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TIME-VARYING ESTIMATES ON THE OPENNESS OF CAPITAL ACCOUNTS IN EAST ASIA AND MEXICO

SUN LIXING

I. INTRODUCTION

THE Asian currency crisis of 1997 and its reverberations in financial markets of developing countries around the world have intensified the debate over regulating the movement of capital, as capital flows to developing countries have grown rapidly since the early 1990s. One main feature of recent capital flows to developing countries is that private (bond and equity) flows, as opposed to official flows, have become a crucial source for financing large current account imbalances. The evolution and magnitude of capital movements have presented both opportunities and challenges to the developing countries. The degree of capital mobility has typically been assessed by the extent to which expected returns are equalized between domestic and foreign assets of the same type. The equalization of returns can be measured by simple interest arbitrage which typically focuses on the short-run relationship between capital flows and interest differentials. Capital mobility is defined as the absence of barriers to the movement of short-term capital across national boundaries. We can examine covered interest differentials for only a subset of countries with relatively well-developed forward markets, and many papers have looked at the mobility of financial capital for industrial countries.[1]

Unfortunately, for a majority of countries that are liberalizing or contemplating liberalization, forward markets are either extremely thin or nonexistent, rendering covered interest parity tests irrelevant and making it difficult to judge the economic impact of capital account liberalization. Therefore, tests of uncovered interest parity conditions have been applied to examine the degree of capital mobility in most developing countries, although there is little evidence to show that uncovered interest parity conditions hold.

This paper examines interest rate determination in two polar cases related to the degree of openness of the economy. If the economy under consideration is one that

I am grateful for the useful comments by Professor M. Ohta and Professor T. Shiba, and also wish to thank the seminar participants for their comments on a prior version.

[1] For a more detailed discussion of covered interest differential measurement, see Chinn and Dooley (1995, 1997), Obstfeld and Taylor (1998), and Marston (1995).

has some controls on capital movements, as most developing countries have, it is possible to visualize that both open and closed economy factors will affect the behavior of domestic interest rates in the short run. I focus on the short-run dynamics of capital flows to developing countries by introducing a time-varying parameter estimation based on the Kalman filter technique (instead of the usual constant parameter estimation) which has also been applied by Reisen and Yeches (1993). Reisen and Yeches used this model to examine the degree of capital mobility for the Republic of Korea and Taiwan during the 1980s. Their findings indicated a low degree of capital mobility for both countries, and no trend toward more financial openness in Korea. Their results were based on using the actual depreciation rate to replace the expected depreciation rate for measuring the uncovered interest parity rate. According to their perfect foresight measurement for the depreciation rate, forecast error problem would easily be found.[2]

In this paper I estimate this model to obtain the time-varying estimates on the openness of capital accounts in Korea, Indonesia, Thailand, and Mexico, which have all experienced currency crises since liberalizing their capital markets in the 1980s. I present an alternative empirical measurement of unobserved expected exchange rate by estimating a univariate SARIMA model. This produces the opposite result that a high degree of capital mobility can be found in all these countries, although the openness of Korea's capital account is lower than the others. Moreover, further financial opening, even for Korea, can also be observed, as will be shown later.

This paper also looks closely at the regional differences in the evolution of capital account liberalization between Asian developing countries and Mexico by examining the time-varying parameter estimates of capital account openness in these countries. Furthermore, I try to explain the phenomenon of accelerating private short-term foreign capital flow into most developing countries during the 1990s. I do this by assessing how the unhedged exchange risk premiums have evolved during the same period. Based on the model of interest determination, my empirical results are also likely to imply an important loss of monetary autonomy, particularly for Indonesia and Thailand.

This paper is organized as follows. Section II outlines the theoretical model and econometric methodology. Section III describes the data. Section IV reports hypothesis tests and estimation results. Section V interprets the empirical results and shows the differences among the countries studied. Section VI presents conclusions and draws some policy implications.

II. THE MODEL AND EMPIRICAL METHODOLOGY

In a departure from the standard methodology, Edwards and Khan (1985) postu-

[2] $i - i^{us} - \Delta s = (i - i^{us} - fd) + (fd - \Delta s^{e}) + (\Delta s^{e} - \Delta s)$, where $(\Delta s^{e} - \Delta s)$ denotes forecast error.

lated that the actual domestic interest rate in a developing country could be expressed as a weighted average of the external (uncovered parity) rate (i^*) and the domestic interest rate (i') that would prevail in a financially closed economy. The weight given to the external rate is interpreted as the extent of capital mobility, and is also called a "coefficient of openness," φ:

$$i = \varphi i^* + (1 - \varphi) i'. \tag{1}$$

Building on this basic framework, Harque and Montiel (1990) derived the coefficient of openness by estimating the money demand equation rather than calculating the Fisher approach for the domestic interest rate.

Reisen and Yeches (1993) added a constant term, α, into this model:

$$i = \varphi(i^* + \alpha) + (1 - \varphi) i'. \tag{2}$$

Equation (3) is derived from equation (2) by transforming the estimation form.

$$i - i' = \varphi\alpha + \varphi(i^* - i'). \tag{3}$$

This constant term, α, is interpreted as the exchange risk premium which reflects the uncovered interest differential due to the difference in asset quality between foreign and domestic financial assets. The parameter φ serves as an index of capital account openness. Running from zero to one, the parameter rises when a country strengthens its financial integration with world financial markets. When $\varphi = 0$, external factors play no role in the determination of the domestic interest rate, but only when the private capital accounts are effectively closed. If $\varphi = 1$, the actual domestic interest rate is equal to its interest parity rate, and capital mobility is assumed to be perfect. Hence, if existing capital controls have been sufficiently effective, interest rates should have been largely determined by domestic monetary conditions, not by world interest rates, meaning that external financial intermediation is ruled out. On the other hand, if capital controls have not been effected and perfect capital mobility prevails, national interest rates should be tied to the world interest rate which is determined by the world credit market. In this case, the removal of existing capital controls and restrictions will reduce the effectiveness of monetary policy unless exchange rates are purely floating.

Below are the procedures for the estimates based on this model.

First, a domestic extended money demand function is estimated in the following simple standard form:[3]

$$\ln(M/P)_t = \alpha_0 + \alpha_1 i_t + \alpha_2 \ln y_t + \alpha_3 \ln(M/P)_{t-1} + \varepsilon_t, \tag{1'}$$

where M_t, P_t, and y_t are money stock, price level, and real GNP, respectively. In

[3] The inclusion of the inflation variable (as another opportunity cost item to hold money) introduces autocorrelation into the money demand function.

addition, $\alpha_1 < 0$, $\alpha_2, \alpha_3 > 0$. The closed economy market-clearing interest rate, i', is solved as follows: if $\ln(M'/P) = \ln(M/P)$,

$$i_t' = -(\hat{\alpha}_0/\hat{\alpha}_1) - (\hat{\alpha}_2/\hat{\alpha}_1)\ln y_t - (\hat{\alpha}_3/\hat{\alpha}_1)\ln(M/P)_{t-1} + (1/\hat{\alpha}_1)\ln(M'/P)_t, \quad (2')$$

which introduces $M_t' = M_t - CAP_t$, while CAP_t is net private capital movement.[4]

Secondly, for the case of the uncovered interest parity rate, I measure i^* by taking the following form:[5]

$$i_t^* = i_t^{us} + [E_t(s_{t+1} \mid I_t) - s_t]/s_t. \quad (3')$$

For the uncovered interest parity rate, the three-month LIBOR interest rate of the dollar (i_t^{us}) is used to reflect world interest rate, and the expected change in the exchange rate (s_t) at the end of the period is measured by a univariate SARIMA exchange rate rational forecasting model.

Finally, to obtain a series of time-varying estimates for φ_t, including exchange risk premium α_t, I apply the Kalman filter iterative procedure into equation (3) as follows:

$$(i_t - i_t') = C_t + \varphi_t(i_t^* - i_t') + \upsilon_t, \quad (4')$$

where $C_t = \varphi_t \alpha_t$.

The Kalman filter method requires some a priori specification of the movement of the time-varying parameter. I assume the following motion process:

$$\varphi_t = \mathbf{A}\varphi_{t-1} + \boldsymbol{\eta}_t, \quad (5')$$

where $\varphi_t = \begin{bmatrix} c_t \\ \varphi_t \end{bmatrix}$, $\mathbf{A} = \begin{pmatrix} a_c & 0 \\ 0 & a_\varphi \end{pmatrix}$, $\boldsymbol{\eta}_t = \begin{bmatrix} \eta_{ct} \\ \eta_{\varphi t} \end{bmatrix}$.

III. DATA

Four developing countries—the Republic of Korea, Indonesia, Thailand, and Mexico—have been chosen for empirical analysis because all have experienced significant financial liberalization, and the regional differences in the process of capital account liberalization between East Asia and Mexico had been examined before the currency crisis.

The sample range in the empirical analysis consists of quarterly data over the period 1980:1 to 1997:1. Data are obtained from the IMF's *International Financial*

[4] Due to the government's sterilization policy from time to time, the closed economy money supply may be underestimated in the form described above.

[5] Strictly speaking, UIP (uncovered interest parity): $i_t^* = i_t^{us} + [E_t^m(s_{t+1} \mid I_t) - s_t]/s_t$, where $E_t^m(\cdot)$ is the market's expectation conditional upon current information. Note that this expectation is not necessarily the statistical expectation, $E_t(\cdot)$. Nonetheless, the expected depreciation rate estimated by the rational forecasting model seems to reflect appropriately the movement of short-term private capital.

Statistics, March 1998.[6] The specification of variable notations in each equation is given in Appendix Table I.

IV. EMPIRICAL ANALYSIS

A domestic money demand function given in equation (1′) is estimated. The results of the constant parameter estimation of money demand function in these countries are presented as follows.

The Estimates of Money Demand Functions

	Korea	Indonesia	Thailand	Mexico
$\hat{\alpha}_0$	–1.472 (0.009)	0.153 (0.125)	–0.118 (0.572)	–0.908 (0.925)
$\hat{\alpha}_1$	–0.009 (0.090)	–0.003 (0.026)	–0.005 (0.000)	–0.002 (0.000)
$\hat{\alpha}_2$	0.220 (0.008)	0.036 (0.221)	0.015 (0.000)	0.187 (0.001)
$\hat{\alpha}_3$	0.818 (0.000)	0.909 (0.000)	0.905 (0.000)	0.819 (0.000)
RHO	–0.283 (0.037)		–0.375 (0.001)	–0.364 (0.003)
$\bar{R}^2$	0.989	0.985	0.993	0.892
Dh	–1.814**	1.083*	–2.373***	–2.255***
LMhet	0.201*	1.575*	1.221*	1.180*

Note: Figures in parentheses are *P*-values. *RHO* represents the autoregressive coefficient of the AR1 residual. *Dh* is the Durbin's *h* statistic for first-order autocorrelation in the presence of a lagged dependent variable. *LMhet* is the Breusch-Pagan Lagrange multiplier test for heteroskedasticity. *, **, and *** indicate significance at the 10 per cent, 5 per cent, and 1 per cent level respectively.

As indicated above, the estimated coefficients of the domestic money demand functions are all of the anticipated signs and significant in these countries, except for insignificant values for most constant terms and the real income for Indonesia. The corrected regression coefficient $\bar{R}^2$ shows a good fit; however, Durbin's *h* statistic shows the presence of autocorrelation in most countries. Thus, for most countries, the AR1 (autoregressive process of order one) method has been applied to eliminate the serial correlation.

The estimates of the money demand function described above allow us to calcu-

[6] The annual GDP of Indonesia and Thailand were changed to quarterly data by using RATS command "Distrib. src," since GDP quarterly data is not available from the IFS CD-ROM.

TABLE I

AUGMENTED DICKEY-FULLER TESTS FOR FIRST DIFFERENCES OF ADJUSTED EXCHANGE RATES

	Korea	Indonesia	Thailand	Mexico
$\hat{\delta}$	−0.568	−0.853	−0.588	−0.810
	(0.002)	(0.000)	(0.000)	(0.000)
DW	1.945	1.984	1.731	1.933
	(0.414)	(0.474)	(0.143)	(0.394)
LMhet	0.336	0.042	0.942	3.908
	(0.562)	(0.838)	(0.332)	(0.048)
Q-stat	0.405	0.092	1.251	2.784
	(0.817)	(0.955)	(0.535)	(0.249)
R^2	0.461	0.426	0.494	0.405

late the hypothetical closed economy interest rate i'.[7] I insert the coefficients estimated in equation (1′) into equation (2′), and calculate the closed economy interest rate i' by replacing the observed money supply with the hypothetical closed economy money supply for each current period. The money supply, which corresponds to the hypothetical situation with a closed private capital account, is defined as a semi-open economy money supply less foreign direct investment, portfolio investment, other short-term capital, and errors and omissions.

To obtain the uncovered parity rate, I first use a univariate SARIMA exchange rate forecasting model to estimate the expected depreciation rate for these countries. Before estimating the model, I perform a unit root test by using Augmented Dickey-Fuller statistics to determine whether the exchange rate series are stationary or whether their first differences are stationary. Moreover, I use the Akaike information criterion (AIC) and Schwarz's Bayesian criterion (SBC) to ascertain the orders of the seasonal autoregressive integrated moving average model (SARIMA). The ADF statistics (Table I) indicate that all first differences of seasonal adjusted exchange rates are stationary in these countries. By comparing the two criteria among different orders, the specifications of the SARIMA model for exchange rate forecasting of each country can be summarized. The results of the SARIMA estimations are as follows.[8]

[7] Before estimating the money demand function by using the semi-open economy observations, I implemented a Wu-Hausman weak-exogeneity test by taking the change in foreign currency reserves as an instrumental variable to identify whether the endogeneity of domestic interest rates still holds in the above function. The results from the Wu-Hausman test indicate that the endogeneity of domestic interest rates still holds in the money demand function for these countries.

[8] Δs_t denotes first-difference logarithm of exchange rate per dollar at time t. The general specification for SARIMA (1, 1, 1, 1, 1, 1) is given as follows:

$$\Delta s_t^e = \gamma \Delta s_{t-4} + \phi(\Delta s_{t-1} - \gamma \Delta s_{t-5}) + \mu_t + \theta \mu_{t-1} + \delta(v_{t-4} - \phi v_{t-5}).$$

Korea: SARIMA(1, 1, 0, 0, 1, 1)

$$\Delta s_t^e = 0.665\Delta s_{t-1} + 0.917(\nu_{t-4} - 0.665\nu_{t-5}),$$
$$\quad (0.000) \qquad (0.000) \qquad (0.000)$$
$$\bar{R}^2 = 0.833, \; DW = 2.020.$$

Indonesia: SARIMA(0, 1, 0, 0, 1, 1)

$$\Delta s_t^e = 0.983\nu_{t-4},$$
$$\quad (0.000)$$
$$\bar{R}^2 = 0.829, \; DW = 1.772.$$

Thailand: SARIMA(0, 1, 1, 0, 1, 1)

$$\Delta s_t^e = -0.510\mu_{t-1} + 0.938\nu_{t-4},$$
$$\quad (0.000) \qquad (0.000)$$
$$\bar{R}^2 = 0.890, \; DW = 2.059.$$

Mexico: SARIMA(1, 1, 1, 0, 1, 1)

$$\Delta s_t^e = 0.782\Delta s_{t-1} + 0.590\mu_{t-1} + 0.903(\nu_{t-4} - 0.782\nu_{t-5}),$$
$$\quad (0.000) \qquad (0.000) \qquad (0.000) \qquad (0.000)$$
$$\bar{R}^2 = 0.775, \; DW = 2.096.$$

The uncovered interest parity rates (i^*) are therefore calculated by LIBOR on three-month dollar deposits plus expected exchange depreciation rate which was forecasted by the SARIMA model presented above.

The main interest of this paper is to identify how the openness of capital accounts (φ_t), as well as the exchange rate risk premium (α_t), have changed since the 1980s in response to major financial policy developments in the four developing countries.[9] I perform a preliminary stationary test for unit roots to the dependent variables and independent variables in equation (3) by using the ADF test before estimation. The results are shown in Tables II and III. They seem to reject the null hypothesis of a unit root for most series, except for Korea. Table IV presents the estimates and the associated test statistics for cointegration between the independent variable and dependent variable given in equation (3) for Korea. The Engle-Granger test for cointegration appears to reject the null hypothesis of no cointegration in equation (3).

The constant parameter estimated results of equation (3) for these countries are summarized as follows:

[9] As pointed out earlier, a statistical error may arise from difficulties in measuring the market's expectation of predictable returns. Therefore, the exchange risk premiums estimated in this paper could not completely represent the real risk premiums. For a detailed empirical study of exchange rate risk premiums, see Cheung (1993).

Constant Parameter Estimates of the Openness of Capital Accounts

	Korea	Indonesia	Thailand	Mexico
$\hat{C}$	0.077 (0.015)	0.027 (0.002)	0.013 (0.182)	0.176 (0.071)
$\hat{\varphi}$	0.866 (0.000)	0.905 (0.000)	0.702 (0.000)	0.811 (0.000)
RHO			0.173 (0.106)	0.354 (0.006)
$\bar{R}^2$	0.873	0.887	0.774	0.837
DW	2.908*	1.826*	1.703**	1.431***
LMhet	0.371*	0.814*	1.221*	8.942**

Note: $\hat{C} = \hat{\varphi}\hat{\alpha}$.

TABLE II

AUGMENTED DICKEY-FULLER TESTS IN EQUATION 3 FOR KOREA AND INDONESIA

Korea	$i_t^* - i_t'$	$i_t - i_t'$	Indonesia	$i_t^* - i_t'$	$i_t - i_t'$
$\hat{\delta}$	–0.276 (0.064)	–0.133 (0.465)	$\hat{\delta}$	–0.980 (0.000)	–0.998 (0.000)
DW	2.364 (0.907)	2.478 (0.991)	*DW*	1.984 (0.423)	1.979 (0.413)
LMhet	0.015 (0.902)	2.508 (0.113)	*LMhet*	1.158 (0.282)	0.873 (0.350)
Q-stat	5.903 (0.207)	13.378 (0.011)	*Q*-stat	0.781 (0.941)	1.085 (0.897)
R^2	0.159	0.079	R^2	0.588	0.597

TABLE III

AUGMENTED DICKEY-FULLER TESTS IN EQUATION 3 FOR THAILAND AND MEXICO

Thailand	$i_t^* - i_t'$	$i_t - i_t'$	Mexico	$i_t^* - i_t'$	$i_t - i_t'$
$\hat{\delta}$	–0.813 (0.001)	–1.008 (0.000)	$\hat{\delta}$	–0.914 (0.000)	–1.077 (0.000)
DW	2.002 (0.450)	1.947 (0.366)	*DW*	1.986 (0.426)	1.992 (0.437)
LMhet	0.006 (0.938)	0.708 (0.400)	*LMhet*	0.027 (0.868)	0.064 (0.800)
Q-stat	2.087 (0.720)	9.717 (0.045)	*Q*-stat	1.844 (0.764)	2.120 (0.714)
R^2	0.478	0.496	R^2	0.453	0.538

TABLE IV

ENGLE-GRANGER TEST IN EQUATION 3 FOR KOREA

$\hat{\delta}$	*DW*	*LMhet*	*Q*-stat	R^2
–1.059	1.832	2.537	6.995	0. 529
(0.000)	(0.254)	(0.146)	(0.136)	

As indicated above, the parameter φ satisfies the theoretical a priori bounds (0, 1), and it is highly significant and correctly signed. If the estimated φ value from this model turns out to be large, it will be interpreted as implying a high degree of capital account openness during the sample period. From the constant parameter regression results, most countries seem to be maintaining a high degree of openness in capital flows. In addition, the specifications appear to pass the diagnostics for heteroskedasticity in these countries. The Durbin-Watson statistics are consistent with the absence of serial correlation of residuals in Korea and Indonesia. For other countries, using the Cochrane-Orcutt procedure eliminated serial correlation. Therefore, this modeling approach (equation 3) allows us to estimate the effective degree of capital mobility (indexed by the parameter φ) for these countries. On the other hand, the constant term in equation (3) is interpreted as the difference in interest rates due to the difference in asset quality between domestic and international financial assets. According to the regression results, the lower and significant values of the constant terms are noticeable, with the exception of the insignificant value for Thailand. Nonetheless, it is difficult to capture the characteristic of structural change in the parameter φ over time by using constant parameter technique. Hence, it is hard to evaluate the timing, speed, and extent of capital market liberalization among these countries.

The model can be estimated by using a Kalman filter technique for obtaining time-varying parameter estimates. In order to assess the variability of φ_t, I plot the Kalman filter estimates with OLS or AR1 constant parameter estimates and the 90 per cent confidence intervals obtained. Under the null hypothesis of a constant parameter, the Kalman filter estimates show significant differences from the constant estimates and thus significant variability over the observation period if the estimates fall outside the 90 per cent confidence interval.

Figures 1.1–1.4 chart the time-varying parameter for the index of capital account openness (φ_t), and Figures 2.1–2.4 also illustrate the time-varying parameter for the index of exchange risk premium (α_t) in the four developing countries. From the time-varying parameter estimates, I would like to stress some unusual points.

First, in these countries, the time-varying parameter estimates satisfy the theoretical interval between zero and one. They almost show "significant" differences from the constant parameter estimates over the observation period, and display a wide variability in the index of capital account openness, except for Japan. Based

Fig. 1.1. Korea's Time-Varying Parameter Estimates of Capital Account Openness

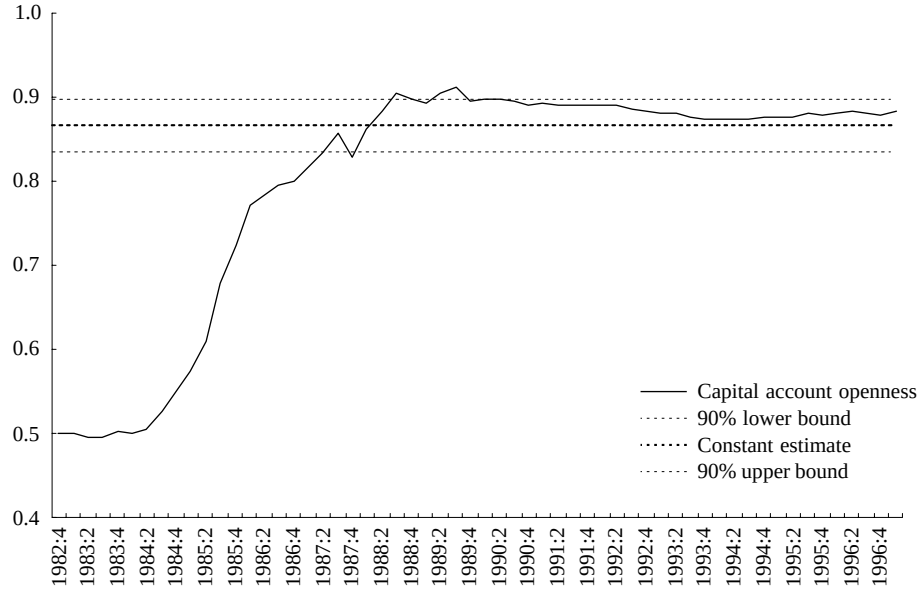


Fig. 1.2. Indonesia's Time-Varying Parameter Estimates of Capital Account Openness

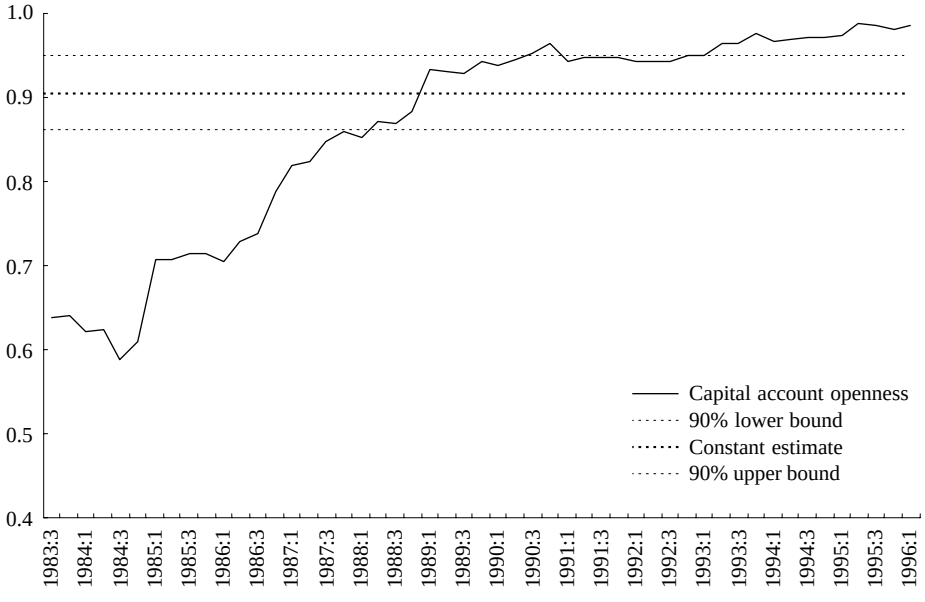


Fig. 1.3. Thailand's Time-Varying Parameter Estimates of Capital Account Openness

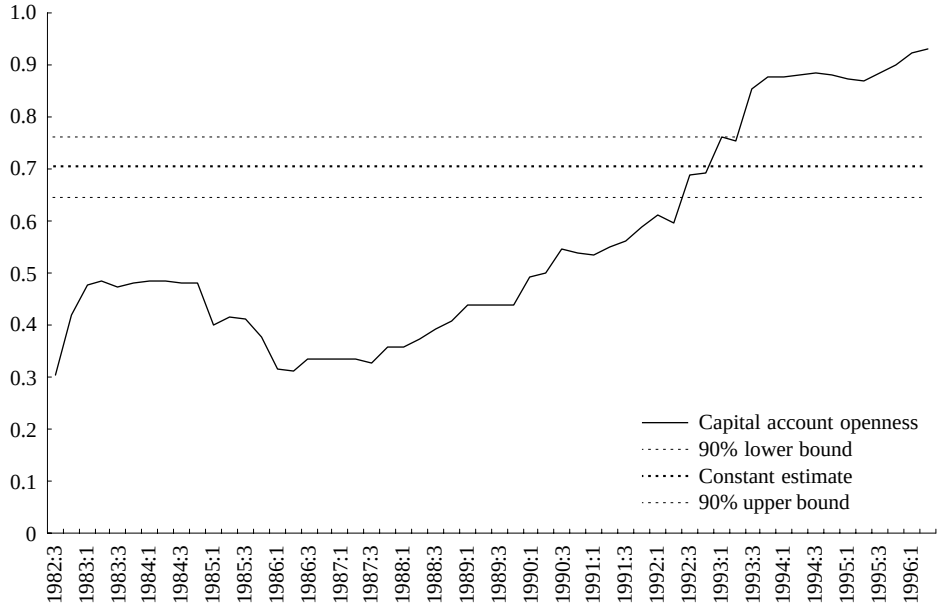


Fig. 1.4. Mexico's Time-Varying Parameter Estimates of Capital Account Openness

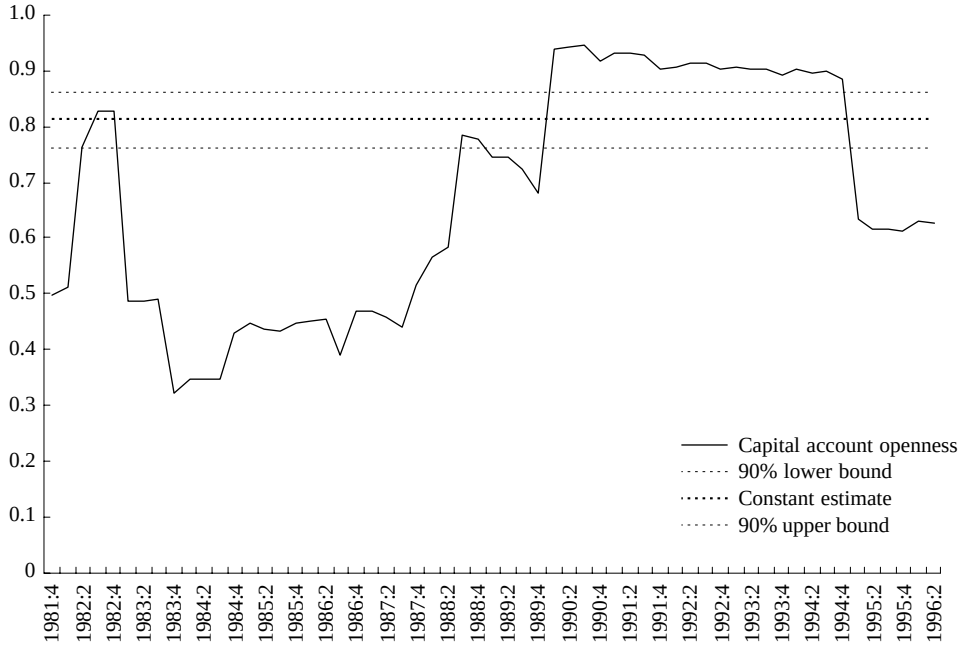


Fig. 2.1. Korea's Risk Premium Estimates

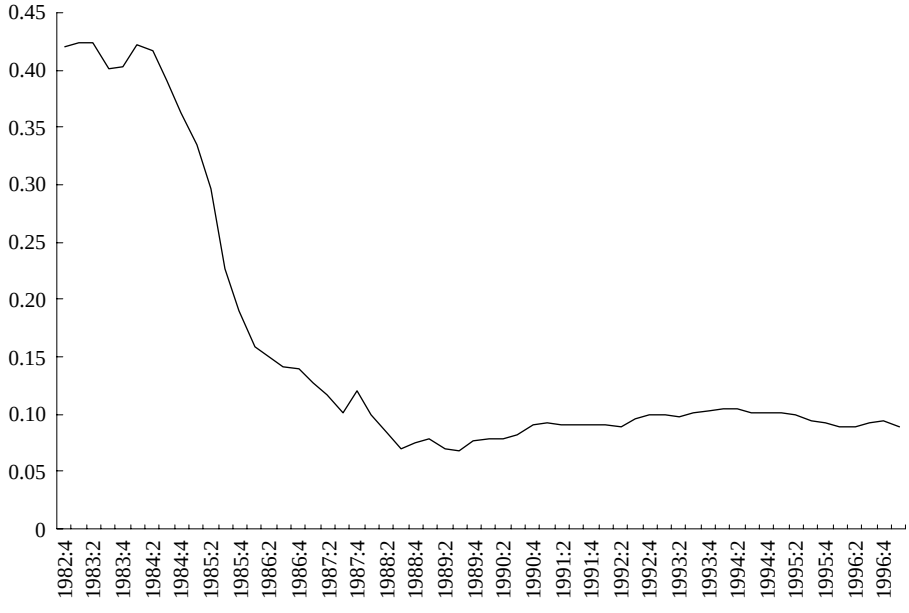


Fig. 2.2. Indonesia's Risk Premium Estimates

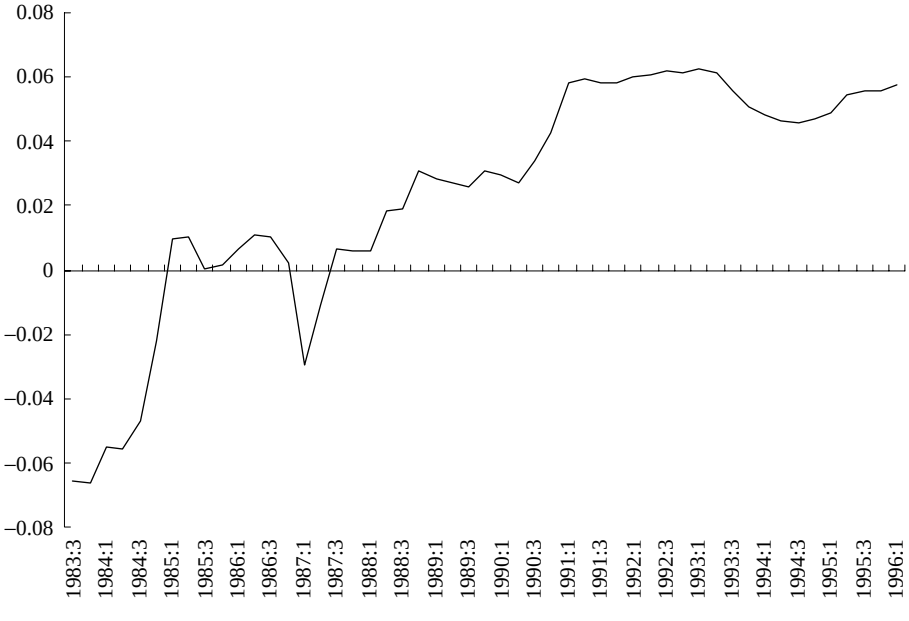


Fig. 2.3. Thailand's Risk Premium Estimates

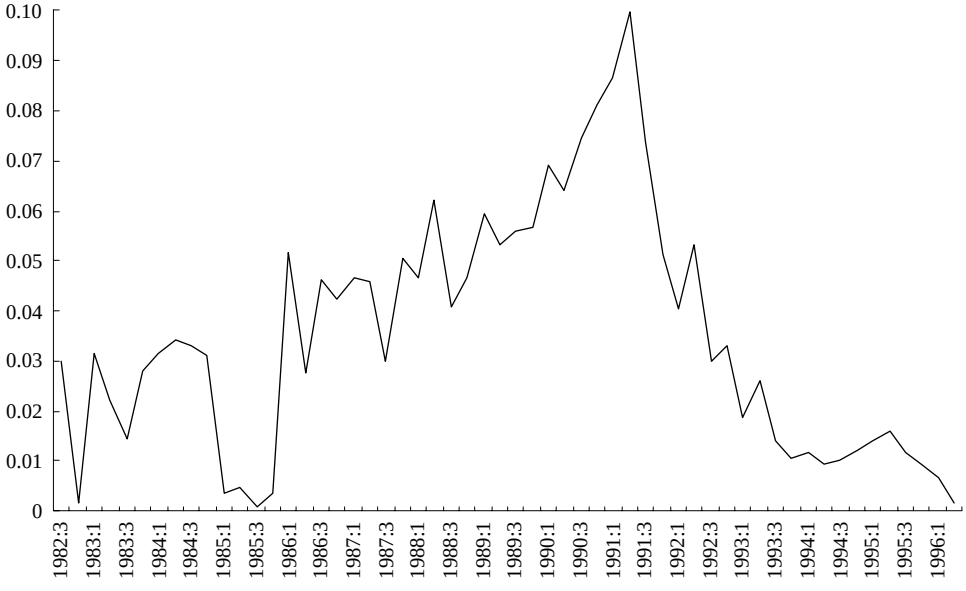


Fig. 2.4. Mexico's Risk Premium Estimates

on the change of the openness of the capital account over the observation period, Korea, Indonesia, and Thailand have followed a gradual approach to capital account liberalization, while Mexico seems to have undertaken a quite rapid capital account liberalization which showed us especially in 1989–90. (The sequencing of external and domestic financial liberalization for the four countries since the 1980s is summarized in Appendix Table II.)

Second, from the results of the Kalman filter estimation, it becomes clear that the four developing countries had reached relatively high levels of capital account openness just before the currency crisis. Korea achieved a reasonably high degree of openness in capital flows, but lower than the other countries.

Third, for Korea the openness of the capital account gradually increased during the early 1980s, then opened more significantly starting in 1985, with a little stagnation after 1987, and renewed opening in 1989. This finding is the opposite to the results of Reisen and Yeches (1993). Their results implied that Korea's openness gradually declined as the 1980s progressed. Their study differs from this study in how to measure the foreign return. Reisen and Yeches incorporated ex post depreciation in their foreign return, while this author uses an SARIMA(1, 1, 0, 0, 1, 1) prediction to model the future spot rate.

Fourth, Korea, Thailand, and Mexico show a reduction in the exchange risk premium during the 1990s. After Mexico's peso crisis at the end of 1994, Mexico's risk premium increased temporarily, then declined. However, in the Asian emerging markets, the same variations in the risk premiums were not found during the same period.

Finally, somewhat surprisingly, the exchange risk premium[10] moves in the opposite direction against the openness of capital accounts, except for Indonesia.

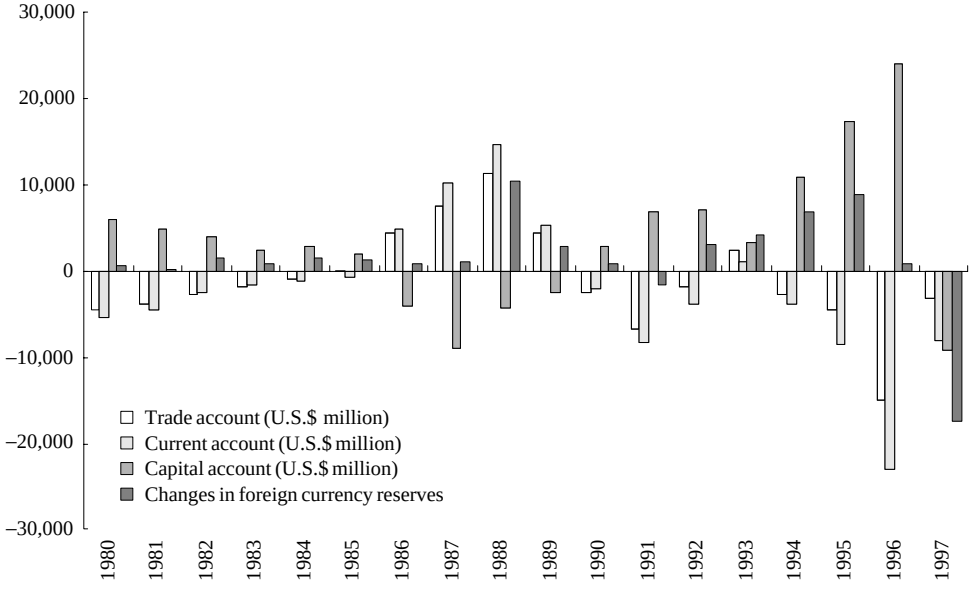
V. INTERPRETATION

Based on the empirical results, this section will provide a plausible interpretation to match the time-varying parameter estimates with coinciding stages in the liberalization of capital accounts for the four countries in this study.

Korea: Time-varying parameter estimates of capital account openness (Figure 1.1) showed a flat movement in the first half of the 1980s. During the same period, the country had current account and trade account deficits (Figure 3.1), and the government encouraged capital inflows and restricted capital outflows in order to prevent capital flight and to finance the current account. Thus there was a net capital inflow (Figure 3.1), and the risk premium (Figure 2.1) reflected a high level of foreign investors. The restrictions on capital movement were eased only in the face of massive current account surpluses (Figure 3.1) during the 1986–89 period which

[10] See footnote 9.

Fig. 3.1. Korea's Balance of Payments



Source: Figures 3.1–3.4 are based on IMF, *International Financial Statistics.*

Fig. 3.2. Indonesia's Balance of Payments

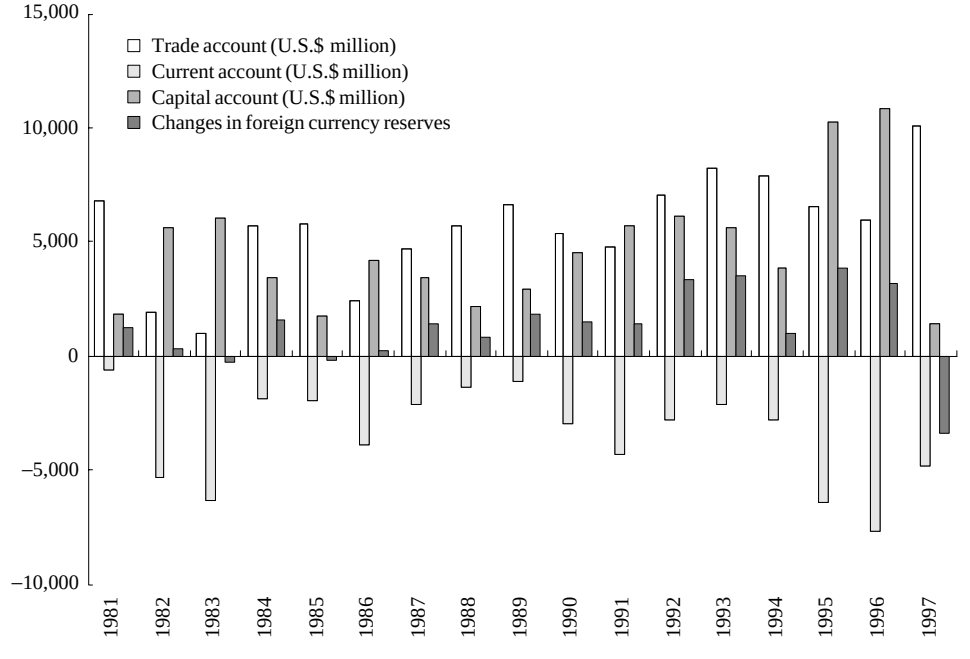
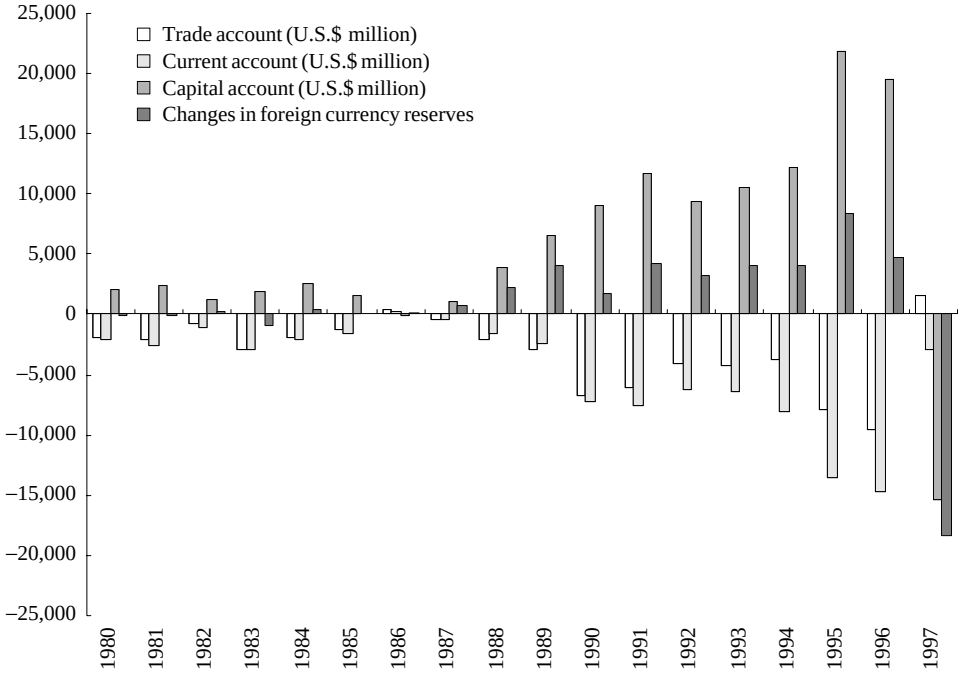


Fig. 3.3. Thailand's Balance of Payments

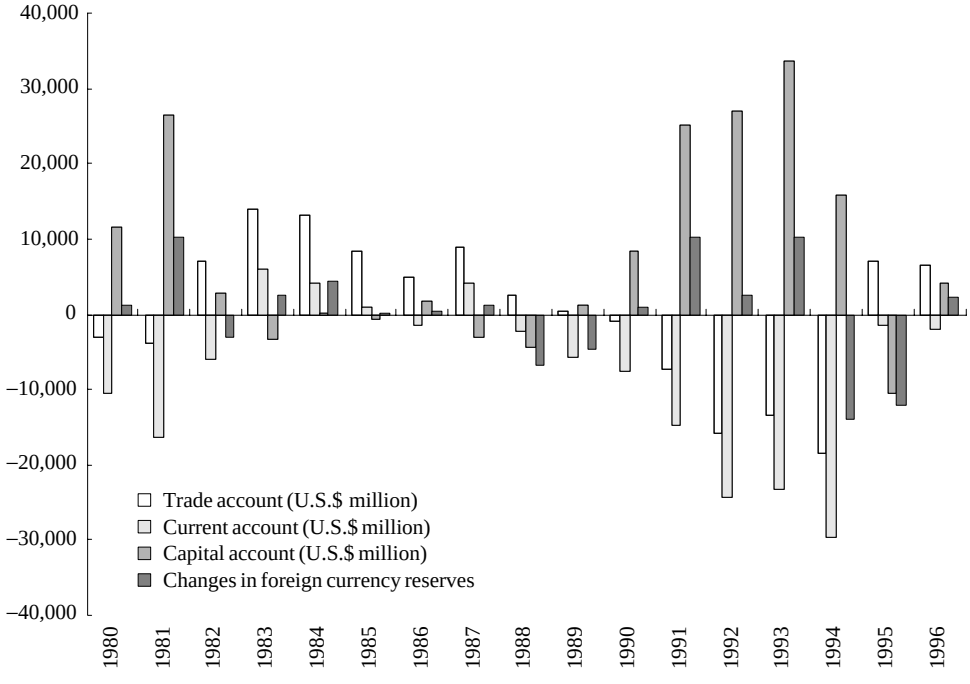


induced rapid monetary growth. Easing included moderating the restrictions on capital outflow, financial institutions and individual foreign borrowing and lending. Therefore net capital outflows (Figure 3.1) were observed. Since the increasing capital account openness (Figure 1.1) implied growing capital account liberalization, with the trade account showing a surplus, the risk premium declined throughout this period. During the 1990s the uncovered interest parity differential[11] remained positive, and thus the pressure of capital inflows was added. Moreover, since the current account remained in deficit, except for 1993, there was a surge in capital inflow (Figure 3.1) to finance the current account. Financial liberalization measures, such as the deregulation of many types of interest rates and foreign portfolio investments, were carried out, however Korea's openness was still not very high on the eve of the currency crisis, which is indicated by the time-varying parameter estimates of capital account openness (Figure 1.1).

Indonesia: The process of capital account liberalization since the 1980s can be divided into three periods. During the first period (from 1983 to 1987), the uncovered interest parity differential experienced great volatility because of exchange

[11] The results of the uncovered interest parity differential for the four developing countries will be supplied upon request.

Fig. 3.4. Mexico's Balance of Payments



rate and interest rate adjustments to liberalization. The exchange rate was depreciated in 1983 and again in 1986, since the country was running a current account deficit (Figure 3.2) during that period. The openness of the capital account (Figure 1.2) was low at that time, and capital inflow increased (Figure 3.2), mainly in the form of external borrowing under the public guarantees of the government and IMF bailout packages. Hence, foreign investors assumed risk premiums to be much lower (Figure 2.2). In the second period (from 1988 to 1991), financial sector reform was promoted by permitting greater foreign participation in the financial sector through the licensing of new foreign banks and branches. In 1989 the authorities liberalized portfolio capital inflows. Foreigners were permitted to invest in the stock market. The time-varying parameter estimates of capital account openness (Figure 1.2) also reflected an upward movement to a relatively high level. As external liabilities gradually increased, the risk premium (Figure 2.2) also grew larger. However, exchange rate policy remained stable, therefore change in the expected exchange rate continued to decrease. The movement in the risk premium also provided a plausible reason why the positive uncovered interest parity differential continued. In 1991 the Indonesian economy began to overheat, the current account deficit (Figure 3.2) widened, and interest rates rose substantially. At the same time the country main-

tained a stable real exchange rate which together with the increase in interest rates induced a substantial inflow of foreign capital (Figure 3.2). The foreign capital inflow was mainly in the form of commercial bank borrowing. During the third period (from 1992 to 1996), limitations were implemented on public sector borrowing from abroad. Nevertheless, the government continued to broaden the arrangements for foreign borrowing by private entities, including sales of securities to nonresidents and liberalization of foreign direct and portfolio investment through the stock markets as part of financial sector development. These measures are reflected in the time-varying parameter estimates of capital account openness which maintained an upward trend during the period. Hence, the large uncovered interest differential under a stable exchange rate could also be explained by the large positive risk premium (Figure 2.2). Moreover, the net private capital inflows were partly offset by a widening in the current account deficit (Figure 3.2).

Thailand: Throughout the 1980s, a decisive change was made to orient trade and industrial policies toward export-led growth. Thailand gave priority to promoting capital inflows through tax and institutional reforms while concurrently developing its financial markets. This policy, together with positive uncovered interest parity differentials and a fixed exchange rate, promoted net capital inflows (Figure 3.3). In contrast to the promotion of capital inflows, controls on capital outflows were liberalized only gradually. Hence, the openness of the capital account (Figure 1.3) was relatively low, and the risk premium (Figure 2.3) continued to rise during the period. It was in the 1990s that Thailand started to substantially liberalize financial capital flows and foreign exchange transactions. Interest rates and credit controls were liberalized gradually, and further capital account liberalization followed in 1992 with the establishment of the Bangkok International Banking Facility (BIBF), an offshore banking center, which greatly eased access to foreign financing and expanded short-term inflows. Therefore, the time-varying parameter estimates of capital account openness (Figure 1.3) moved to a much higher level and risk premium (Figure 2.3) decreased sharply. The government managed to absorb excess liquidity caused by large short-term capital inflows (Figure 3.3), but they had to take high interest rate measures which led to positive uncovered interest parity differentials. Consequently in 1995 Thailand began to restrict short-term capital inflows by imposing a 7 per cent reserve requirement on nonresident baht bank accounts. These restrictions were extended in 1996 to cover new foreign borrowing of less than one year. Nonetheless, Thailand's growth and investment levels deteriorated in the face of an appreciating real exchange rate and a large current account deficit (Figure 3.3). High interest rates to counteract outflows aggravated the solvency and liquidity position of many banks and finance companies.

Mexico: The process of capital account liberalization can be divided into three periods. From 1983 to 1987 a comprehensive stabilization program was put into place and fiscal consolidation took place, one being the reduction of public expen-

ditures, in order to pay back massive foreign debts. Trade was the main area of liberalization, therefore the openness of the capital account (Figure 1.4) was relatively low, and the risk premium (Figure 2.4) rose. Important financial reform was initiated in 1988 when interest rates were freed. A wide-ranging privatization program was also put into effect. Small manufacturing firms were privatized first, then public utilities, followed by banks. Drastic capital account liberalization culminated with the signing of NAFTA (North American Free Trade Agreement). Private capital inflows began in the late 1980s and grew continually until the December 1994 peso crisis. Hence, from 1988 to 1991, the time-varying parameter estimates of capital account openness (Figure 1.4) increased dramatically, and the risk premium (Figure 2.4) declined sharply. Moreover, the uncovered interest parity differential was shortened but remained positive which led to increasing net capital inflows (Figure 3.4). Finally, from 1992 to 1994, the openness of the capital account remained at a high level (Figure 1.4), and the risk premium (Figure 2.4) stayed very low. There was a surge of capital inflow (Figure 3.4) in the form of portfolio investments, although controls on bank borrowing from abroad were applied.

VI. CONCLUSION

This study has applied a Kalman filter technique to evaluate the time-varying parameter estimates of capital account openness, as well as risk premium. It examined four developing countries that have undergone significant capital account liberalization since the second half of the 1980s.

When comparing the capital account liberalization in the three Asian countries to that in Mexico, the results indicate that the three Asian countries have taken a rather gradual approach in contrast to the relatively rapid approach by Mexico. This coincides with the stages in the liberalization process that these countries actually went through.

Despite their more gradual approach to capital account liberalization, the three Asian countries were unable to avoid large-scale speculative attacks on foreign exchange in the second half of 1997, similar to what was observed in Mexico in late 1994.

The empirical estimates of capital account openness presented in this study strongly support the view that domestic market interest rates in the four countries have become more closely linked in recent years with rates in the rest of the world. The recent surge in capital inflows can be initially attributed to domestic and external reforms. Foreign capital can finance investment and stimulate economic growth. However, large capital inflows can also have less desirable macroeconomic effects, including rapid monetary expansion, inflationary pressures, and real exchange rate appreciation. Thus, governments have to take strong intervention measures in the foreign exchange market in order to insulate the money supply and/or the exchange

rate from the effects of capital inflows. Unfortunately, all of these policies have tended to provide especially strong incentives for short-term capital inflows as have been seen in most developing countries.

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APPENDIX TABLE I

Variables	Description
M_t	Money stock M1
P_t	Consumer price index
y_t	GDP at constant prices (1990)
i_t	Money market rate: corporate bond rate for Korea, call money rate for Indonesia, money market rate for Thailand, and treasury bill rate for Mexico
i_t^{us}	LIBOR (London Interbank Offered Rate) on 3-month dollar deposits
s_t	Spot exchange rate (local currency units per U.S.$) at the end of the period

APPENDIX TABLE II

SEQUENCE OF EXTERNAL AND DOMESTIC FINANCIAL LIBERALIZATION

	Korea	Indonesia	Thailand	Mexico
Liberalization process (1)	1981–85: Interest rate regulated; capital inflow encouraged; outflow controlled	1983–87: Trade liberalized; interest rate decontrolled; direct investment inflow encouraged	1981–89: Export-led industries developed; foreign capital inflows encouraged	1983–87: Trade liberalized; public expenditure reduced; multiple exchange rates; capital controlled
Liberalization process (2)	1986–89: Capital outflow decontrolled; capital inflow controlled; monetary stabilization bonds issued	1988–91: Domestic financial sector reformed; entry of joint venture banks relaxed; foreign exchange market liberalized	1990–95: Interest rates and credit controls removed; capital outflow decontrolled; financial sector reformed	1988–91: Financial sector reformed; foreign direct investment and portfolio capital inflow decontrolled; privatization boomed
Liberalization process (3)	1990–97: Interest rate liberalized; portfolio capital flow allowed; domestic financial system reformed	1992–97: Foreign portfolio investment liberalized; domestic capital markets strengthened; public sector borrowing limited	1996–97: Short-term capital inflows restricted; managed floating exchanged rate regime adopted	1992–94: Bank borrowing from abroad regulated; entry of foreign financial institutions relaxed; sterilization adopted