence is found on the hypothesis of a unit root in the interest rate. In this model, the restriction is imposed such that a positive shock to the interest rate decreases the exchange rate (since an increase in the interest rate makes the domestic currency asset more attractive) while a positive shock to the exchange rate increases the interest rate (since the policy authority tries to stabilize the exchange rate by increasing the interest rate). That is, in structural VMA form,

$$(6)\quad \begin{bmatrix} \Delta E_t \\ \Delta R_t \end{bmatrix} = \begin{bmatrix} C_{11}(L) & C_{12}(L) \\ C_{21}(L) & C_{22}(L) \end{bmatrix} \begin{bmatrix} e_{E,t} \\ e_{R,t} \end{bmatrix},$$

where R is the interest rate, e_E and e_R are the structural shock to the exchange rate and the structural shocks to interest rate, respectively, and the sign restrictions imposed on this model are $C11\ (0) \geq 0$, $C12\ (0) \leq 0$, $C21\ (0) \geq 0$, and $C22\ (0) \geq 0$.

3. Exchange Rate Arrangements

3.1. De Jure Exchange Rate Arrangements

This study has focused on countries that have experienced a severe currency crisis because these countries are likely to have been deliberating on the exchange rate regime choice and have

[8] For more details, refer to Appendix 2.

made choices regarding the exchange rate regimes after realistically considering the possibility of a future crisis. This study also has focused on recent crisis episodes, since various views on exchange rate regimes (such as the vulnerability of the soft peg regime) have become widely known in recent years.

Eleven countries are considered: five Asian crisis countries (Korea, Indonesia, Philippines, Malaysia, and Thailand), Mexico, Brazil, Russia, Ecuador, Bulgaria, and Turkey. Most of these countries announced changes in their respective exchange rate regime after the crisis. Table 1 reports roughly the date of the currency crisis and de jure exchange rate regime that each country reported to the IMF, found in the IMF's *Exchange Arrangements and Exchange Restrictions*.

De jure exchange rate regimes for the pre-crisis period can be described as intermediate regimes such as a managed float and a soft peg. There are at least eight such cases.[9] Korea, Indonesia, Mexico, Brazil, and Russia announced a managed float while Malaysia and Thailand announced a soft peg regime. On the other hand, de jure exchange rate regimes for the post-crisis period are directed more towards polar regimes such as a currency board, dollarization, and a free float. There are at least seven such cases. Five countries (Korea, the Philippines, Mexico, Brazil, and Turkey) announced a free float regime. Ecuador announced a hard peg (dollarization) regime. Bulgaria first announced a soft peg, and then announced a hard peg (currency board) regime about two years after the crisis. Thailand, Indonesia, and Russia announced a free float just after the crisis, but then announced a managed float regime a few years after the crisis. Malaysia announced a peg (with capital account restrictions) regime about fifteen months after the crisis. To summarize, based on de jure regime classification, the bi-polar view has some support.

[9] The exchange rate regime of Ecuador may not be clearly categorized. Ecuador announced a managed float from 1995, but then announced a free float from early 1999. The crisis occurred in late 1999.

3.2. Data and Benchmarks

Although some support for the bi-polar view was found based on de jure classification, as suggested by Calvo and Reinhart (2002), each country may act differently from what they say. In order to infer de facto exchange rate arrangements, the methodology developed in Section 2 is applied.

During the periods around the crisis date, abnormal behaviors of the exchange rate and policy instruments are often observed. Therefore, some months before and after the crisis dates are excluded for estimation.[10] Also, in each country, the sample size of the pre-crisis period has been adjusted to be roughly equal to the sample size of the post-crisis period, in order to make a better comparison between the pre- and post-crisis periods. The estimation periods are reported in Table 2.

To infer the size of the estimated policy reactions in each country, two benchmark cases are considered. First, in order to distinguish between a free float and a managed float regime, Australia is used as the benchmark. Among the countries that are often regarded as free floaters, for example, the U.S., Japan, and Australia, Australia turns out to have the strongest policy reactions, based on the current methodology.[11] Therefore, the size of Australian reactions is considered as the upper limit of policy reactions of free floaters. The estimation period is from January 1984 to December 2003, when Australia has been a free floater.[12] Second, in order to distinguish between a

[10] In this regard, there are some claims that the effects of monetary policy on the exchange rate are dramatically different during a crisis period. For example, Radelet and Sachs (1998), Stiglitz (1999), and Wade (1998) suggest that a high interest rate policy further depreciated the currency during a currency crisis.

[11] The reserve and interest rate reactions of the Japan against the U.S. dollar for the period of 1983-2003 are –0.30~-0.33 and 0.06~0.08, respectively. The reserve and interest rate reactions of the US against Japanese Yen for the period of 1983-2003 are -0.24~-0.59 and 0.08~0.09, respectively. Those against DM for the period of 1983-1998 are -0.30~-1.23 and 0.11~0.09, respectively. Those against euro for the period of 1999-2003 are -0.17~-0.84 and 0.06~0.05, respectively.

[12] The estimation periods are chosen based on the IMF's *Exchange Arrangements and Exchange Restrictions*. To be more consistent with the estimation periods of the sample countries, the size of Australian policy reaction was also estimated over the periods of 1992-1996 and 1999-2003. The main conclusions do not

managed float and a fixed exchange rate arrangement, the Exchange Rate Mechanism (ERM) period of Denmark is used as the benchmark because the ERM can be regarded as more rigid than a usual managed float but more flexible than a peg. The estimation period is from March 1979 to December 1998, when Denmark participated in the ERM of the European monetary System (EMS).[13]

Monthly data is used for estimation. All data series are collected from *International Financial Statistics*. For European countries, the exchange rate against the DM, before 1999, or the Euro, from 1999, is used. For all other countries, the exchange rate against the US dollar is used.[14] The foreign exchange reserves, in terms of foreign currency, are used (that is, the foreign exchange reserves in terms of the DM or the Euro for European countries and the foreign exchange reserves in terms of US dollars for other countries) because the exchange rate movements would change foreign exchange reserves in terms of the domestic currency without any foreign exchange policy actions.[15] The original monetary base data is in terms of domestic currency, so it is converted to foreign currency terms.[16] For the interest rate, money market rates are used.[17] In all estimations, one lag is chosen based on the Schwartz Criterion and a constant term is included.

3.3. Estimated Reaction Functions and Impulse Responses

The estimated reaction function is reported in Table 2. The first column shows the country

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change.

[13] Denmark, among ERM countries, is chosen as it is one of very few countries that have been within the ERM without much trouble. See Eichengreen and Wyplozs (1993). In order to confirm that the policy reactions of Denmark during the ERM period are weaker than those of the fixed exchange rate regime, I investigated two fixed exchange rate regime cases, Denmark for the period of 1999-2003 and Hong Kong for the period of 1996-2003. The estimated reserve and interest rate reactions of Denmark for the period of 1999-2003 are –113.4~-121.0 and 1.59~2.69, respectively, and those of Hong Kong are -198.14~-252.18 and 20.57~15.05, respectively. These reactions are stronger than those of Denmark during the ERM period.

[14] Monthly end-of-period bilateral exchange rates (IFS line ..AE.) are used.

[15] For reserves, total reserves minus gold (IFS line .1L.D) are used.

[16] For monetary base, IFS line 14… is used.

[17] IFS line 60B.. is used, except for Ecuador. For Ecuador, discount rate (IFS line 60…) is used.

name, the base foreign currency (in parenthesis, “DM” indicates German Mark or Euro), and the crisis date (below the country name). The second column shows the estimation period; the third, the de jure classification reported to IMF; the fourth and fifth show the reaction function of the foreign exchange reserves to the exchange rate (the first month and the sixth month); the sixth and eighth, the reaction function of the interest rate. Note that all the numbers of the reaction functions are cumulative numbers over time. The numbers in parentheses are 68% probability bands. There are three cases in which the numbers are not reported because the exchange rate is literally fixed and the reaction functions cannot be calculated.

First, the benchmark countries are examined. The point estimates of Australian foreign exchange reserve reactions show that foreign exchange reserves decreased by 1.84% (of the monetary base) in the first month and by 1.64% up to the sixth month, as a reaction to a 1% exchange rate depreciation. The point estimates of interest rate reactions show that the interest rate increased by 0.18-0.29% in reaction to a 1% exchange rate depreciation. On the other hand, the point estimates of Danish foreign exchange reserve and interest rate reactions are -20.5~-17.6% and 2.13~1.32%, respectively. In most cases, the lower band of the Danish reaction (in absolute value) was larger than the upper band of the Australian reaction (in absolute value). This implies that the Danish reaction is significantly stronger than the Australian reaction.

The estimated impulse responses to one standard deviation shocks in percentage terms, with 68% probability bands, in the two variable model, with the exchange rate and foreign exchange reserves for the post-crisis period of South-Korea, are reported in Figure 1. Since the impulse responses, themselves, do not help much to infer the exact size of policy reaction clearly, only one case is reported. The graphs in the first and the second columns show the responses of

percentage changes in the exchange rate and the changes in the foreign exchange reserves (as a percentage of the monetary base in the previous period) to the exchange rate shocks and foreign exchange reserve shocks, respectively. To be consistent with the sign restrictions, the foreign exchange reserves and the exchange rate move in opposite directions in response to exchange rate shocks while two variables move in the same direction in response to foreign exchange reserve shocks. Note that foreign exchange reserve shocks generate a substantial volatility of exchange rate and foreign exchange reserve movements. Note also that different ratios of exchange rate movements to foreign exchange reserve movement are generated from exchange rate shocks and foreign exchange reserve shocks. These results suggest that the current empirical methodology based on only exchange rate shocks may provide different results than the previous methodology based on unconditional volatility.

3.4. Probability Measures and De Facto Exchange Rate Regime Classification

To compare the size of policy reaction of each country with those of the benchmark cases and to infer de facto exchange rate regime of each country, three types of probabilities are calculated by applying a Bayesian procedure: (1) the probability that the size of policy reaction of each country is weaker than that of Australia, (2) the probability that the size of policy reaction of each country is stronger than that of Australia but weaker than that of Denmark, and (3) the probability that the size of policy reaction of each country is stronger than that of Denmark.

As explained previously, Denmark can be regarded as a tightly managed exchange rate arrangement that lies between a peg and a usual managed float, while the size of policy reaction of Australia may represent the upper limit of a free floater. Therefore, (1), (2), and (3) may be interpreted as the probabilities that each country has a de facto free float, managed float, and peg,

respectively.

To calculate the probability measures, the following procedure is used. For each draw from posterior distribution of impulse responses, the sum of the size of interest rate reaction and (the negative of) the size of reserve reactions of each country and those of the benchmark cases are compared at each horizon. Based on at least 5000 draws, three probabilities are calculated for the reaction horizons from 1 month to six months. Then, the average of the probabilities for reactions horizons from one to six months is used as the probability measure in each case.[18] We give the equal weight to the changes in the log of the reserves and the changes in the interest rate, following past studies that used "exchange rate market pressure index," for example, Eichengreen, Rose, and Wyplosz (1995, 1996).

Table 3 (1) and (2) report the probability measures for the pre-crisis period and the post-crisis period, respectively. The first column shows the country name. The second column shows the estimation period; the third de jure exchange rate regime classification; the fourth, the fifth, and the sixth, the probability that each country adopted a de facto free float, a managed float, and a peg, respectively; the seventh, the de facto exchange rate regime classification. The case with the highest probability is chosen as the de facto exchange rate regime classification. When the highest probability is less than 0.5, "(?)" is added in order to show that the level of uncertainty is high.

3.5. Do Crisis Countries Move to Polar Regimes?

Now the main issue of the paper is discussed; do crisis countries move to polar regimes? First, the pre-crisis period is examined. Based on the de facto classification based on the probability measures, six countries (Korea, the Philippines, Mexico, Brazil, Ecuador, and Turkey) are

[18] We discard the draw for which the size of Danish reaction is weaker than the size of Australian reaction. However, such cases are very rare (about 2% of draws), and such cases would not affect the main conclusion.

categorized as managed floats, four countries (Indonesia, Malaysia, Thailand, and Russia) are categorized as soft pegs, and only one country (Bulgaria) is categorized as a free float. Overall, ten out of eleven countries can be characterized as intermediate regimes.

Next, the post-crisis period is analyzed. Four countries (Indonesia, Mexico, Brazil, and Turkey) are categorized as free floats while two countries (Ecuador and Bulgaria) are categorized as hard pegs. Two countries (Korea and Malaysia) are categorized as managed floats, and one country (Malaysia) is categorized as a peg (with capital controls). Two countries (Thailand and Russia) are categorized as free floats for the period just after the crisis but as managed floats in one or two years after the crisis. Overall, the majority (at least six countries) of the eleven countries are categorized as polar regimes. In conclusion, these results support the bi-polar view or "Hollow Middle" hypothesis.

3.6. Do Countries Over-State Exchange Rate Flexibility?

Now it is investigated whether countries over-state their exchange rate flexibility (or whether under-state their exchange rate controls). In the pre-crisis period, two countries claimed a free float and eight countries claimed a managed float ("de jure") regime. In one of two countries that claimed a free float, the Philippines, the interest rate reactions are too large to be regarded as a free float, and it is categorized as a managed float based on the probability measures ("de facto"). This case can be regarded as "Fear of Floating." In three out of eight countries that claimed a managed float (Russia, Malaysia, and Indonesia), the size of reactions is stronger than that of Denmark, and these three countries are categorized as a peg based on the probability measures ("de facto").

In the post-crisis period, there are only two cases of "Fear of Floating" (Korea and the

Philippines) out of eight cases that claimed a free float regime. Further, among three cases that announced a managed float, there is no case that a country overstates its exchange rate flexibility. To summarize, the cases where countries over-state the exchange rate flexibility, including "Fear of Floating" are frequently found in the pre-crisis samples under consideration but such a tendency is weaker in the post-crisis period than in the pre-crisis period.

3.7. Extended Experiments

Various extended experiments are carried out to confirm the robustness of the main results. The results are summarized in Table 4. First, the average value of the probabilities for the reaction horizons from one to six months is used in the baseline calculation, but the average value of the probabilities for different reaction horizons are examined. Table 4 under "3 Month" reports the results based on the average value of the probabilities for the reaction horizons from one to three months. Second, the inference is made only based on the reserve policy reaction because the reserve reaction might be regarded as a more fundamental indicator to infer the exchange rate regime classification in general than the interest rate reaction ("Res only"). Third, the probabilities that the *sum* of the reserve and interest rate reactions of each country is stronger (or weaker) than those of the benchmark countries are used in the baseline case, but the *average* of the probability based on the size of reserve reactions and the probability based on the size of interest rate reactions is also examined ("Prob Av."). Fourth, a three variable model is constructed that includes two policy instruments' changes and the exchange rate changes together ("3 VAR"). The same restrictions as those in the two-variable models are imposed.

In these experiments, there are a few cases where a country's de facto exchange rate classification turns out to be somewhat different from that based on the baseline measure. However,

the main conclusion holds in each experiment; the countries tend to move to polar regimes after a crisis, and the countries tend to overstate exchange rate flexibility less frequently after a crisis.

4. Conclusion

This paper first develops a method to identify the de facto exchange rate arrangements using a structural VAR model with sign restrictions on impulse responses. The method improves upon the previous methodologies as it uses only relevant information for inferring exchange rate stabilization, and it formally derives the policy reaction function.

By applying the method to the countries that have recently experienced a severe crisis, the exchange rate policy transition around the crisis period is examined. In the post-crisis period, a large fraction of these countries have moved to bi-polar regimes, either hard pegs or more flexible exchange arrangements that are close to a free float. This is consistent with the bi-polar view. Countries often over-state their exchange rate flexibility, but such a tendency is a bit weaker in the post-crisis period than in the pre-crisis period. Indeed, these countries appear to have learned from their crisis. By moving toward polar regimes, they appear to be trying to lower the possibility of a future crisis in integrated capital markets. They may have also learned that just saying is not enough since they experienced crisis regardless of what they had said. Financial market may have disciplined them in not trying to manipulate mutually inconsistent policy objectives as well as in fostering a move towards greater transparency.

Appendix 1. Empirical Methodology

This Appendix explains details on the implementation of the sign restrictions discussed in

the main text of this paper. The reduced form VAR equations can be written as $Y_t = A(L)\varepsilon_t$, where Y_t is a n×1 data vector, A(L) is an n×n matrix polynomial in lag operator L, εt is a serially uncorrelated n×1 vector of residuals in the reduced form equation, and var(ε)=Σ. Finding the structural form amounts to finding an n×n matrix, K, such that ε_t = K et where var(e_t) = In. Cholesky Factorization of Σ is one example of finding a structural form. That is, a Cholesky factor, P, can be used as K, where Σ=PP' and P is a Cholesky factor. Also, note that PN where N is an n×n orthonormal matrix, that is, NN' = In, can be regarded as K. As discussed in Uhlig (2005) and Uhlig and Mountford (1999), the space of K is spanned by N given P. A(L) and Σ are drawn from normal Wishart distribution. To draw N, some elements of N are drawn from the standard normal distribution and other elements are recovered by using the restrictions that are implied by NN' = In.

For the two-variable model, I draw each element in the first row of N from the standard normal distribution and normalized to have the norm of 1 (which is implied by NN' = I_n). The second row of N is derived from the restriction NN' = I_n given the drawn two elements of the first row of N. For the three variable model, I draw each element in the first row of N from the standard normal distribution, normalized to have the norm as 1. In the case of the three-variable model, another element in N is still needed to recover all elements of N. Thus, I draw each element in the second row of N from the standard normal distribution and normalized them to have the norm as 1. Since only one element is needed, I only use the first element of the second row, and discard other elements. The remaining five elements are drawn from the restriction NN' = I_n given four drawn elements.

I generate 10000 draws and keep the draws that satisfy the sign restrictions, while discarding the draws that do not, and then calculate the median impulse responses and probability

bands. For the two-variable model of the exchange rate and the foreign exchange reserve, I discard the draws where both shocks move two variables in the same direction or in opposite directions. However, I keep the draws where one shock moves two variables in the same direction and the other shock moves two variables in opposite directions and define the former as the shocks to the foreign exchange reserves and the latter as the shocks to the exchange rate. For other models, a similar procedure is used. For simulation experiments to compare the size of policy reactions between two cases, I make draws from the posterior distribution of impulse responses, compare the sizes of policy reactions for each draw, and calculate the probability that the size of policy reactions of one case is not larger (or smaller) than that of the other case.

Appendix 2. Policy Reaction Function

This appendix shows that parameters in equation (5) are theoretically equal to those in the formal policy reaction function in the case of two-variable model. The structural form equations in VAR (vector auto-regression) form are:

$$\text{(A1)} \quad \begin{bmatrix} B_{0,11} & B_{0,12} \\ B_{0,21} & B_{0,22} \end{bmatrix} \begin{bmatrix} \Delta E_t \\ \Delta FR_t \end{bmatrix} = \begin{bmatrix} B_{11}(L) & B_{12}(L) \\ B_{21}(L) & B_{22}(L) \end{bmatrix} \begin{bmatrix} \Delta E_{t-1} \\ \Delta FR_{t-1} \end{bmatrix} + \begin{bmatrix} e_{E,t} \\ e_{FR,t} \end{bmatrix},$$

where B_0s are constants and $B(L)$s are polynomials in the lag operator, L. The structural form coefficients of the VMA from (2) and the VAR from (A1) are related by $C(L) = (B0 - B(L)L)$-1. Note that the first equation in (A1) can be interpreted as the foreign exchange market equation and the second equation as the policy reaction function.[19]

[19] It can be shown that the sign restrictions on impulse responses also imply corresponding sign restrictions on contemporaneous structural parameters, which are $B_{0,11} \geq 0$, $B_{0,12} \leq 0$, $B_{0,21} \geq 0$, and $B_{0,22} \geq 0$. The

From the second equation in (A1),

(A2) $\Delta FR_t = \left(B_{0,22} - B_{22}(L)L\right)^{-1}\left[\left(B_{0,21} - B_{21}(L)L\right)\Delta E_t + e_{FR,t}\right].$

By tracing coefficients on ΔE_t, ΔE_{t-1}, ΔE_{t-2},… in (A2), we can examine the percentage changes that the foreign exchange reserves exhibit over time in reaction to a 1% depreciation in the exchange rate. In this two-variable model, using the relation $C(L) = (B0 - B(L)L)$-1, it can be shown that the coefficients in equations (5) and (A2) are the same, that is, $\frac{B_{0,21} - B_{21}(L)L}{B_{0,22} - B_{22}(L)L} = \frac{C_{21}(L)}{C_{11}(L)}$. That is, by exploiting the impulse responses to the shocks to the exchange rate that the policy reacts to, the actual policy reaction function can be recovered.

restrictions on the contemporaneous structural parameters, $B_{0,}$ can be easily interpreted as follows. An increase in the foreign exchange reserves depreciates the exchange rate, (in the foreign exchange market) while the policy authority decreases the foreign exchange reserves in reaction to the exchange rate depreciation in order to stabilize the exchange rate (in the policy reaction function).

References

Baig, T., 2001. Characterizing Exchange Rate Regimes in Post-Crisis East Asia. IMF Working Paper 01/125.

Bernanke, B., 1986. Alternative explanations of the money-income correlation, in: Brunner, K., Metzler, A. (Eds.), Real Business Cycles, Real Exchange Rates, and Actual Policies. Carnegie-Rochester Series on Public Policy 25, North-Holland, Amsterdam, pp. 49-99.

Blanchard, J.O., Quah, D., 1989. The dynamic effects of aggregate demand and supply disturbances. American Economic Review 79, 655—673.

Blanchard, O.J., Watson, M.W., 1986. Are business cycles all alike? in: Gordon, R. (Ed.), The American Business Cycle: Continuity and Change. University of Chicago Press, Chicago, IL, pp. 123-56.

Bubula, A., Ötker-Rober, I., 2002. The Evolution of Exchange Rate Regimes Since 1990: Evidence from De Facto Policies. IMF Working Paper 02/155.

Calvo, G., Reinhart, C., 2002. Fear of floating. Quarterly Journal of Economics 117, 379--408.

Canova, F., De Nicolo, G., 2002. Monetary disturbances matter for business fluctuations in the G7. Journal of Monetary Economics 49, 1131--1159.

Eichengreen, B., 1994. International Monetary Arrangements for the 21st Century. Brookings Institution, Washington DC.

Eichengreen, B., Wyplosz, C., 1993. The unstable EMS. Brookings Papers on Economic Activity 1, 51--143.

Eichengreen, B., A. Rose, and C. Wyplosz, 1995, Exchange Market Mayhem: The Antecedents and Aftermath of Speculative Attacks, Economic Policy, 251-296.

Eichengreen, B., A. Rose, and C. Wyplosz, 1996, Speculative Attacks on Pegged Exchange Rates: An Empirical Exploration with Special Reference to the European Monetary System, in M. Canzoneri, P. Masson, and V. Grilli, eds., Transatlantic Economic Issues, Cambridge University Press, Cambridge, UK.

Fischer, S., 2001. Exchange rate regimes: Is the bipolar view correct? Journal of Economic Perspectives 15 (2), 3--24.

Ghosh, A., Gulde, A., Wolf, H., 2003. Exchange Rate Regimes: Choices and Consequences (Cambridge, Massachusetts: MIT Press).

Hernandez, L., Montiel, P.J., 2003. Post-crisis exchange rate policy in five Asian countries: Filling in the "Hollow Middle"? Journal of Japanese and International Economies 17, 336--369.

Kim, S., 2003. Monetary policy, foreign exchange intervention, and exchange rate in a unifying framework. Journal of International Economics 60, 355--386.

Kim, S., 2005. Monetary policy, foreign exchange policy, and delayed overshooting. Journal of Money, Credit, and Banking 37, 775--782.

Krueger, A.O., 2000. Conflicting demands on the international monetary fund. American Economic Review: papers and Proceedings 90, 38--42.

Levy-Yeyati, E., Sturzenegger, F., 2005. Classifying Exchange Rate Regimes: Deeds vs. Words. European Economic Review 49, 1603--1635.

McKinnon, R.I., 2000. After the Crisis, the east Asian Dollar Standard Resurrected: An Interpretation of High-Frequency Exchange Rate Pegging. Working Paper, Stanford University, in http://www-econ.standord.edu/faculty/workp/swp00013.html.

Mussa, M., Masson, P.R., Soboda, A.K., Jadresic, E., Mauro, P., Gerg, A., 2000. Exchange Rate

Regimes in an Increasingly Integrated World Economy. IMF Occasional Paper No. 193. International Monetary Fund, Washington.

Obstfeld, M., Rogoff, K., 1995. The mirage of fixed exchange rates. Journal of Economic Perspectives, Volume 9, No.4, pp. 73-96.

Radelet, S., Sachs, J., 1998. The East Asian Financial Crisis: Diagnosis, Remedies, Prospects. Working Paper, Harvard Institute for International Development.

Reinhart, C., Rogoff, K.S., 2002. The Modern History of Exchange Rate Arrangements: A Reinterpretation. NBER Working Paper 8963.

Sims, C.A., 1980. Macroeconomics and reality. Econometrica 48, 1—48.

Sims, C.A., 1986. Are forecasting models usable for policy analysis? Federal Reserve Bank of Minneapolis Quarterly Review 10, 2--16.

Stiglitz, J., 1999. Lessons from East Asia. Working Paper.

Uhlig, H., 2005. What are the effects of monetary policy on output? Results from an agnostic identification procedure. Journal of Monetary Economics 52, 381--419.

Wade, R., 1998. The Asian debt and development crisis of 1997: Causes and consequences. World Development 26, 1535--53.

Table 1. De Jure Exchange Rate Regime Classification

Country	Crisis Date	De Jure Exchange Rate Regime Classification
Korea	1997.9.	1980.3-1997.12.15: Managed Floating 1997.12.16 - : Independently Floating
Indonesia	1997.6	1978.11-1997.8.13: Managed Floating 1997.8.14 – 2001.6.29: Independently Floating 2001.6.30-: Managed Floating
The Philippines	1997.6	1988.1 - : Independently Floating
Malaysia	1997.6	1990.3.-1992.11: Fixed 1992.12-1998.9.1: Managed Floating 1998.9.2.-: Fixed
Thailand	1997.7	1970.1.-1997.7.1: Fixed 1997.7.2.-2001.6.29: Independently Floating 2001.6.30: Managed Floating
Mexico	1994.11	1982-1994.12.21: Managed Floating 1993.12.22 - : Independently Floating
Brazil	1998.12	1994.7.1.-1999.1.17: Managed Floating 1999.1.18: Independently Floating
Russia	1998.7	1995.7.6-1998.9.1: Managed Floating (band) 1998.9.2.-1999.9.29: Managed Floating 1999.9.30-2000.11.30: Independently Floating 2000.12.1-: Managed Floating
Ecuador	1999.12	1995.10.27-1999.2.11: Managed Floating (band) 1999.2.12-2000.3.12: Independently Floating 2000.3.13-: Dollarization
Bulgaria	1996.12	1991.2.8-1997.6.30: Independently Floating 1997.7.1-1998.12.31: Fixed (pegged to DM) 1999.1.1 -: Currency Board
Turkey	2001.1	1975 – 1998.6.29: Managed Floating 1998.6.30-2001.2.21: Crawling Peg 2001.2.22-: Independently Floating

Table 2. Estimated Policy Reaction Function

Country (vs.) Crisis Date	Estimation Period	De Jure	Reserve Reactions		Interest Rate Reactions	
			1 month	6 month	1 month	6 month
Australia ($)	84.1-03.12	IF	-1.84 (-0.60,-4.13)	-1.64 (-0.72,-3.17)	0.18 (0.05,0.54)	0.29 (0.10,0.95)
Denmark (DM)	79.3-98.12	EM	-20.5 (-5.75,-57.3)	-17.6 (-7.48,-51.7)	2.13 (0.59,6.60)	1.32 (0.38,3.79)
Korea ($)	92.1-96.12	MF	-3.35(-0.98,-7.92)	-2.92 (-1.37,-6.62)	1.64 (0.48,4.89)	0.71 (0.05,1.54)
1997.9	99.1-03.12	IF	-2.55 (-0.79,-6.27)	-3.33 (-1.83,-6.23)	0.06 (0.01,0.34)	0.09 (0.01,0.56)
Indonesia ($)	92.1-96.12	MF	-19.6(-4.54,-104.5)	-23.0 (-5.09,-991)	3.99 (1.14,11.8)	3.61 (1.05,22.5)
1997.6	99.1-01.6	IF	-0.80 (-0.29,-1.51)	-0.38 (-0.05,-0.79)	0.52 (0.16,1.31)	0.56 (0.27,1.18)
	01.7-03.12	MF	-0.84 (-0.25,-2.07)	-0.91 (-0.43,-1.60)	0.55 (0.15,1.63)	0.18(-0.03,0.55)
Philippines ($)	92.1-96.12	IF	-3.26 (-0.89,-9.91)	-2.92 (-1.11,-7.46)	2.75 (0.71,8.74)	1.12 (0.38,3.51)
1997.6	99.1-03.12	IF	-2.68 (-0.80,-6.79)	-2.34 (-0.81,-5.38)	0.28 (0.09,0.62)	0.35 (0.13,0.58)
Malaysia ($)	92.12-96.12	MF	-21.39(-4.98,-93.6)	-74.48(-9.1,-3140)	0.30 (0.06,1.54)	0.21 (0.04,1.15)
1997.6	99.1-03.12	F	----	----	----	----
Thailand ($)	92.12-96.12	F	-10.23(-2.79,-34.8)	-10.02(-4.53,-26.9)	5.98(1.41,30.17)	7.75 (2.70,273)
1997.7	99.1-01.6	IF	-2.10 (-0.60,-5.86)	-0.93 (0.07,-2.15)	0.19 (0.05,0.55)	0.10 (0.00,0.42)
	01.7-03.12	MF	-3.20 (-1.00,-6.97)	-2.83 (-1.13,-4.58)	0.14 (0.03,0.66)	0.02 (-1.02,0.11)
Mexico ($)	89.1-93.12	MF	-19.12 (-6.32,-42.0)	-5.95 (-1.09,-18.46)	4.69 (1.26,15.5)	2.80 (0.25,13.09)
1994.11	97.1-03.12	IF	-1.71 (-0.53,-4.01)	-0.96 (-0.09,-2.55)	0.84 (0.42,1.25)	0.84 (0.50,1.18)
Brazil ($)	94.7-97.12	MF	-4.09 (-1.26,-9.98)	-2.82 (0.26,-12.08)	3.86 (1.35,7.72)	2.23 (0.26,4.32)
1998.12	00.1-03.12	IF	-1.95 (-0.49,-7.95)	-0.85 (-0.05,-4.18)	0.10 (0.03,0.27)	0.38 (0.16,1.06)
Russia ($)	95.8-97.12	MF	-19.1 (-5.16,-72.0)	-1.92 (48.1,-6.09)	60.0 (17.6,165.4)	5.85 (-6.26,25.9)
1998.7	99.10-00.11	IF	-1.75 (-0.71,-3.13)	-1.17 (0.23,-2.73)	1.40 (0.46,3.27)	0.32 (-0.28,2.28)
	00.12-03.12	MF	-7.26 (-2.27,-16.6)	-4.44 (-2.56,-6.84)	7.25 (2.18,18.66)	1.59 (0.36,4.24)
Ecuador ($)	95.11-98.12	MF	-4.12 (-1.23,-9.78)	-1.43(0.97,-3.26)	1.03 (0.26,4.15)	1.23 (0.38,3.29)
1999.12	01.1-03.12	F(D)	----	----	----	----
Bulgaria (DM)	93.12-95.12	IF	-2.02 (-0.51,-7.88)	0.21 (1.23,-1.46)	0.43 (0.16,0.81)	0.47 (0.05,0.91)
1996.12	97.7-98.12	F	-62.5 (-16.8,-217.2)	-84.3 (-23.5,-299.0)	1.95 (0.63,4.59)	3.32 (1.20,8.85)
	99.1-03.12	F(C)	----	----	----	----
Turkey (DM)	93.7-98.6	MF	-1.75 (-0.47,-5.20)	-1.30 (-0.44,-2.48)	7.53 (2.12,22.11)	1.09(-296.7,2.96)
2001.1	99.1-00.6	CD	-4.68 (-1.31,-16.0)	-5.93 (-1.95,-491.7)	5.86 (1.48,23.80)	-1.47(-504,1.47)
	02.1-03.12	IF	-1.78 (-0.53,-4.27)	-1.15 (-0.40,-3.05)	0.23 (0.07,0.57)	0.41 (0.19,1.61)

* IF: Independently Floating, MF: Managed Floating, F: Fixed, CP: Crawling Peg, F(D): Dollarization, F(C): Currency Board, EM: Exchange Rate Mechanism

* The numbers show the cumulative policy reaction functions, and the numbers in parenthesis show 68% probability bands

Table 3. Probability Measures and De Facto Exchange Rate Classification

(1) Pre-Crisis Period

Country (i)	Estimation Period	De Jure	Probability of			De Facto
			IF	MF	F	
Korea	92.1-96.12	MF	0.25	0.66	0.09	MF
Indonesia	92.1-96.12	MF	0.03	0.36	0.61	F
Philippines	92.1-96.12	IF	0.20	0.65	0.15	MF
Malaysia	92.12-96.12	MF	0.05	0.31	0.64	F
Thailand	92.12-96.12	F	0.02	0.42	0.56	F
Mexico	89.1-93.12	MF	0.11	0.53	0.36	MF
Brazil	94.7-97.12	MF	0.20	0.65	0.15	MF
Russia	95.8-97.12	MF	0.30	0.28	0.42	F (?)
Ecuador	95.11-98.12	MF	0.33	0.56	0.11	MF
Bulgaria	93.12-95.12	IF	0.70	0.23	0.06	IF
Turkey	93.7-98.6	MF	0.36	0.48	0.16	MF (?)
	99.1-00.6	CD	0.25	0.39	0.36	MF (?)

(2) Post-Crisis Period

Country (i)	Estimation Period	De Jure	Probability of			De Facto
			IF	MF	F	
Korea	99.1-03.12	IF	0.29	0.65	0.06	MF
Indonesia	99.1-01.6	IF	0.75	0.24	0.01	IF
	01.7-03.12	MF	0.67	0.30	0.03	IF
Philippines	99.1-03.12	IF	0.40	0.56	0.04	MF
Malaysia	99.1-03.12	F	----	--	--	F
Thailand	99.1-01.6	IF	0.62	0.32	0.05	IF
	01.7-03.12	MF	0.38	0.56	0.06	MF
Mexico	97.1-03.12	IF	0.54	0.45	0.01	IF
Brazil	00.1-03.12	IF	0.57	0.34	0.09	IF
Russia	99.10-00.11	IF	0.51	0.43	0.06	IF
	00.12-03.12	MF	0.11	0.72	0.17	MF
Ecuador	01.1-03.12	F(D)	----	--	--	F(D)
Bulgaria	97.7-98.12	F	0.04	0.14	0.81	F
	99.1-03.12	F(C)	----	--	--	F(C)
Turkey	02.1-03.12	IF	0.52	0.42	0.06	IF

* These tables show the probabilities that each country's de facto exchange rate arrangement is independent floating (IF), managed floating (MF), and fixed exchange rate regime (F). The case with the highest probability is chosen as the de facto classification. "?" indicates that the level of uncertainty is high. IF, MF, and F indicate independently floating, managed floating, and fixed exchange rate regime, respectively.

Table 4. Extended Experiments for De Facto Exchange Rate Classification

(1) Pre-Crisis Period

Country (i)	Period	De Jure	Baseline	3 Month	Res only	Prob Av.	3 VAR
Korea	92.1-96.12	MF	MF	MF	MF	MF	MF
Indonesia	92.1-96.12	MF	F	F	F	F	F
Philippines	92.1-96.12	IF	MF	MF	MF	MF	MF
Malaysia	92.12-96.12	MF	F	F	F	F (?)	MF (?)
Thailand	92.12-96.12	F	F	F	MF	F	F
Mexico	89.1-93.12	MF	MF	MF	MF	F (?)	F (?)
Brazil	94.7-97.12	MF	MF	MF	MF	MF (?)	MF
Russia	95.8-97.12	MF	F (?)	F	MF (?)	F (?)	F
Ecuador	95.11-98.12	MF	MF	MF	IF (?)	IF (?)	IF (?)
Bulgaria	93.12-95.12	IF	IF	IF	IF	IF	IF
Turkey	93.7-98.6	MF	MF (?)	MF	IF (?)	IF (?)	IF (?)
	99.1-00.6	CD	MF (?)	MF	MF (?)	F (?)	MF (?)

(2) Post-Crisis Period

Country (i)	Period	De Jure	Baseline	3 Month	Res only	Prob Av.	3 VAR
Korea	99.1-03.12	IF	MF	MF	MF	IF (?)	MF
Indonesia	99.1-01.6	IF	IF	IF	IF	IF	IF
	01.7-03.12	MF	IF	IF	IF	IF	IF
Philippines	99.1-03.12	IF	MF	MF	MF	MF	IF
Malaysia	99.1-03.12	F	F	F	F	F	F
Thailand	99.1-01.6	IF	IF	IF	IF	IF	IF
	01.7-03.12	MF	MF	MF	MF	IF	IF
Mexico	97.1-03.12	IF	IF	IF	IF	MF	IF
Brazil	00.1-03.12	IF	IF	IF	IF	IF	IF
Russia	99.10-00.11	IF	IF	MF (?)	IF	IF	MF (?)
	00.12-03.12	MF	MF	MF	MF	MF	MF
Ecuador	01.1-03.12	F (D)	F (D)	F (D)	F (D)	F (D)	F (D)
Bulgaria	97.7-98.12	F	F	F	F	F	F
	99.1-03.12	F(C)	F(C)	F(C)	F(C)	F(C)	F(C)
Turkey	02.1-03.12	IF	IF	IF	IF	MF (?)	IF (?)

* These tables show de facto exchange rate classifications based on various measures. “De Jure,” “Basic,” “3 Month,” “Res only,” “Prob Av.,” and “3 VAR” indicate de jure classification, the baseline method, the average of the reactions for horizons from one to three months, the measure based on reserve reactions only, the measure using the average of the probability based on reserve reactions and the probability based on interest rate reactions, and the measure based on three variable VAR model, respectively. “?” indicates that the level of uncertainty is high. IF, MF, and F indicate independently floating, managed floating, and fixed exchange rate regimes, respectively.

Figure 1. Impulse Responses, Korea, 1999-2003