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SIMULATION ANALYSIS OF EXCHANGE RATE DYNAMICS: THE CASE OF INDONESIA

TAKAO FUKUCHI
SUMINORI TOKUNAGA

I. INTRODUCTION

THIS paper aims to quantitatively analyze the trend of the exchange rate in conjunction with external transactions in Indonesia before and after the Asian currency crisis (ACC) initiated in July 1997 in Thailand. The economy of Indonesia currently faces the risk of free fall based on various vicious circles, and requires some adequate counter-measures. One of the key relations is the interaction of the exchange rate and external transactions. To clarify this relation, we constructed a monthly econometric model with eleven equations (exchange rate, inflow, outflow, net inflow and stock of short-term capital, dollar and rupiah values of export and import, trade balance, and real GDP) for the period February 1996–December 1997. We selected the purchasing power parity (PPP), bandwagon effect, and net private capital inflow as three basic explanatory variables that affect the exchange rate. Based on the final test, we clarified the contributions of these variables to the changes of the exchange rate. We also applied the model to in-sample simulations and conditional forecast until December 1998.

The structure of this paper is as follows. In Section II we review the chronology of ACC, and trends of relevant variables in Indonesia, and discuss the possible determinants of the exchange rate. In Section III we construct the monthly model, and show the results of final test and factor decomposition of the changes of the exchange rate. In Section IV we show the results of in-sample simulation of the exchange rate depreciation. In Section V we apply the model to conditional forecasts until December 1998. Section VI concludes the paper.

II. CHRONOLOGY OF THE ASIAN CURRENCY CRISIS

In 1993, the World Bank published the report entitled *The East Asian Miracle*, and praised eight Asian countries for their remarkable growth achievements by refer-

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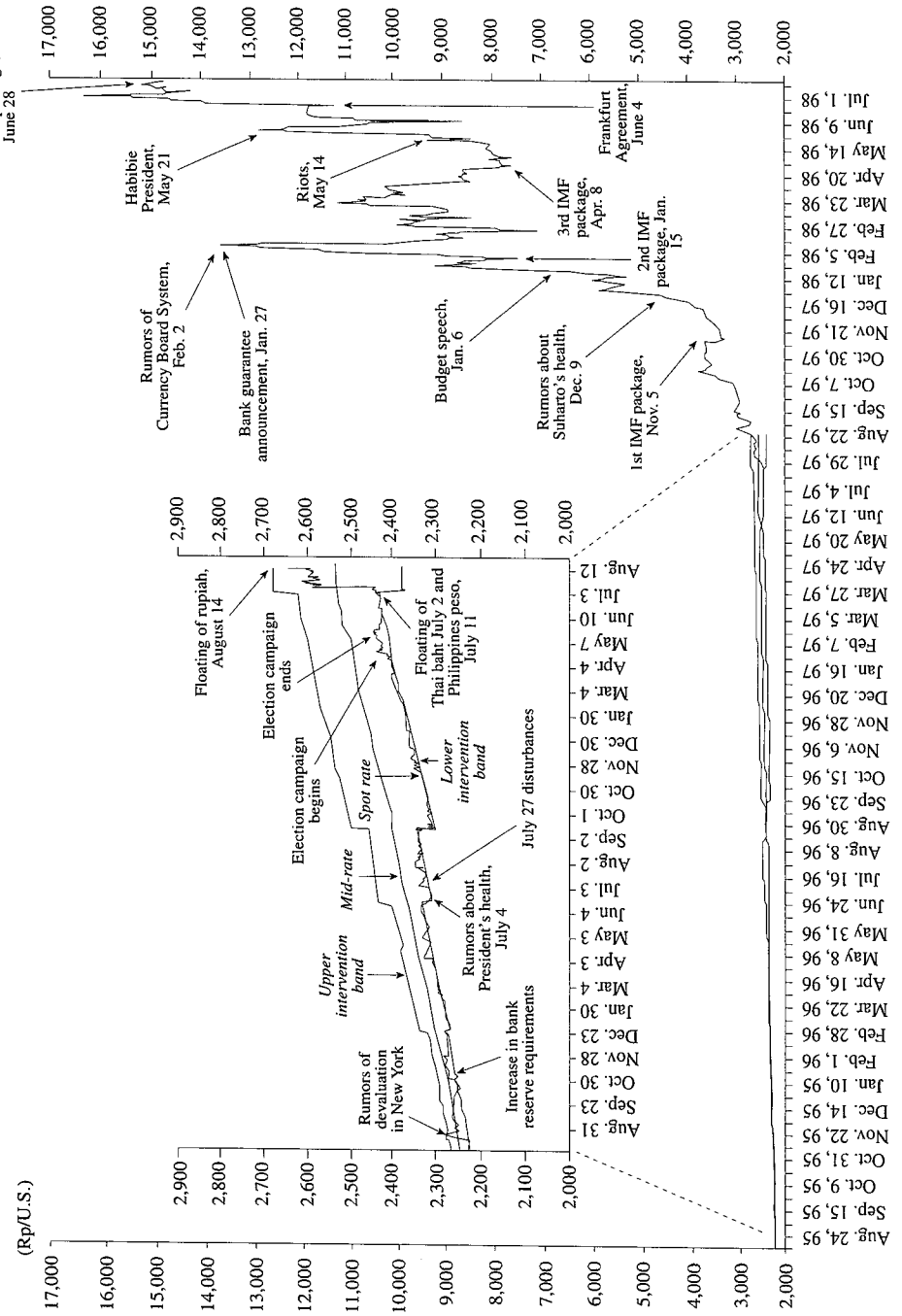
ring to them as "high-performing Asian economies (HPAEs)." Based on the confidence in the future growth potential of these countries, and also stimulated by the low interest rate in advanced economies, massive direct and equity investments flowed into these countries. Until 1996, long-term as well as short-term private debts accumulated quickly in many Asian countries. The massive capital inflow resulted in the appreciation of the national currencies of these countries. The appreciation of the exchange rate worsened the trade balance, but the trade deficit was successfully covered by the continuation of further capital inflow. The strong confidence of investors in the future growth potentials of these economies contributed to a continuing source of foreign currency earnings. We might call this tendency the East Asian disease in the same way as the Dutch disease.

But as the degree of appreciation increased, the chance of speculative attack increased. In July 1997, the Thai baht collapsed by the speculative attack, and then ACC exerted wide and serious impacts on other Asian countries based on the bandwagon effect, and halved the value of the national currency of Thailand, Indonesia, and the Republic of Korea by the end of 1997. Based on the prompt agreement with the International Monetary Fund (IMF) about the structural reform package and rapid injection of international rescue funds, the ACC in Thailand or in Korea began to be quickly fixed politically in the short-run and economically in the medium term. However, the Indonesian government could not rapidly implement the necessary agreement with the IMF, and the second injection of the IMF tranche was postponed until April, while the Indonesian rupiah experienced a further devaluation of 70–80 per cent compared with the level before ACC (from Rp 2,300 in July 1997 to more than Rp 10,000 in January and March 1998). The devaluation of the rupiah exacerbated the debt burden, which increased the probability of default and accelerated further devaluation. Such a vicious circle was successfully cut off in Thailand and Korea, but exerted a full impact on the whole economy in Indonesia. Thus ACC can be separated into two subperiods: first subperiod until December 1997 during which a similar devaluation tendency was disseminated to many Asian economies based on the bandwagon effect, and a second subperiod during which a vicious circle was stopped in Thailand and Korea, but did materialize in Indonesia (Figure 1).[1]

Why was Indonesia trapped in such a vicious circle? What are the basic conditions of materialization of a vicious circle? To deduce the conditions, we need a workable exchange rate equation. The fact that the actual exchange rate remained

[1] World Bank report (1998) is based on a more detailed subdivision of the events: first stage, July–October 1997; second stage, November and first week of December 1997; third stage, from December 5 (first IMF Package), December 9, 1997 (Suharto's health problems), January 6 (Budget speech) to January 27, 1998 (banking sector restructuring plan and private debt initiative); fourth stage, April 8, 1998 (third IMF package) until the student protest in April; and fifth stage, after the protests. Soesatro and Basri (1998) gives a detailed review of the events until February 1998. Such a definition suggests that we even need a weekly or daily approach to deepen the analysis. This is beyond the scope of our analysis.

Fig. 1. Chronology of the Crisis Based on the Rupiah Exchange Rate
(Spot Rate and Intervention Bands, August 1995–July 1998)



Source: World Bank (1998, Fig. 1.3) based on Bank Indonesia data.

at the lowest bottom of the band during the period from the spring of 1996 to the summer of 1997, and suddenly sprang up over the upper limit of the band after August 1997 suggests that the actual exchange rate dynamics clearly diverged either from the Mundell-Fleming model, which emphasizes the influence of current balance, and also from the monetarist model, which assumes the perfect substitutability among monetary assets of different countries, and the persistence of a short-term PPP relation. Therefore, we decided to adopt an eclectic portfolio balance approach, which recognized the influence of current and capital balances and also partial reversion to PPP. Therefore we assume that the following three factors were the main determinants of the exchange rate.[2]

(a) Purchasing power parity (PPP)—Long-run equilibrium exchange rate. The exchange rate is the ratio between the purchasing power of local and reference currencies. In a sense the exchange rate is interpreted as the relative price of non-traded goods to traded goods. When we assume that the price of traded goods is internationally common, the exchange rate can be represented as the ratio of non-traded good prices between two countries. Therefore, it is expected that in the long-run the exchange rate will converge to long-run PPP. But there are three issues to consider for the successful convergence: (i) selection of reference currency, (ii) existence of long-run PPP, (iii) convergence speed of actual rate to PPP.

(i) Among the developed countries, the export price is set by exporter's currency (Grassman's law), but "setting price in the importer's currency maximizes expected utility when risk aversion and forward currency market are introduced" (Friberg 1998, p. 59). In the case of Indonesia, U.S. dollar is the best reference currency to calculate PPP, based on the large export share to the United States.

(ii) Existence of long-run PPP. Pattinasarany (1997) used the data of November 1978 to July 1996 in Indonesia, and showed that "there exists a long-run equilibrium relation among exchange rate and WPI for Indonesia and the US over the last decade, [but] the absolute long-run PPP equilibrium does not prevail" (p. 259). Alse and Bahmani-Oskooee (1995) showed that there was no long-run relationship between terms-of-trade effective exchange rate for twenty-five countries. Currently it is difficult to define the PPP (represented by the ratio of CPI, consumer price index, with reference country) equilibrium exchange rate, when the expected rate of inflation exceeds 80 per cent.

(iii) Wei and Parsley (1995) used the ninty-one OECD countries pairs of 1973–86, and showed that the deviation was positively related to the exchange rate volatility. He pointed out that there was a tendency of mean reversion to

[2] Our approach differs from the various structural monetary models or their reduced forms, which explain the exchange rate based on money supply, interest rate, total output (see Bhawnani and Kadiyala [1997]).

PPP, and that the half-life of the deviation from PPP exceeded four years.

Based on these three considerations, (i)–(iii), we conclude that long-run PPP may not exist, and even if it exists, the actual rate diverges from it, and the convergence speed is moderate. Thus in the actual economy, we can safely assume that the exchange rate tends to approach the PPP variable in the short-run.

(b) Trade balance equilibrium exchange rate. The depreciation (appreciation) results in the improvement (deterioration) of the trade balance when the Marshall-Lerner stability condition is met, and pass-through is positive. When the surrounding countries have a similar trade pattern, the depreciation (appreciation) puts the pressure in the same direction to maintain the international competitiveness, so that the condition can be interpreted in the relative sense.

(c) Private capital market equilibrium exchange rate. When the capital inflow matches or slightly exceeds the outflow, since the capital movement may exert a mild and stable appreciation pressure upon the current exchange rate, its effect is negligible on the exchange rate determination. But when the investor's confidence drastically changes, a volatile movement in capital movement occurs which may exert a strong impact on the exchange rate.

There are contrasting interpretations about the currency crisis: (1) emphasis placed on the volatile changes of investor's expectation, (2) structural weakness of countries in crisis, (3) a fatal combination of several self-reinforcing factors (Chowdury 1998, p. 2). The first interpretation emphasizes the dominance of short-term capital market rate, (c). The second interpretation points to the divergence of the on-going exchange rate from (a) or (b). Our interpretation is similar to (3), and we consider that the current exchange rate volatility resulted from a series of external shocks: bandwagon effect from Thailand, worsening domestic economy with accelerated inflation, self-fulfilling debt repayment crisis, and repetition of political shocks. In other words, the exchange volatility can be described endogenously by a simultaneous equation system in which the exchange rate changes with three factors, and also had repercussions on the whole economy. Based on these considerations, we selected three basic factors for the determination of the exchange rate.

(a) PPP consideration (crawling peg based on relative CPI). As shown in Figure 1, the Government of Indonesia initiated a crawling peg operation with a band, and the rate was depreciated annually by 2–3 per cent until July 1997. This basic trend can be adequately described by the relative CPI variable: CPI of Indonesia to CPI of the United States. We refer to this as PPP variable.

(b) Bandwagon effect. The rapid depreciation of the currency in competing exporting countries led to a relative appreciation of the Indonesian rupiah, and resulted in the deterioration of the trade balance, and in a countervailing reaction of depreciation. The real Thai baht was selected as the representative currency based on its dominant influence until December 1997, although many other currencies also influenced to the rupiah after 1998.

(c) Private capital inflow. From August 1996 until August 1997, the rupiah exchange rate adhered to the lower band. This appreciation pressure originated from the strong tendency of private capital inflow. Therefore, we introduced the ratio of net private capital inflow to the private capital stock as the proxy of pressure from private capital inflow.

We estimated the exchange rate equation based on these three variables. Later we will try to clarify the relative contribution of each variable empirically. In the first few months of 1998, the exchange rate exhibited a volatile change while private capital outflow practically ceased. This implies that the exchange rate trend after January 1998 was influenced not only by basic factors, but also by many noneconomic disturbances. We are interested in analyzing the effects of various instruments on the exchange rate and short-term capital movement. Thus the first task is to evaluate the influences of noneconomic factors and add these influences to the exchange rate equation, so that the projected path could simulate the actual trend of the exchange rate. For that purpose, our strategy is as follows: (1) to derive a workable exchange rate equation based on the existing data until December 1997, and (2) to extrapolate the trend by the whole model until March 1998, considering the basic three variables but not the noneconomic disturbances (we refer to this trend as simple or fundamental trend), and (3) to determine the values of noneconomic disturbances for the period January–March 1998, assuming that the estimated values of the exchange rate by the whole model coincide with the actual values, and (4) to project the model until December 1998 assuming the existence of these noneconomic disturbances (we refer to this trend as projected trend). We explain the results in Section V.

III. MODEL ESTIMATION

We prepared the monthly data for January 1995–December 1998, and estimated the monthly model with eleven equations based on the monthly data of twenty-three samples from February 1996 to December 1997. But as the capital outflow equation includes the capital inflow of the preceding year, the model utilized the data of three years (January 1995–December 1997). Figure 1 shows the tendency of the exchange rate in recent years. During the period February 1996–July 1997, the exchange rate adhered to a narrow band, and the trend changed after August 1997 and also after January 1998. When we regress the exchange rate (*RATE*) on the time trend (*TIME*), the results are as follows:

$$RATE = \underset{(3.66)}{1{,}050.71} + \underset{(5.28)}{34.31} \cdot TIME + u \text{ (Feb. 1996–Dec. 1997)}, \qquad (1)$$

$$R^2 = 0.4588,\ RA^2 = 0.1957,\ R = 0.6773,\ RA = 0.4423,$$
$$S = 387.65,\ d = 0.26.$$

$$RATE = -1{,}891.21 + 112.48 \cdot TIME + u \text{ (Feb. 1996–Mar. 1998)}, \quad (2)$$
$$(-1.61) \quad (4.41)$$
$$R^2 = 0.3508,\ RA^2 = 0.1107,\ R = 0.5923,\ RA = 0.3327,$$
$$S = 1{,}724.04,\ d = 0.37.$$

We introduced two dummies ($DUM1$, $DUM2$) to check the structural changes:

$$RATE = (8.929 + 147.8 \cdot DUM1 + 203.5 \cdot DUM2) \cdot TIME$$
$$(1.51) \quad (0.68) \quad (1.03)$$
$$+ 1{,}976.27 - 14{,}041 \cdot DUM1 - 5{,}176 \cdot DUM2$$
$$(8.10) \quad (-1.05) \quad (-0.42)$$
$$+ u \text{ (Feb. 1996–Mar. 1998)}, \quad (3)$$
$$R^2 = 0.9849,\ RA^2 = 0.9653,\ R = 0.9924,\ RA = 0.9825,\ S = 279.22,\ d = 2.99.$$
$$[DUM1 = 1 \text{ (97:7–12)}, = 0 \text{ (other periods)};\ DUM2 = 1 \text{ (98:1–3)},$$
$$= 0 \text{ (other periods)}]$$

Although relatively small t-values for dummies are based on the relatively short influencing periods (six and three months), the major improvement of fitting revealed that the structural changes expressed by two dummies actually occurred. The exchange rate increased by Rp 1,773 per year after July 1997, and by Rp 2,442 per year after January 1998 along with the corresponding decrease of the constant term. Obviously, since a dummy is a black-box variable without any theoretical implication, our strategy is to explain the tendency in the observation period (February 1996–December 1997) with three basic variables without using dummy variables.

The estimated results of the model are as follows. Figure 2 shows the causal ordering map of the model. The whole model can be interpreted as an amalgamation of two submodels: capital movement submodel (inflow, outflow, net inflow, stock of private capital, and exchange rate) and commodity trade submodel (dollar and rupiah values of export and of import, real GDP, and exchange rate). Two submodels consist of different groups of variables, while the exchange rate of only one common variable. We utilize two submodels and the whole model for simulation studies at later stages. The list of the variables of the whole model, and the results of estimation by the ordinary least square method are as follows.

List of Variables (Whole Model)

Endogenous variables:

RATE:	Exchange rate	(Rupiahs per U.S. dollar)
FIN$:	Private capital inflow	(U.S.$ million)
FOUT$:	Private capital outflow	(U.S.$ million)
NET$:	Net private capital inflow	(U.S.$ million)
SF$:	Outstanding stock of private capital	(U.S.$ million)

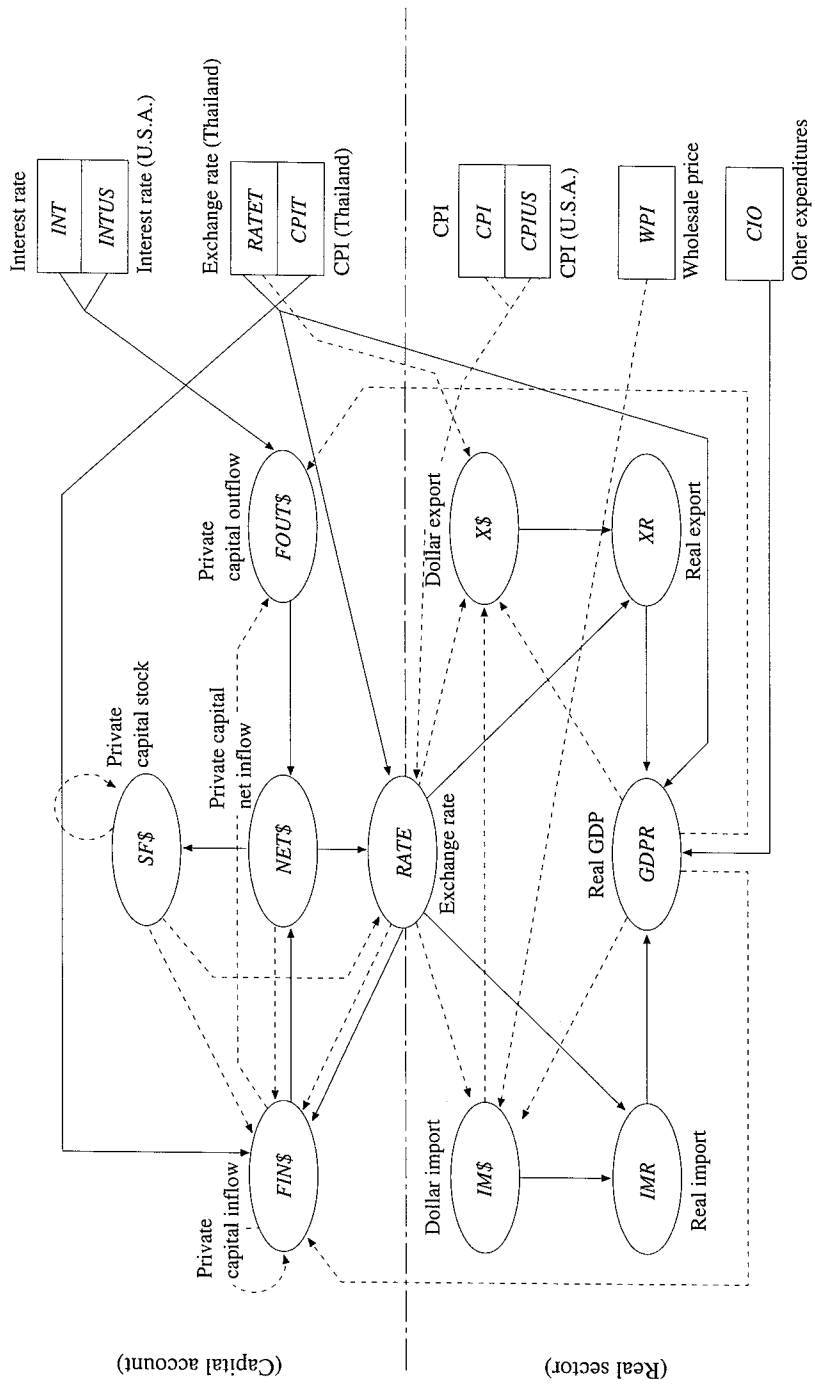


Fig. 2. Causal Ordering Map of Exchange Rate Model, February 1996–December 1997

X$:	Dollar value of export	(U.S.$ million)
IM$:	Dollar value of import	(U.S.$ million)
TB$:	Trade balance	(U.S.$ million)
XR:	Rupiah value of real export	(Rp billion)
IMR:	Rupiah value of real import	(Rp billion)
GDPR:	Rupiah value of real GDP	(Rp billion)

Exogenous variables:

CPI:	Consumers price index	(1990 = 100)
WPI:	Wholesale price index	(1990 = 100)
CIO:	Rupiah value of other expenditure items	(Rp billion)
CPIT:	Consumers price index of Thailand	(1990 = 100)
CPIUS:	Consumers price index of the United States	(1990 = 100)
RATET:	Exchange rate of Thailand	(Bahts per U.S. dollar)
INT:	Interest rate	(%)
INTUS:	Interest rate of the United States	(%)
AT$:	Adjustment term	(U.S.$ million)

Short-Term Monthly Model of Indonesian Economy (Feb. 1996–Dec. 1997)

1. Exchange Rate (*RATE*)

$$RATE = \underset{(-1.97)}{-3{,}505.90} + \underset{(8.92)}{12{,}819}\cdot(RATET/CPIT) - \underset{(-2.16)}{6{,}344}\cdot(NET\$/SF\$)(-1) + \underset{(1.90)}{2{,}285}\cdot(CPI/CPIUS)(-1) + u, \quad \text{(E-1)}$$

$R^2 = 0.9825$, $RA^2 = 0.9598$, $R = 0.9912$, $RA = 0.9797$, S = 85.20, $d = 2.96$.

2. Private Capital Inflow (*FIN$*)

$$FIN\$ - FIN\$(-1) = \underset{(1.63)}{1{,}511.54} + \underset{(3.29)}{3{,}672}\cdot(RATE/RATE(-1)) - \underset{(-2.11)}{13{,}759}\cdot(NET\$/SF\$)(-1) - \underset{(-6.69)}{25{,}949}\cdot(RATET/CPIT) + \underset{(1.16)}{0.1539}\cdot(GDPR(-3) - GDPR(-4)) + u, \quad \text{(E-2)}$$

$R^2 = 0.8775$, $RA^2 = 0.7230$, $R = 0.9367$, $RA = 0.8503$, $S = 199.14$, $d = 1.70$.

3. Private Capital Outflow (*FOUT$*)

$$FOUT\$ = \underset{(1.36)}{169.109} - \underset{(-3.12)}{15.14}\cdot(INT - INTUS) + \underset{(2.21)}{0.09010}\cdot(GDPR(-1) - GDPR(-2)) + \underset{(42.50)}{0.1366}\cdot S + u, \quad \text{(E-3)}$$

where S is the sum of past short-term capital inflow of seven periods:

$$S = FIN\$(-6) + FIN\$(-7) + FIN\$(-8) + FIN\$(-9) + FIN\$(-10) + FIN\$(-11) + FIN\$(-12),$$

$R^2 = 0.9910$, $RA^2 = 0.9792$, $R = 0.9955$, $RA = 0.9895$, $S = 68.32$, $d = 0.76$.

4. Net Private Capital Inflow ($NET\$$)

$$NET\$ = FIN\$ - FOUT\$. \tag{E-4}$$

5. Outstanding Stock of Private Capital ($SF\$$)

$$SF\$ = SF\$(-1) + NET\$ \tag{E-5}$$

6. Dollar Value of Export ($X\$$)

$$\begin{aligned}\log(X\$) = {} & -12.9768 + 1.044 \cdot \log(RATE(-3)/RATET(-3)) \\ & \quad (-6.82) \qquad (3.64) \\ & + 0.3641 \cdot \log(IM\$(-3)) \\ & \quad (3.98) \\ & + 1.314 \cdot \log(GDPR(-4)) + u, \\ & \quad (11.10)\end{aligned} \tag{E-6}$$

$R^2 = 0.8989$, $RA^2 = 0.7796$, $R = 0.9481$, $RA = 0.8830$,
$S = 0.02640$, $d = 1.15$.

7. Dollar Value of Import ($IM\$$)

$$\begin{aligned}\log(IM\$ \cdot RATE(-5)) = {} & 15.0809 + 1.233 \cdot \log(WPI(-5)/RATE(-5)) \\ & \quad (5.27) \qquad (2.30) \\ & + 0.3453 \cdot \log(GDPR(-4)) + u, \\ & \quad (1.40)\end{aligned} \tag{E-7}$$

$R^2 = 0.2729$, $RA^2 = 0.0401$, $R = 0.5224$, $RA = 0.2002$, $S = 0.05620$, $d = 1.37$.

8. Rupiah Value of Real Export (XR)

$$\begin{aligned}XR = {} & 6{,}029.24 + 0.0002331 \cdot RATE \cdot X\$ + u, \\ & \quad (13.95) \qquad (6.40)\end{aligned} \tag{E-8}$$

$R^2 = 0.6614$, $RA^2 = 0.4164$, $R = 0.8133$, $RA = 0.6453$, $S = 548.06$, $d = 0.44$.

9. Rupiah Value of Real Import (IMR)

$$\begin{aligned}IMR = {} & 7{,}188.66 + 2.089 \cdot RATE \cdot IM\$ + u, \\ & \quad (11.62) \qquad (3.20)\end{aligned} \tag{E-9}$$

$R^2 = 0.3281$, $RA^2 = 0.0877$, $R = 0.5728$, $RA = 0.2961$, $S = 543.66$, $d = 0.59$.

10. Definition of Rupiah Value of Real *GDP* ($GDPR$)

$$GDPR = CIO + XR - IMR. \tag{E-10}$$

11. Definition of Trade Balance ($TB\$$)

$$TB\$ = X\$ - IM\$ + AT\$. \tag{E-11}$$

(Note: R (RA) refers to the multiple correlation coefficient before (after) the correction of degree of freedom. S refers to the standard deviation of equation error. d corresponds to the Durbin-Watson statistic. Number in parenthesis indicates the t-value.)

The results of the final test for the period from February 1996 to December 1997

(twenty-three samples) are compiled below by the mean average per cent error (MAPE, %) for the final five subperiods. The fact that all the MAPE values were less than 10 per cent confirmed the overall good fitting of the model.

Variable Name	MAPE
RATE	3.4444
FIN$	4.1417
FOUT$	1.6807
(*NET$*)	(17.7031)
SF$	0.5205
X$	4.5975
IM$	8.4789
(*TB$*)	(20.0401)
XR	1.8282
IMR	1.1126
GDPR	0.3040

Note: Since net short-term capital inflow (*NET$*) and trade balance (*TB$*) can take zero value, their MAPE values are not meaningful.

We calculated the relative contribution of each of the three explanatory variables in the exchange rate changes based on the final test values. In Table I-A, the increment of the exchange rate, *D*(*RATE*), is decomposed into three components: the changes of bandwagon variables (real Thai exchange rate, ratio of net private capital inflow, and PPP variable [relative CPI ratio]) multiplied by a corresponding coefficient, which are shown in columns (3)–(5), and added up to the column (2). The relative contribution of each variable is calculated by dividing each contribution by the increment of the exchange rate, and is shown in columns, (6)–(8), which adds up to unity. In some months like June 1996 and May 1997, the relative contribution exceeded 100 per cent in absolute value, because the increment of the exchange rate was very small. As we are interested in measuring the average influence of each explanatory variable in two years, we calculated the sum of the absolute value of contribution of each variable for three different periods: March 1996–December 1997, January–December 1997, and July–December 1997 indicated in Table I-B, columns, (3)–(5), which does not add up to the increment of the exchange rate listed in column (1). We divided each number in the columns (3)–(5) by the sum, (3) + (4) + (5). The result is shown in columns, (6)–(8), which add up to unity. We take the case of the whole observation period (February 1996–December 1997). For the whole observation period, out of the total variation of the exchange rate, 65.99 per cent can be explained by the bandwagon variable, 15.64 per cent by the private capital movement, and 18.35 per cent by the PPP variable. When the observation period covers the year 1997 and the latter half of 1997, the contribution of the bandwagon effect (PPP variable) becomes larger (smaller), while that of the private capital movement remains approximately constant.

TABLE I

Period (1)	*D* (*RATE*) (2)	*D* (*X*1) (3)	*D* (*X*2) (4)	*D* (*X*3) (5)	*SD* (*X*1) (6)	*SD* (*X*2) (7)	*SD* (*X*3) (8)
A. Decomposition of exchange rate variation, March 1996–December 1997							
96:03	35.3435	−9.9804	−2.5596	47.8836	−28.2384	−7.2421	135.4805
96:04	−45.3548	−6.8334	0.8692	−39.3905	15.0666	−1.9164	86.8498
96:05	17.4726	−8.9864	10.9117	15.5473	−51.4314	62.4504	88.9811
96:06	2.4505	5.2943	3.9076	−6.7514	216.0541	159.4630	−275.5171
96:07	−7.7136	−6.0588	0.8228	−2.4776	78.5466	−10.6666	32.1200
96:08	−10.2881	−30.1275	4.6883	15.1510	292.8370	−45.5701	−147.2669
96:09	1.9491	4.9855	−6.8319	3.7956	255.7803	−350.5093	194.7290
96:10	−21.5964	−3.3553	−5.1755	−13.0656	15.5363	23.9648	60.4989
96:11	−12.3756	−13.3773	−1.6679	2.6695	108.0939	13.4771	−21.5710
96:12	21.9841	11.6305	−3.9624	14.3161	52.9041	−18.0240	65.1199
97:01	35.1555	9.1741	6.5937	19.3877	26.0957	18.7559	55.1484
97:02	34.5544	8.2408	1.2632	25.0504	23.8488	3.6556	72.4955
97:03	16.3497	−10.4219	0.7632	26.0084	−63.7436	4.6681	159.0755
97:04	−14.4522	4.3187	−5.4280	−13.3429	−29.8828	37.5583	92.3245
97:05	−6.0997	−25.4159	2.1283	17.1878	416.6727	−34.8925	−281.7803
97:06	−9.0422	−13.5398	−2.3987	6.8963	149.7404	26.5281	−76.2685
97:07	388.1132	400.5392	−3.3209	−9.1050	103.2016	−0.8557	−2.3460
97:08	151.4560	121.2986	12.0662	18.0912	80.0883	7.9668	11.9449
97:09	408.8863	325.1750	57.5111	26.2002	79.5270	14.0653	6.4077
97:10	177.6435	71.9360	67.5849	38.1226	40.4946	38.0452	21.4602
97:11	310.1966	139.6948	105.9629	64.5388	45.0343	34.1599	20.8058
97:12	691.1905	520.3990	108.7222	62.0694	75.2902	15.7297	8.9801
B. Contribution of variables for exchange rate							
96:03–97:12	2,652.9726	1,750.7832	415.1403	487.0491	65.9933	15.6481	18.3586
97:01–97:12	2,349.8981	1,650.1538	373.7434	326.0009	70.2224	15.9047	13.8730
97:07–97:12	2,152.3380	1,579.0425	355.1682	218.1273	73.3641	16.5015	10.1344

Note: $X1 = RATET/CPIT$, $X2 = (FIN\$/SF\$)\ (-1)$, $X3 = (CPI/CPIUS)\ (-1)$.

As the interpolation error is sufficiently small, and especially the jump in December 1997 was correctly predicted endogenously, we considered that the model is suitable for simulation studies. In the next sections, we will apply the model to in-sample and out-of-sample simulations.

IV. IN-SAMPLE SIMULATION STUDY: DEVALUATION EFFECT

In our model, the exchange rate is an endogenous variable, which is influenced by three factors (bandwagon, capital inflow, PPP), and also exerts various direct impacts on the capital inflow, dollar export and import, and capital account and current account. To analyze the exchange rate dynamics, it is important to determine the over-time depreciation effects of the exchange rate, by assuming an once-for-all increase of the exchange rate and conducting simulation studies.

We calculated the depreciation effect of the exchange rate by using three models: (1) the capital movement submodel (with inflow, outflow, net inflow, stock of private capital, and exchange rate), (2) then the commodity trade submodel (with dollar and rupiah values of export and import, real GDP, and exchange rate), and (3) finally by whole model. We assumed an once-for-all increase of the exchange rate by Rs 100 in February 1996, which is equivalent to 4.30 per cent of the actual level (2,322 Rp/$), and calculated the changes of variables until December 1997. To clarify the time pattern of the impact, we recorded the changes of variables after seven and twenty-two months (Table II), in which "difference" involves the per cent change.

Some observations are as follows.

(a) Simulation results using the capital movement submodel (Table II-A)

(a-1) The positive deviation of the exchange rate over the final test level decreased from 4.18 per cent after seven months to 2.25 per cent after twenty-two months.

(a-2) After seven months, as the increment of inflow exceeded the increase of outflow, net inflow and stock of capital increased.

(a-3) After twenty-two months, as the increase of outflow exceeded the increase of inflow, net inflow became negative.

(a-4) The twenty-two-month sum of net inflow was slightly positive, the twenty-two-month impact of the exchange rate depreciation on capital account was slightly positive.

(b) Simulation results using the commodity trade submodel (Table II-B)

(b-1) The positive deviation of the exchange rate over the final test level decreased from to 4.16 per cent after seven months to 2.19 per cent after twenty-two months.

(b-2) After seven months, as the dollar (rupiah) value of export (import) increased (decreased), the trade balance improved.

(b-3) After twenty-two months, as the dollar (rupiah) value of export (import) increased (decreased), the trade balance improved.

(b-4) The positive deviation of the trade balance decreased from U.S.$530 million after seven months to U.S.$235 million after twenty-two months. The twenty-two month impact on the trade balance was slightly positive.

(c) Simulation results using the whole model (Table II-C)

(c-1) The positive deviation of the exchange rate over the final test level decreased from 4.13 per cent after seven months to 2.23 per cent after twenty-two months.

(c-2) After seven months, as the dollar (rupiah) value of export (import) increased (decreased), the trade balance improved.

(c-3) After twenty-two months, as the dollar (rupiah) value of export (import) increased (decreased), the trade balance improved.

TABLE II

RESULTS OF SIMULATION, FEBRUARY 1996–DECEMBER 1997
(Exchange Rate Depreciated by Rp 100 in February 1996)

Variable Name	Effects after Seven Months, September 1996			Effects after Twenty-Two Months, December 1997		
	Simulated	Final Test	Difference (%)	Simulated	Final Test	Difference (%)
A. Capital movement submodel						
FIN$	6,344.4816	6,300.8391	0.6926	2,237.7046	2,234.2457	0.1547
FOUT$	5,256.2682	5,221.5796	0.6643	6,739.1280	6,682.3747	0.8493
NET$	1,088.2134	1,079.2595	0.8296	–4,501.4235	–4,448.1272	1.1982
SF$	66,038.3329	65,489.5821	0.8379	68,589.8858	68,234.3427	0.5211
RATE	2,455.8762	2,357.1403	4.1888	4,620.7024	4,518.5922	2.2598
B. Commodity trade submodel						
X$	4,447.7275	4,234.3841	5.0384	5,064.4754	5,015.5186	0.9761
IM$	3,265.3216	3,582.2128	–8.8462	2,388.8314	2,575.4765	–7.2470
TB$	1,182.4059	652.1713	81.3030	2,675.6440	2,440.0421	9.6556
RATE	2,499.1239	2,399.1239	4.1682	4,645.6102	4,545.6102	2.1999
GDPR	32,731.9895	32,418.3168	0.9676	34,986.1994	34,688.8599	0.8572
XR	8,800.8274	8,577.7915	2.6002	11,694.7514	11,524.7866	1.4748
IMR	8,893.9560	8,984.5928	–1.0088	9,507.7323	9,635.1069	–1.3220
C. Whole model						
FIN$	6,340.2788	6,286.8422	0.8500	2,227.5849	2,200.6061	1.2260
FOUT$	5,256.0088	5,221.3413	0.6640	6,766.4900	6,696.9623	1.0382
NET$	1,084.2699	1,065.5008	1.7615	–4,538.9051	–4,496.3562	0.9463
SF$	66,039.3069	65,458.0367	0.8880	68,975.2854	68,462.9202	0.7484
X$	4,495.6937	4,294.9360	4.6743	5,114.7642	5,064.8109	0.9863
IM$	3,233.6070	3,513.7557	–7.9729	2,442.7273	2,635.3039	–7.3076
TB$	1,262.0867	781.1803	61.5615	2,672.0369	2,429.5070	9.9827
RATE	2,447.6650	2,350.5793	4.1303	4,623.5210	4,522.5429	2.2328
GDPR	32,757.3351	32,473.5416	0.8739	34,973.2807	34,669.7344	0.8755
XR	8,774.8378	8,563.0505	2.4733	11,722.8792	11,549.7880	1.4987
IMR	8,842.6209	8,914.6270	–0.8077	9,548.7787	9,679.2338	–1.3478

(c-4) The positive deviation of the trade balance decreased from U.S.$530 million after seven months to U.S.$235 million after twenty-two months. The twenty-two-month impact on the trade balance was slightly positive.

Therefore, based on the experiment using the whole model, the depreciation of the exchange rate resulted in the increase of net foreign capital inflow and the improvement of the trade balance in the short-term (until seven months), As a result, the depreciation improved the balance-of-payment. But since the deviation of net capital inflow and trade balance tended to decrease over time, the improving effect declined over time, although the accumulation of deviations still remained positive after twenty-two months.

V. OUT-OF-SAMPLE SIMULATIONS: CONDITIONAL FORECAST FOR 1998

We examined various forecasts for the projection period, January–December 1998. We paid special attention to the following four factors in case of projection.

(a) Disappearance of bandwagon effect. The bandwagon effect proxied by the real Thai baht exerted a strong impact on the Indonesian rupiah until December 1997. However, since the Thai baht became relatively stable in 1998, we assumed that the values of the Thai baht and Thai CPI would remain at the same level of January 1998 throughout the year 1998. This implies that the depreciation pressure from the Thai baht or the contagion effect ceased in 1998. Thus the trend of the exchange rate should be decided by other forces including PPP and capital market trend.

(b) Emergence and trend of political disturbances. As shown in Figure 1, there were big jumps in the exchange rate in January, May, and June 1998, which are widely interpreted as the result of noneconomic factors including political uncertainty. But how and to what extent these noneconomic disturbances could be alleviated until December 1998 remains to be determined. Therefore, we decided to treat them by using a dummy variable with a set coefficient and introduce them in the conditional forecast until December 1998, and change the coefficient based on alternative assumptions.

(c) Limited private capital outflow. The private capital outflow was limited by various noneconomic factors. It practically stopped based on the intention of the financial authorities, i.e., a suggestion to stop the amortization by three months until the settlement of talks about the private debt. Thereafter, the amortization was also largely suspended based on the Frankfurt agreement, i.e., three years of grace period will be given in the case of successful settling down within the INDRA (Indonesian Debt Restructuring Agency) framework. Therefore, we assumed that the short-term capital outflow would be restricted to U.S.$1,000 million (compared with U.S.$6,779 million in December 1997).

(d) Institutional barriers for export promotion. Usually a large depreciation of the exchange rate results in a burst of commodity export and drastic reduction of commodity import. But the dollar export did not increase drastically in 1998, due to many institutional factors as follows: a low degree of pass-through based on the market structure, a limited acceptance of L/C of exporters due to the lack of confidence in the economy, the uncertainty of delivery day, the shortage of containers caused by a very low level of commodity import, and others. On the other hand, some of the export sectors actually benefited from the rapid exchange rate depreciation, especially out of Java island. Our export function reflects the strong export-

promotion effect of depreciation. But due to the above considerations, we set a limit for monthly dollar export growth.

Our strategy was as follows. (1) We first calculated the simple projection until March 1998, by assuming that the Thai baht and Thai CPI would remain at the actual level of January 1998, i.e., 53.812 and 148.3 respectively, and by adopting the actual values for other exogenous variables. (2) We compared the extrapolated value of the exchange rate of January–March 1998 with the actual value, and interpreted the difference as the size of noneconomic factors or the coefficient of dummy variables, which took unity after January 1998. (3) We recalculated the conditional forecast, assuming that the real Thai baht would remain at the same level as that of January 1998, and introducing the noneconomic dummy with the set coefficient, and also by restricting the monthly export growth under a set constraint.

Assumption of exogenous variables. After January 1998, the values of exogenous variables were set as follows:

CPI of the United States (*CPIUS*): monthly change is 0.2% (annual change is 2.42%),

CPI, WPI: monthly change is 5% (annual change is 79.58%),

CPI of Thailand (*CPIT*): fixed at the actual level of January 1998,

Exchange rate of Thailand (*RATET*): fixed at the actual level of January 1998,

Interest rate (*INT*): fixed at 55%,

Interest rate in the United States (*INTUS*): fixed at 8.5%.

CIO (other expenditures): *CIO* refers to the sum of *CPR* (private consumption), *CGR* (public consumption), and *IR* (investment). We assumed that after January 1998, *CPR*, *CGR*, and *IR* would decrease monthly by 5%, 5%, and 10% respectively. This implies that *CPR*, *CGR*, and *IR* annually decreased by 28.94%, 22.55%, and 47.57% in 1998 compared with 1997, respectively.

Adjustment term (of current balance, *AT$*): fixed at zero.

Simple extrapolation (simple projection) for the period January–March 1998. We first calculated the simple projection with the trends of exogenous variables specified above, and compared the extrapolated values of the exchange rate with actual values. Then the results were as follows.

Value of Exchange Rate (Rp/$)

Month	Extrapolated Value	Actual Value	Difference (*D*)
January 1998	5,468	10,375	4,907
February 1998	5,886	8,750	2,864
March 1998	6,160	10,800	4,640

We assumed that the exchange rate had increased based on noneconomic factors by these differences (*D*) during the period January–March 1998. Blomberg-Hess

(1997) directly measured the impact of political events on the exchange rate in advanced countries. Further clarification of such a mechanism is an important task for the future.[3]

Revised extrapolation (conditional projection). The basis of this projection is that (i) the bandwagon effect ceased in 1998, (ii) the size of noneconomic disturbances (Rp 4,640 in March 1998) will be reduced by $100R$ per cent in December 1998, and (iii) the private capital outflow is limited to a set value (U.S.$1,000 million), and (iv) monthly dollar export growth is restricted by L per cent. So we repeated the conditional projection based on the different combinations of two parameter values (R and L).

(a) Assumption of reduction speed of noneconomic disturbances (R).
  (a-1) The size of noneconomic disturbances (or the difference defined above) will remain constant until December 1998 ($R = 0$).
  (a-2) The size will be halved in December 1998 ($R = 0.5$).
  (a-3) The size of noneconomic disturbances (or the difference defined above) will completely disappear by December 1998 ($R = 1$).

(b) Assumption of limit of monthly dollar export growth (L).
  (b-1) Monthly growth of dollar export cannot exceed the value of the previous month ($L = 0\%$).
  (b-2) Monthly growth of dollar export is restricted by 1% ($L = 1\%$).
  (b-3) Monthly growth of dollar export is restricted by 2% ($L = 2\%$).
  (b-4) Monthly growth of dollar export is restricted by 3% ($L = 3\%$).

We selected three cases:

Case 1 (Pessimistic case: $R = 0, L = 0\%$): Noneconomic disturbances persist, and constraint on export growth is strong.

Case 2 (Intermediate case: $R = 0.5$, $L = 1\%$): Noneconomic disturbances are reduced by a half, and constraint on export growth is partly relaxed.

Case 3 (Optimistic case: $R = 1$, $L = 2\%$): Noneconomic disturbances are eliminated, and export growth constraint is weak.

We designated the above cases as pessimistic, intermediate, and optimistic cases, rather independently of the GDP growth rate. Such a designation stemmed from the assumption that the debt repayment is at most a crucial long-term task although we do not explicitly analyzed the debt-overhang problem in our model. Therefore a higher level of exchange rate may increase the repayment burden. Table III shows the results of the simulations for the three cases. Figure 3 shows the alterna-

[3] Blomberg and Hess (1997) discussed the direct impact of political factors on the exchange rate. Another two-step approach is conceivable, in which political factors influence the investor's confidence (proxied by the probability of default), and then the exchange rate. Balkan (1992) described the relation between the default probability and many political and economic factors. This can be a reference for the first step of the chain.

tive trends of exchange rate. The values of selected variables are as follows.

(*R*, *L*)	*RATE* (Dec. 98)	GR (*GDPR*, %)	*TB$* (98, M$)	GR (*X$*, 98, %)	GR (*IM$*, 98, %)	GR (*XR*, 98, %)	GR (*IMR*, 98, %)
0, 0*	12,530	−11.93	42,111	−5.97	−75.88	89.40	−2.38
0, 1	12,530	−10.13	44,899	−0.95	−75.84	96.10	−2.35
0, 2	12,530	− 8.21	47,856	4.37	−74.80	103.22	−2.31
0, 3	12,530	− 6.70	50,165	8.54	−75.77	108.81	−2.28
0.5, 0	10,210	−15.47	40,249	−9.13	−75.63	75.95	−2.79
0.5, 1*	10,210	−13.89	42,903	−4.34	−75.59	81.80	−2.76
0.5, 2	10,210	−12.22	45,719	0.73	−75.55	88.00	−2.73
0.5, 3	10,210	−10.92	47,905	4.68	−75.52	92.81	−2.70
1, 0	7,890	−18.60	38,365	−12.27	−75.32	63.97	−3.24
1, 1	7,890	−17.21	40,902	−7.69	−75.28	69.09	−3.21
1, 2*	7,890	−15.75	43,590	−2.84	−75.24	74.52	−3.18
1, 3	7,890	−14.63	45,667	0.90	−75.21	78.68	−3.16

Note: The asterisk symbol (*) indicates the three typical cases cited above.

We can draw some conclusions from these projections:

(a) The expected level of the exchange rate in December 1998 will be around 12,530 Rp/$ if the noneconomic disturbances which occurred in January–March persist until December 1998, and around about 10,210 Rp/$ if they are reduced to a half, and around 7,890 Rp/$ if they completely disappear and the confidence in the Indonesian economy recovers.

(b) The expected real annual growth rate (GR) of GDP in 1998 ranges between −18.60 per cent and 6.70 per cent. It will be around −14 per cent in the intermediate case.

(c) The expected annual growth rate of dollar export ranges between −12.27 per cent and 8.54 per cent, and around −4 per cent in the intermediate case. As a result, the dollar export growth will be very low (even negative) in spite of the large depreciation of the exchange rate.

(d) When the restriction for monthly export growth is lessened by one percent (or a higher value of export growth is permitted), the growth of dollar export will increase by about 4 per cent. Thus the elimination of the constraint on export growth is important although the constraint is not necessary binding every month.

(e) The dollar import value will be reduced by about 75 per cent in every case, because when the exchange rate decreases, a larger decrease of GDP growth rate cancels out the import-enhancing effect of the lower exchange rate.

(f) A higher GDP growth rate is accompanied by a higher trade balance, because export increase is the engine-of-growth, and import is not sensitive to the depreciation of the exchange rate or the relaxation of export constraint.

(g) A higher end-of-year exchange rate is accompanied by a higher real annual growth rate of GDP and an improved trade balance, but implies a further increase of rupiah repayment burden.

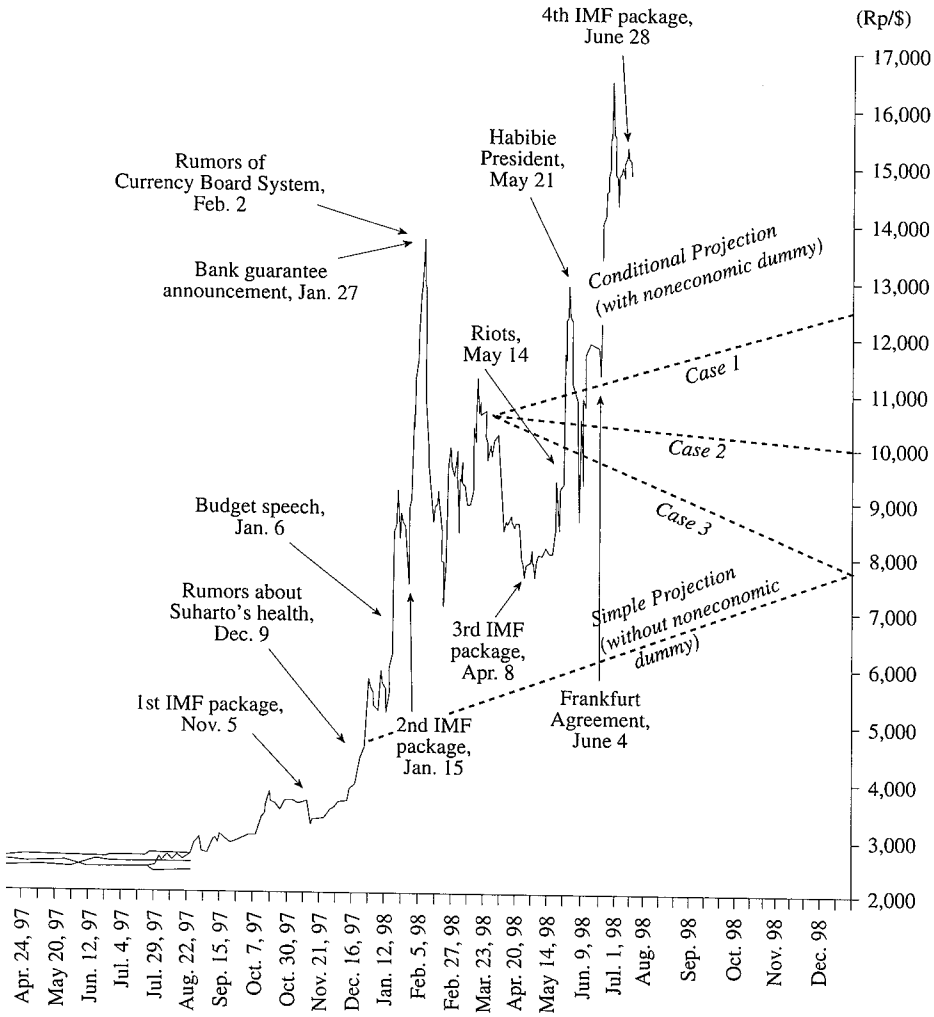
TABLE III

ANNUAL GROWTH RATE, 1997–98

Variable Name	*X* (1998)	*X* (1997)	Growth Rate 1998 (%)	Growth Rate 1997 (%)
(Simple projection: No disturbances)				
FIN$	0.000	73,453.085	−100.0000	−0.4142
FOUT	44,029.274	73,821.630	−40.3572	21.0496
NET$	−44,029.274	−368.544	11,846.8104	−102.8851
SF$	23,920.971	68,462.920	−65.0600	19.5985
X$	45,114.231	55,754.730	−19.0845	12.8958
IM$	13,398.666	42,739.986	−68.6507	0.7520
TB$	31,715.565	11,236.745	182.2487	69.7393
RATE	7,771.901	4,522.543	71.8480	1.1939
GDPR	303,903.323	417,666.581	−27.2378	8.8331
XR	145,497.849	113,203.478	28.5277	9.9332
IMR	104,497.563	112,189.986	−6.8566	7.9395
(Disturbance decrease ratio = 0; Export growth limit = 0)				
FIN$	3,524.474	73,453.085	−95.2017	−0.4142
FOUT	46,708.519	73,821.630	−36.7279	21.0496
NET$	−43,184.044	−368.544	11,617.4676	−102.8851
SF$	24,766.200	68,462.920	−63.8254	19.5985
X$	52,420.775	55,754.730	−5.9797	12.8958
IM$	10,308.897	42,739.986	−75.8800	0.7520
TB$	42,111.878	11,236.745	274.7694	69.7393
RATE	12,530.526	4,522.543	177.0682	1.1939
GDPR	367,799.572	417,666.581	−11.9394	8.8331
XR	214,411.712	113,203.478	89.4038	9.9332
IMR	109515.178	112189.986	−2.3842	7.9395
(Disturbance decrease ratio = 0.5; Export growth limit = 0.01)				
FIN$	3,524.474	73,453.085	−95.2017	−0.4142
FOUT	46,706.169	73,821.630	−36.7311	21.0496
NET$	−43,181.695	−368.544	11,616.8301	−102.8851
SF$	24,768.550	68,462.920	−63.8219	19.5985
X$	53,333.304	55,754.730	−4.3430	12.8958
IM$	10,429.482	42,739.986	−75.5978	0.7520
TB$	42,903.822	11,236.745	281.8172	69.7393
BATE	10,210.480	4,522.543	125.7686	1.1939
GDPR	359,619.924	417,666.581	−13.8978	8.8331
XR	205,806.093	113,203.478	81.8019	9.9332
IMR	109,089.207	112,189.986	−2.7639	7. 9395
(Disturbance decrease ratio = 1; Export growth limit = 0.02)				
FIN$	3,524.474	73,453.085	−95.2017	−0.4142
FOUT	46,703.939	73,821.630	−36.7341	21.0496
NET$	−43,179.464	−368.544	11,616.2249	−102.8851
SF$	24,770.781	68,462.920	−63.8187	19.5985
X$	54,169.247	55,754.730	−2.8437	12.8958
IM$	10,579.191	42,739.986	−75.2476	0.7520
TB$	43,590.056	11,236.745	287.9242	69.7393
RATE	7,890.417	4,522.543	74.4686	1.1939
GDPR	351,854.229	417,666.581	−15.7572	8.8331
XR	197,563.377	113,203.478	74.5206	9.9332
IMR	108,612.185	112,189.986	−3.1891	7.9395

Note: For *SF$* and *RATE*, the growth rate was calculated by comparing the values of December of each year.

Fig. 3. Trend of Exchange Rate (Rp/$)



In 1998, the Indonesian economy was hit by three external shocks: the Asian currency crisis, the lengthy rainfall shortage caused by El Niño (and its negative impact on rice harvest), and a large decrease of the oil price. We could not explicitly take into consideration the latter two shocks as our data were mainly based on the period until March 1998. But we assume that the influences of these shocks are implicitly considered by the manipulation of the dummy coefficient.

We can interpret the separate trends of exchange rate as a parallel exchange rate regime: one exchange rate decided by fundamentals only, and the other rate also influenced by the private debt repayment burden. The first exchange rate regime was a continuation of the actual trend until December 1997, and of the simple projection trend after January 1998. The second exchange rate regime was only implicit and nor detectable until December 1997, and suddenly became detectable as trend of conditional projection. The regime change occurred at the end of 1997, and what we observed was the trend of the first rate until December 1997, and of the second rate after 1998.[4]

After March 1998, many new events occurred that generated volatile changes of the exchange rate, including the May 21 riot. On August 4, 1998, INDRA announced an exchange rate of 13,233 Rp/$ as the reference rate for private debt amortization through INDRA, which is very close to the current level of exchange rate, and 80 per cent lower than that before the occurrence of the Asian currency crisis. The debtors which hoped that a more favorable rate like 8,000 Rp/$ would prevail were disappointed and the Indonesian Chamber of Commerce and Industry complained that it will take 100 years to pay the private debt. But the Bank Indonesia announced that the Government of Indonesia is not prepared to take any exchange rate risk. On August 23, the exchange rate appreciated to 11,600 Rp/$, reflecting the information issued by the Indonesian Bank Reconstruction Agency (IBRA) on August 20 that IBRA would close down a few banks, and will dispose of the non-performing loans owned by the Assets Management Unit based on the owners' contribution, investment from abroad, and government fund. The government already injected Rp 167 trillion, including the interest rate paid to the Bank Indonesia for banking restructuring. The appreciation of the exchange rate by Rs 1,600 implies that the investors' confidence improved to some extent due to these banking restructuring operations. However, the level of exchange rate still stood at more than 11,000 Rp/$ at the end of August. In October, an abrupt appreciation of the yen resulted in an appreciation of the rupiah to 8,750 Rp/$. After November, selling operation of inflowed dollar rescue fund further pressed the rupiah rate downward.

While the exchange rate may eventually converge to a PPP-equilibrium level, the current position still corresponds to "exchange-rate-overshooting," as the exchange rate increased by more than three times, and the domestic price approximately doubled after the 1997 summer. The simulation studies above suggest that after experiencing highly volatile changes during the period January–June 1998, the exchange rate may converge to a stable level by the end of 1998. If this equilibrating tendency continues, the price of nontraded goods and wage level will even-

[4] Agénor (1991) discussed the cases of twelve countries. Baghestani (1997) modeled the case of India.

tually catch up. Currently a wider social safety network is needed as the level of economic activity is shrinking, and the number of households in poverty exceeds 40 per cent, therefore the injection of higher subsidies and related bond-financing by the government is scheduled. Then such fiscal-deficit-based price increase will accelerate inflation. The inflationary trend between August and December 1998 will include a mixture of PPP-pulling factor and fiscal-deficit-pushing factor.

VI. SUMMARY AND CONCLUSION

To analyze the current Indonesian economic crisis and clarify the exchange rate dynamics, we prepared monthly data for core economic variables, and constructed a monthly econometric model for the Indonesian economy for the period February 1996 to December 1997. After confirming the suitability by a final test, we applied the model for in-sample and out-of-sample simulation studies.

Factor decomposition of exchange rate changes. Based on the interpolated values, the changes of the exchange rate were decomposed into three basic factors: bandwagon effect (66.0 per cent), net capital inflow (15.6 per cent), and PPP variable (18.4 per cent). The high contribution of the bandwagon effect was partly attributed to the fact that the bandwagon variable explained a major part of the big jump of the exchange rate after the summer of 1997.

Assessment of exchange rate depreciation. The monthly model consists of a combination of two submodels: capital movement submodel and real sector submodel. Based on in-sample simulation using the two submodels and whole model, we confirmed that the depreciation exerted a positive effect on the trade balance with a declining scale over time.

Simple projection and assessment of noneconomic disturbances. Based on the extrapolation of the past trend, we constructed the simple projection until March 1998. By comparing the values of the exchange rate with actual values, we estimated that the influences of noneconomic factors would lead to a rate of Rp 4,907 in January, Rp 2,864 in February, and Rp 4,640 in March 1998.

Conditional projections for the year 1998. We assume that (i) the Bandwagon effect ceased in 1998, (ii) the capital outflow was restricted, (iii) the export growth was restricted by various factors, (iv) the noneconomic disturbances may totally or partially persist. Among the various experiments, the results of the intermediate case show that the exchange rate was around 10,210 Rp/$ in December 1998, the growth rate of GDP (1998) around −14 per cent, and the trade balance (1998) around U.S.$42 billion as export growth stagnated, while the import decreased by 75 per cent. It was also found that a higher (more depreciated) exchange rate was accompanied by a higher GDP growth rate (through expansion of export). The persistence of noneconomic disturbances would result in a higher (more depreciated) exchange rate, higher GDP growth rate, and larger trade balance. A higher (more

depreciated) exchange rate implies a larger rupiah cost of debt repayment. Therefore, there is a strong trade-off between the short-term target of regaining economic growth, and long-term target of successful debt repayment.[5]

Since the economic crisis continues and is evolving, the current statistical observation is still partial and incomplete. In a sense, our analysis is of a very tentative nature, and subject to essential improvement in the future. The modeling work can be and must be improved in many aspects. First, the estimation can be upgraded by the addition of new data. Secondly, we must attempt to endogenize additional variables like consumption, investment, and domestic prices. This may imply the construction of a full-version of a monthly national model. Thirdly, the repercussions among different currencies can be introduced explicitly to describe the complex bandwagon effect. Fourthly, we need to combine our data with another model to examine the wider aspects of the Asian currency crisis and to evaluate the accompanying social safety cost and the debt repayment burden.

[5] On October 5, 1998, the Central Statistical Office announced that the GDP growth rate was –13.7 per cent for 1998, the accumulated value of trade surplus during the period January–July 1998 was U.S.$13.5 billion, and the accumulated rate of inflation until September was 75.47 per cent.

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APPENDIX

PREPARATION OF MONTHLY DATA

The official quarterly data are available for 1993–97 for goods and service trade, net balance of inflow and outflow of official or private capital, monetary movement, and foreign currency reserves. But the official figures are not consistent. The increment of foreign currency reserves does not necessarily coincide with the monetary movement, especially in 1997. Therefore, we used the figures of monetary movement, and reconstructed the series of foreign currency reserves. The debt outstanding was fixed at U.S.$68 billion in December 1997 (Soesatro-Basri [1998, p. 21] listed figures of private nonbanks at U.S.$58 billion and securities at U.S.$11 billion). Then we converted these quarterly data to monthly data, assuming that the sum of corresponding three months exactly matched the quarterly figures.