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INFLATIONARY BURST AND FREE FALL OF THE INDONESIAN ECONOMY DURING THE KRISMON PERIOD
—A Vicious Circle of Real and Monetary Aspects—

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I. INTRODUCTION

THE Indonesian economy had achieved a sustained growth in the past, and was included in the group of the "high-performing Asian-economies" in a World Bank report published in 1993 (World Bank 1993). However this growth ended in July 1997, when the Asian currency crisis which started in Thailand quickly reached other countries including Indonesia. At first the monetary aspect of the economy was largely affected as the exchange rate doubled and bad performing loans and debts accumulated until the end of 1997, but the real GDP still continued to grow. However, at the beginning of 1998, political instability worsened, and was mutually aggravated by the economic decline which eventually resulted in the downfall of the Suharto regime. Between January and June 1998, the real GDP decreased by 19 per cent, while the exchange rate skyrocketed to more than Rp 10,000 per U.S. dollar in January and June. After June 1998, economic stagnation continued up to 1999. This overall economic and social crisis was referred to as Krismon.[1] The objective of this paper is to conduct a quantitative analysis of the impact of Krismon.

Krismon was characterized by three basic features. First, the occurrence of short-term drastic changes. Since the whole Krismon period (August 1997–December 1998) can be clearly subdivided into three subperiods, detailed analysis will be made based on this chronology. Considering the short-term character of Krismon, I prepared monthly time-series data for four years (January 1995–December 1998) and constructed a monthly econometric model based on the data for three years (January 1996–December 1998). The additional year (twelve months of 1995) was

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[1] "Krismon" is an Indonesian term referring to the "monetary crisis" which occurred in Indonesia. I used the term Asian currency crisis for the economic crisis which occurred in the Asian countries (Thailand, R.O.K. and Indonesia), and Krismon for the impacts limited to the Indonesian economy.

utilized for the preparation of data of lagged variables, and also for data construction of international capital transactions.[2] This empirical study is a continuation of past efforts, and is the third version of the monthly model for Indonesia.[3]

The second feature is the interaction between the fall of the real economic activity and the inflationary trend of the price system, which was reflected in the volatile bursts in the exchange rate, interest rate, and consumer price index. In this paper, attempts were made to analyze the interaction of these real and monetary aspects of the economy during the Krismon period by including major variables of real activity and price system as endogenous variables, and by implementing several simulations.

The third feature of Krismon is the strong interaction between political instability and economic collapse, which made the process of Krismon very complex. Actually, how political changes might influence economic growth and how their mutual relationship evolves has been continuously and extensively discussed. For example, Alesina and Perotti (1994, p. 358) surveyed 1, 860 cases in all the countries, in which the growth rate in years without and with major government changes was 2.8 per cent and 0.1 per cent, respectively. The growth rate in 299 cases in years when coups d'état occurred was −1.3 per cent. Also, some empirical studies using the growth equation clarified the negative impact of political instability. Barro (1991) showed that the number of revolutions and murders significantly affected economic growth in a negative manner, in a sample of ninety-eight countries between 1960 and 1985.[4] To describe such interaction one step further, I first estimated the exchange rate equation and interpreted its error as a surrogate measure of noneconomic (political and social) disturbances, and introduced it into several behavioral equations.

One important aspect is to separate the Krismon impact from the negative impact of deteriorating trends which had already occurred even before the onset of Asian currency crisis. The GDP of the agricultural sector reached a peak (Rp 9,081 billion) in May 1996, and thereafter it recorded a volatile decreasing trend. The GDP of the monetary sector reached a peak (Rp 3,610 billion) in November 1996, and steadily decreased until August 1997 (Rp 2,890 billion) by 20 per cent. Therefore, it is necessary to separate the effects of the negative trends, which already existed before the Asian currency crisis. As a result, I treated the GDP of the agricultural and monetary sectors as an exogenous variable in the modeling work so that the

[2] Part of the foreign capital outflow is associated with the reimbursement of accumulated past capital inflow. Therefore, the outflow in January depends on the inflow in the past twelve months and the data of one preceding year are necessary for data preparation.

[3] The former version of the monthly econometric model of Indonesia was compiled in Fukuchi and Tokunaga (1999). Fukuchi (1999, 2000) reported the results of growth decomposition by using the GDP equation. This paper reports the results of the third version.

[4] Balkan (1992) also used two political variables to explain the probability of default: Arat modified index of democracy, and political instability index.

mechanism of Krismon and its impact on the overall economy could be clearly recognized independently.

The structure of the paper is as follows. In Section II, I describe the chronology of Krismon, and define three subperiods. In Section III, I define the noneconomic disturbances based on the exchange rate equation. In Section IV, I describe the results of model estimation. Section V contains the results of simulation studies of the Krismon impact. Section VI presents a decision model approach. Section VII concludes the paper.

II. CHRONOLOGY OF KRISMON: DIVISION INTO THREE SUBPERIODS

The Asian currency crisis started by the drastic devaluation of the Thailand baht in July 1997, and immediately affected Indonesia. At first its impact was confined to the monetary aspect of the economy, but gradually the worsening economic conditions led to political and social instability, and the interaction of all the negative factors resulted in an overall rapid downfall (free fall) of the economy associated with severe inflation. In the first six months of 1998, the overall economic activity (GDP) recorded a 16 per cent decrease. On the other hand, the consumer price index (CPI), narrow money supply (M1), broad money supply (M2), and exchange rate rose by 46, 39, 59, and 220 percent, respectively. The interest rate rose from 40.6 per cent to 64.0 per cent. The records of some important economic variables are shown in Table I. I followed the three subdivisions of the Krismon period: first subperiod (August–December 1997), second subperiod (January–June 1998), and third subperiod (July–December 1998) (See Fukuchi 2000).

The period between January 1996 and July 1997 was a period of sustained growth before the occurrence of Krismon. In the course of one year and a half, the GDP had increased by 11.5%, and the GDP of major sectors also increased steadily: GDP of the agricultural sector (GDP agri.), manufacturing sector (GDP manuf.), commerce sector (GDP comm.), monetary sector (GDP mon.), and other sectors (GDP other) increased by 10.0%, 19.5%, 9.7%, 3.1%, and 9.7%, respectively. Clearly, the manufacturing sector was the leading sector of high growth. Major components of the expenditure side also rapidly increased: private consumption by 9.1%, investment by 27.0%, exports by 18.4%, and imports by 30.7%. Only government consumption showed volatile changes partly because of seasonal variations, and recorded a value of −14.3%. On the monetary side, the interest rate (money market rate) had remained low between 13% and 15%, and the exchange rate slightly increased from Rp 2,311 to Rp 2,599 per U.S. dollar. Private capital net inflow remained continuously positive around U.S.$1 billion, while the official aid inflow was slightly negative. Reflecting the positive net total capital balance, the total debt increased from U.S.$147 billion to U.S.$164 billion, while the foreign currency

TABLE I

TRENDS OF MAJOR ECONOMIC VARIABLES

	January 1996	July 1997	December 1997	June 1998	December 1998
GDP	32,619	36,377	36,289	30,784	29,958
GDP agri.	8,111	8,920	7,975	8,656	8,159
GDP manuf.	7,696	9,201	9,503	7,467	7,867
GDP comm.	5,513	6,049	6,103	4,689	4,823
GDP mon.	2,875	2,966	3,737	2,624	1,618
GDP other	8,422	9,239	8,969	7,346	7,489
Private consumption	20,672	22,550	23,821	22,460	22,406
Government consumption	2,861	2,454	2,757	2,196	2,318
Investment	9,509	12,080	10,482	6,152	6,647
Exports	8,670	10,271	12,349	12,138	6,838
Imports	8,350	10,919	13,669	12,869	6,366
Interest (%)	13.08	15.87	40.67	64.09	33.44
Exchage rate (Rp/U.S.$)	2,311	2,599	4,650	14,900	8,025
CPI: 1990 = 100	181.7	195.8	211.6	310.1	376.1
M1	52,183	69,268	78,343	109,480	101,197
M2	222,900	312,839	355,643	565,785	577,381
Private capital net inflow (U.S.$ million)	1,013	721	–3,777	–847	–1,903
Official aid inflow (U.S.$ million)	–51	–131	946	898	1,306
Foreign currency reserves (U.S.$ million)	13,888	20,233	16,587	17,950	22,713
Total debt (U.S.$ million)	147,934	164,855	157,216	151,217	146,870
GDP/N/365 (Rp)	4,560	4,945	4,936	4,155	4,012
GDP/N/365 (U.S.$)	1.97	2.01	1.06	0.27	0.50

Source: Prepared by the author from various sources.
Note: The unit is 1 billion rupiah at 1993 price unless the unit is explicitly stated.

reserves increased from U.S.$13.8 billion to U.S.$20.2 billion. The real per capita daily GDP (GDP/N/365, at 1993 price) increased by 8.4% from Rp 4,560 to Rp 4,945 or from U.S.$1.97 to U.S.$2.01 in dollar terms. The difference between the growth rate of the GDP and per capita GDP reflects the population growth rate, which in recent years had been about 1.6% per annum. All these observations indicate symptoms of sustained growth, although the dependency on foreign capital was high and the changing trend of income distribution was unclear based on these macro-level observations.

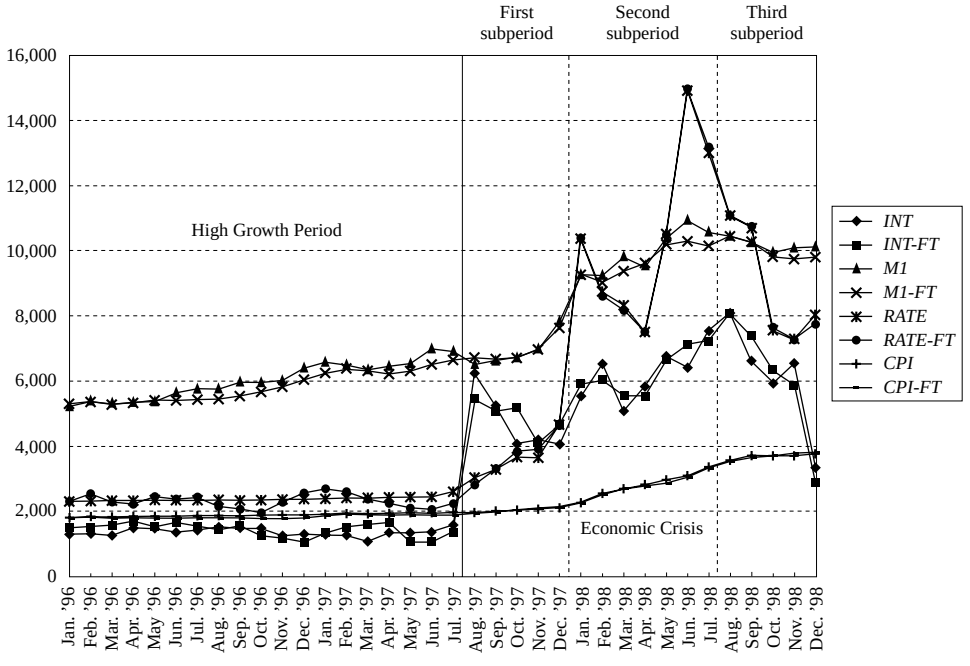
The period of August–December 1997 corresponds to the initial phase of Krismon. During this period, the exchange rate doubled to Rp 4,650 per U.S. dollar in De-

cember, and the private capital balance dramatically turned negative and recorded a value of –U.S.$3.7 billion in December. The foreign currency reserves quickly decreased to U.S.$15.7 billion, and the total debt decreased by U.S.$7.6 billion. The interest rate rose to 40.6% to stem further capital flight. Reflecting this major turmoil on the monetary side, the real sector was partly damaged, but the impact varied with the sectors. The GDP which grew until November, started to decrease afterwards and recorded a slightly lower level than before Krismon. However this decrease was mainly due to a substantial decline in the agricultural sector, which was caused by a severe rainfall shortage, while the manufacturing sector still grew continuously. On the expenditure side, consumption, exports, and imports continued to grow, but the investment activity decreased rapidly by 13.3%, suggesting the further decline of the economic activity in the following periods.

The period of January–July 1998 was the period of free fall. The initial negative Asian-currency-crisis impact permeated all the economic activities and ignited the political and social instability. This situation was aggravated by various news about the illness of President Suharto, the delay in the negotiations with the IMF, rumors about the establishment of a currency board, which further hampered the economic activity. These factors were entangled and aggravated each other, and eventually resulted in the downfall of the thirty-two-year Suharto regime. As a result, the exchange rate recorded a large hump in June, and skyrocketed to Rp 14,900 per U.S. dollar. The interest rate remained abnormally high at 64 per cent in June. The private capital balance remained negative, and the total debt outstanding decreased slightly. On the other hand, the official aid inflow reached about U.S.$1 billion and supported the foreign currency holdings, which recorded a small increase of U.S.$1.3 billion. The GDP fell by 15 per cent, and all the sectors recorded a large negative growth. The only exception was the agricultural sector, which recorded an 8.5 per cent growth due to the improvement of the weather conditions and brisk exports. Consumption, exports, and imports also decreased. Investment collapsed and decreased by 41.4 per cent.

The period of August–December 1998 was basically a period of stagnation after free fall. After the skyrocketing hump of June 1998, the nominal exchange rate slowly decreased and remained at the Rp 8,000/U.S.$ level, and the interest rate also decreased to 33.4 per cent in December. The private capital outflow persisted and the total debt decreased by U.S.$4.3 billion, while the official aid inflow increased and the foreign currency reserves rose to U.S.$22.7 billion. The real side of the economy stagnated as a whole, but the pattern differed depending on each component. The GDP of the agricultural and other sectors slightly decreased, while that of remaining sectors slightly increased. Investment and government consumption recovered to some extent, while private consumption decreased slightly. A remarkable characteristic was the decrease of real exports and imports, which heralded further stagnation in the future.

Fig. 1. Trends of Price Variables during the Krismon Period



Note: For convenience, *INT* and *CPI* were multiplied by 100 and 10 respectively, and *M1* was divided by 10. *X-FT* indicates the calculated value of variable *X* in the final test.

Based on these observations, I divided the Krismon period into the following three subperiods:

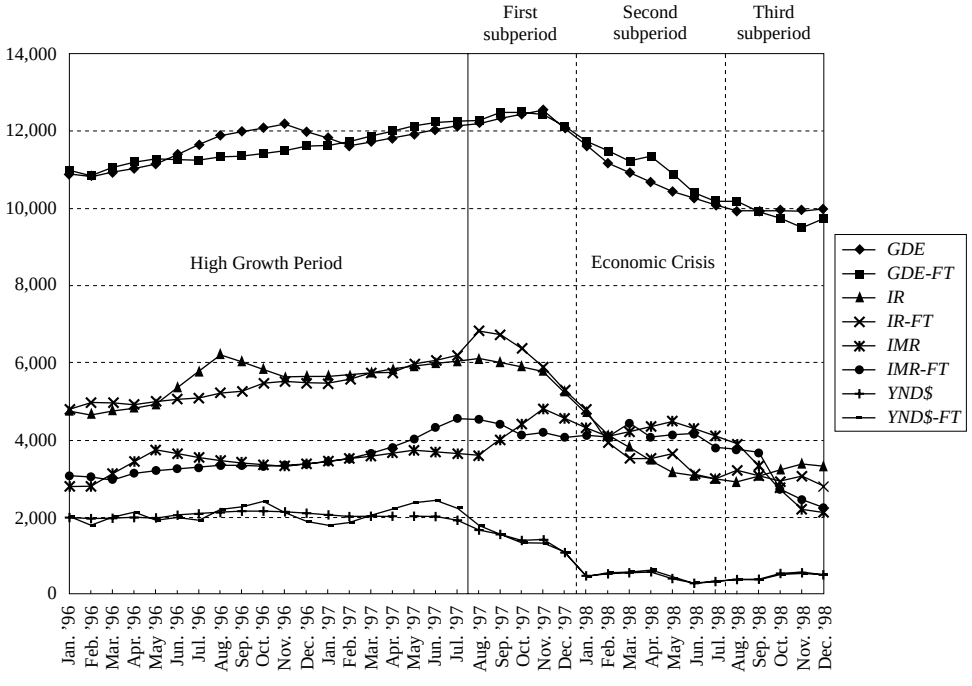
(1) First subperiod (August–December 1997): Initial stage of Krismon. There was a considerable turmoil in the foreign capital outflow and the monetary aspect of the economy, while the real economy still kept growing.

(2) Second subperiod (January–July 1998): Main stage of Krismon which was characterized by the interaction of political turmoil, economic free fall, and inflationary burst. Real per capita GDP fell by 15.8 per cent, and the Suharto regime eventually collapsed.

(3) Third subperiod (August–December 1998): Stagnation stage of Krismon. The exchange rate converged to a high level, and the real economy stagnated. Real per capita GDP fell further by 4.5 per cent.

Figure 1 shows the actual trends of price variables: interest rate (*INT*), M1, exchange rate (*RATE*), and CPI. All the variables displayed quick inflationary trends during the second subperiod. Figure 2 shows the actual trends of real activities: gross domestic expenditure (*GDE*), real investment (*IR*), real imports (*IMR*) and daily per capita GDP in dollar terms (*YND$*). All these indices showed a rapid fall during the second subperiod, followed by stagnation. Thus these figures confirmed

Fig. 2. Trends of Real Variables during the Krismon Period



Note: For convenience, *GDE*, *IR*, and *IMR* were divided by 3, 2, and 3 respectively, and *YND$* was multiplied by 1,000. *X-FT* indicates the calculated value of variable *X* in the final test.

the suitability of subdividing the Krismon period into three subperiods, and also suggested the presence of a close interaction between the collapse of real activities and burst of prices. Hereafter I will use this subdivision of the Krismon period. The GDP level of about Rp 30,000 billion was similar to the level in 1994. Therefore, the free fall threw the Indonesian economy four years back in terms of GDP.

III. SPECIFICATION OF NONECONOMIC DISTURBANCES

One of the basic characteristics of Krismon was the strong interaction between economic and noneconomic factors. After the Asian currency crisis hit Indonesia, the value of the rupiah quickly depreciated from Rp 2,400 per U.S. dollar in July to Rp 4,650 per U.S. dollar in December 1997. This depreciation heralded further devaluation, induced a large capital flight, and suddenly increased the local debt repayment burden as many borrowers from overseas had not properly hedged the debt. At the beginning of 1998, as this negative impact accumulated, the real economy started to decline. The illness of ex-president Suharto, delay in the negotiations with the IMF, rumors about the establishment of a currency board led to an unstable social situation, and the exchange rate showed a hump in January. Then the politi-

cal turmoil increased, eventually resulting in the downfall of the Suharto regime, and the exchange rate reached a historical high of Rp 15,000 per U.S. dollar in June 1998. It gradually decreased but remained at Rp 8,000 per U.S. dollar in December 1998. The economic factors could explain the generally increasing tendency until the end of 1998, but completely failed to explain the large hump of June 1998. Clearly this hump resulted from a considerable noneconomic turmoil.

I first tested several regressions based on various influential economic variables, and always found large errors especially during the Krismon period. Therefore, I adopted the following strategy. I collected many economic variables based on sound economic rationality and tried to get a good fit for the period until December 1997. I used this equation and predicted the exchange rate until June 1999, and calculated errors between actual and estimated values. Then I attributed this error to the noneconomic (political and social) disturbances (NEDIS), which could not be explained adequately by economic factors alone.

I adopted the following explanatory variables. The sign (+, −) shows the postulated sign condition for each variable:

A. PPP variable (+)($X1 = CPIUS + WEIGHJ \cdot CPIJ$): The inflation in main importing countries exerted a positive impact. Before Krismon, the Bank Indonesia considered this as one of the factors to adjust the ceiling level of the exchange rate. As a proxy, I adopted the weighted average of CPI of the United States (*CPIUS*) and of Japan (*CPIJ*) using the ratio of nonoil dollar exports to Japan over export to the United States as the weight (*WEIGHJ*).

B. "Bandwagon" variable (+)($X2 = RATET/CPIT + RATEK/CPIK$): The real exchange rate of Thailand (*RATET*/*CPIT*) and of the Republic of Korea (*RATEK*/*CPIK*) exerted a strong "Bandwagon" effect due to the associated change of expectation, i.e., the common weakness for speculation attack based on weak financial institutions, and due to the fact that Thailand was the main competing exporter. Before addition, the real rates were normalized to the value of 1990, which was taken as 100.

C. Interest rate differential (+)($INT - INTUS$): Uncovered parity implies that the future expectation of the exchange rate change is equivalent to the difference of the domestic interest rate (*INT*) minus foreign interest rate (represented by U.S. interest rate, *INTUS*). This variable shows such an expectation. Higher domestic interest rate accelerates foreign capital inflow and influences the exchange rate, but such an indirect effect is represented by the private capital balance variable. The formula $(INT - INTUS) = (f - e)/e$, where f and e stand for forward and spot exchange rates, is frequently referred to as uncovered interest rate parity, e.g., Goldberg (1994, p. 417), MacDonald (1995, p. 450), and Mahyudin (1996, p. 53).

D. Foreign currency reserves (−)(*FR$*/*KR*): Higher foreign currency reserves (*FR$*) reduce the expectation of default, and exert a negative effect on the exchange

rate. To convert to unit per size of economy, this and following variables were deflated by the real capital stock.

E. Total debt outstanding (+)(*STCAP$*/*KR*): A higher debt (*STCAP$*) normalized by capital stock increases the risk of default, and exerts a positive impact on exchange rate.

F. Short-term capital balance (−)(*TCAPB$*/*KR*): The total capital balance (*TCAPB$*) shows more volatile changes than the current account in the short term. These volatile changes exert a negative effect on the exchange rate as a higher value implies the existence of a large excess inflow of foreign capital.

This specification implies that the actual exchange rate is largely determined by the market forces or the micro-behavior of economic entities and is basically not controllable by authority. In the past, there was a period of strategic exchange rate protection (Warr 1984), but more recently, the Bank Indonesia has adopted a crawling peg system with a band, which was widened from 2, 4, 8 to 12 per cent just before the Asian currency crisis. When Krismon started, the Bank Indonesia wasted more than 1 billion dollars for protection, and eventually switched to a flexible system. This was another proof that the intervention had failed. The sample period includes two periods of dirty and clean floating systems. I assumed that the pegging determination in the former period was implicitly described by the PPP variable and other variables which supplement this, and also played a major role in explaining the market forces during the clean floating period. The equation aimed at explaining the short-term change of the exchange rate. It differs from other specifications with a longer perspective like those of Faruqee (1995) and the NATREX model (Stein 1992), the normal mixture model of Jung (1995). It is partially similar to the fundamental equilibrium exchange rate model developed by Hojman (1989), in which the exchange rate is in equilibrium with the sum of trade and capital balances.

The results were as follows. The sample size was twenty-four (January 1996–December 1997).

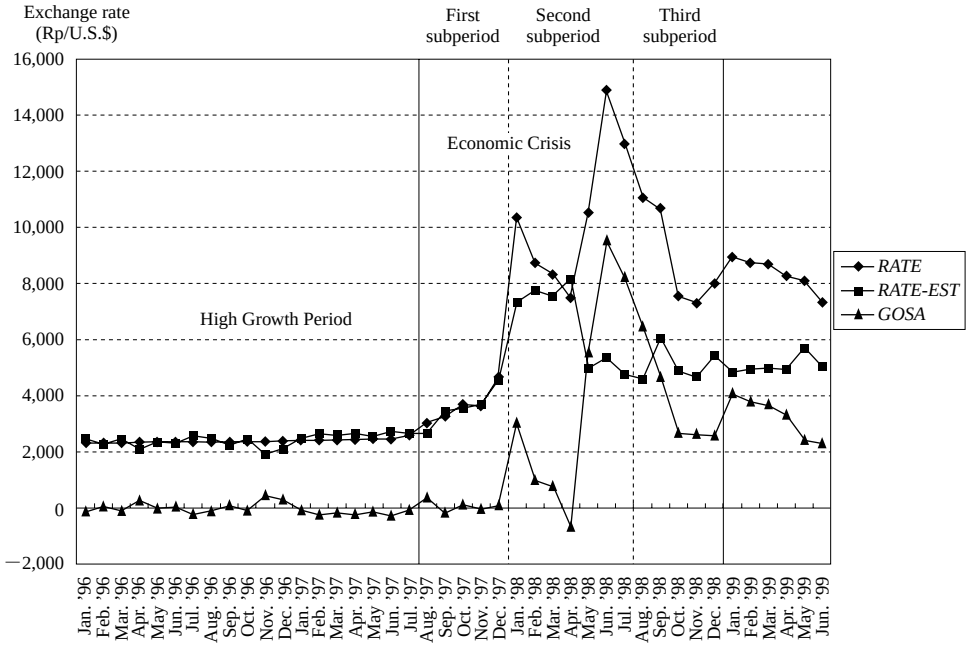
Exchange rate (*RATE*):

$$\begin{aligned} RATE/X1 = {} & -5.4834 + 3.334 \cdot X2(-1) + 0.04788 \cdot (INT - INTUS)\,(-1) \\ & \quad (-0.93) \qquad (4.20) \qquad\quad (2.48) \\ & -154.0 \cdot (FR\$/KR)\,(-1) + 11.02 \cdot (STCAP\$/KR)\,(-2) \\ & \quad (-2.61) \qquad\qquad\quad (2.64) \\ & -14.35 \cdot (TCAPB\$/KR)\,(-1) + u, \qquad\qquad\qquad\qquad (\text{E-1}) \\ & \quad (-1.60) \end{aligned}$$

$R = 0.9590$, $RA = 0.8974$, $S = 0.9726$, $d = 2.38$.

As indicated in Figure 3, the equation showed a good fit, and all the expected signs of variables were satisfied. It could also successfully explain the large jump recorded in December 1997. I extrapolated the exchange rate until June 1999 based

Fig. 3. Impact of Noneconomic Disturbances on Exchange Rate



Note: *RATE*, actual data; *RATE-EST*, estimated by the exchange rate equation based on the data of sustained growth period (May 1996–August 1997); *GOSA*, residuals between actual and estimated values.

on the actual values of explanatory variables. The errors (= actual value minus estimated value) were attributed to NEDIS. As shown in Figure 3, the absolute value of this variable was very low until December 1997, and reflected a good fit. The largest error was Rp 310 in November 1996. However at the beginning of 1998, NEDIS suddenly jumped twice, and recorded a large value of Rp 10,000 in June 1998. The economic factors could explain the generally increasing tendency of the exchange rate until the end of 1998, but completely failed to explain the large hump of June 1998, which clearly resulted from noneconomic turmoil. My interpretation is in agreement with the definition of Knight (1921): "risk designates events in which insurance market do exist and uncertainty situation in which they do not" (Seabra 1995, p. 443). Seabra calculated the absolute variance of the depreciation equation, and attributed it to the short-run uncertainty. In a similar way, I assigned the residual to NEDIS.[5]

[5] Blomberg-Hess (1997) directly introduced three political variables (partisan, election, and approve) into the autoregressive exchange rate equation for dollar, mark, and pound, and confirmed the significance in in-sample estimation. Because the observation period was too short, I could not use such a surrogate method.

In the past, the collapse of the exchange rate regime was usually interpreted as a monetary phenomenon: domestic credit generation, and domestic spending excesses, were considered to be the primary factors of reserve depletion and of an eventual collapse of the exchange rate regime (Goldberg 1994, p. 417; Flood and Garber 1984). In the equation above, the dirty-floating regime collapsed due to speculation attack initiated by the Asian currency crisis as these models have explained. Thereafter, the rate skyrocketed due to the interaction of economic and noneconomic factors.

IV. CONSTRUCTION OF MONTHLY ECONOMETRIC MODEL

The estimated results of the model are as follows. The whole model can be interpreted as an amalgamation of different submodels: a combination of an international transaction submodel (exports and imports, capital inflow and outflow, stock of foreign capital, and exchange rate) and a domestic economy submodel (components of GDP and GDE, capital stock), or another combination of the real (GDP and others) and the monetary (interest rate, exchange rate, money supply, and consumer price) aspects of the economy. The list of variables of the whole model and the results of estimation by the ordinary least square (OLS) method are as follows. Since none of the estimated equations contained the current values of endogenous variables at the right-hand side, so the OLS estimation is expected to bring consistent estimates. The model consists of seventeen estimated equations and additional identities.

Some features of the model are as follows: (a) The real aspect of the economy (sectoral GDP, consumption, investment, capital stock, exports, and imports) influences and is influenced by monetary aspects (prices, exchange rate, money supply, foreign currency reserves, and interest rate). (b) The domestic activities (sectoral production, domestic expenditure, and domestic prices) influence and are influenced by the international activities (capital inflow and outflow, exports and imports, and exchange rate). (c) Exchange rate, interest rate, money supply (M1, M2) and real government consumption are usually treated as exogenous variables in other models. Because the changes of these variables reflect the discretionary decisions of the authorities, it is very difficult to explain their changes based on economic variables, especially in a rapidly changing transitory period like Krismon. But these variables are treated as endogenous. (d) The main components of international transactions (capital inflow and outflow, capital balance, exports and imports, current balance, and foreign currency reserves) are endogenously explained, although the capital transactions were highly volatile during the Krismon period. (e) The results of the final test are very good, and the estimation error was less than 10 per cent after thirty-six months, after trying to restrict the use of dummies as much as possible. (f) In many occasions I used the real capital stock as the surro-

gate of scale of economy. For example, in the exchange rate equation, the foreign currency holdings (*FR$*) were deflated by the real capital stock (*KR*) to express the size of the holdings per size of the economy. (g) The agricultural sector and monetary sector showed highly volatile changes even before Krismon based on external factors like bad weather and the burst of the bubble. Their GDP drastically decreased in 1998 by 12 and 61 per cent, respectively. Therefore, I treated the GDP of the two sectors as exogenous variables. The GDP of the two sectors accounted for 30.7 and 32.6 per cent at the end of 1996 and 1998, respectively. Therefore, the model explains endogenously about 70 per cent of the GDP. (h) The GDP of the monetary sector reflects two aspects: part of the effective demand, and the supply of important monetary services, each of which contributes to the demand or supply side of the economy, and exerts positive and negative effects on price changes.

List of Variables

Endogenous variables (thirty-one):

RATE:	Exchange rate	(Rp/U.S.$)
FIN$:	Private non-FDI capital inflow	(U.S.$ million)
FOUT$:	Private non-FDI capital outflow	(U.S.$ million)
PCOTHB$:	Private non-FDI capital balance	(U.S.$ million)
PCAPB$:	Private capital balance	(U.S.$ million)
TCAPB$:	Total capital balance	(U.S.$ million)
SPOTH$:	Outstanding stock of private non-FDI capital	(U.S.$ million)
SPCAP$:	Outstanding stock of private capital	(U.S.$ million)
STCAP$:	Outstanding stock of total capital	(U.S.$ million)
X$:	Dollar value of exports	(U.S.$ million)
IM$:	Dollar value of imports	(U.S.$ million)
TB$:	Trade balance	(U.S.$ million)
CA$:	Current balance	(U.S.$ million)
TOT$:	Total balance of payment	(U.S.$ million)
FR$:	Foreign currency reserves	(U.S.$ million)
GDPMA:	GDP of manufacturing sector	(Rp billion)
GDPCO:	GDP of commerce sector	(Rp billion)
GDPOT:	GDP of other sectors	(Rp billion)
GDP:	Real GDP (GDE)	(Rp billion)
CPR:	Real private consumption	(Rp billion)
CGR:	Real government consumption	(Rp billion)
IR:	Real investment	(Rp billion)
KR:	Real capital stock	(Rp billion)
XR:	Rupiah value of real exports	(Rp billion)
IMR:	Rupiah value of real imports	(Rp billion)
YNDR:	Daily per capita GDP in rupiah	(Rp)
YND$:	Daily per capita GDP in U.S. dollar	(U.S.$)

CPI:	Consumer price index	(1990 = 100)
INT:	Money market interest rate	(%)
M1:	Money supply (M1)	(Rp billion)
M2:	Money supply (M2)	(Rp billion)

Exogenous variables (twenty-three):

CPIJ:	Consumer price index of Japan	(1990 = 100)
CPIK:	Consumer price index of Korea	(1990 = 100)
CPIT:	Consumer price index of Thailand	(1990 = 100)
CPIUS:	Consumer price index of the United States	(1990 = 100)
DKRIS:	Krismon dummy	(August 1997–December 1998 = 1)
ERO$:	Errors and omissions of balance of payment	(U.S.$ million)
FDI$:	Net inflow of FDI in U.S. dollar	(U.S.$ million)
GDPAG:	GDP of agricultural sector	(Rp billion)
GDPMO:	GDP of monetary sector	(Rp billion)
INTUS:	Interest rate of the United States	(%)
NEDIS:	Noneconomic disturbances	(Rp/U.S.$)
OCAPB$:	Official capital balance	(U.S.$ million)
POP:	Population	(Million)
RATEJ:	Exchange rate of Japan	(Yen/U.S.$)
RATEK:	Exchange rate of Korea	(Won/U.S.$)
RATET:	Exchange rate of Thailand	(Baht/U.S.$)
SDTB$:	Adjustment term in trade balance	(U.S.$ million)
SERB$:	Service trade balance	(U.S.$ million)
SFDIR:	Real FDI stock	(Rp billion)
TIME:	Month	(January 1995 = 1)
WEIGHJ:	Relative nonoil exports of Japan to the United States	(Ratio)
WPI:	Wholesale price index	(1990 = 100)
YW:	World GDP	(U.S.$ million)

Short-Term Monthly Model of Indonesian Economy (January 1996–December 1997: thirty-six samples)

1. Exchange rate (*RATE*) (twenty-four samples: January 1996–December 1997)

$$\begin{aligned} RATE/X1 = {} & -5.4834 + 3.334 \cdot X2(-1) + 0.04788 \cdot (INT - INTUS)(-1) \\ & \quad (-0.93) \quad (4.20) \qquad\quad (2.48) \\ & -154.0 \cdot (FR\$/KR)(-1) + 11.02 \cdot (STCAP\$/KR)(-2) \\ & \quad (-2.61) \qquad\quad (2.64) \\ & -14.35 \cdot (CAPB\$/KR)(-1) + NEDIS. \qquad\qquad \text{(E-1)} \\ & \quad (-1.60) \end{aligned}$$

$$X1 = CPIUS + WEIGHJ \cdot CPIJ,$$

$$X2 = RATET/CPIT + RATEK/CPIK,$$

$R = 0.9590$, $RA = 0.8974$, $S = 0.9726$, $d = 2.38$.

(Note: *NEDIS* represents the equation errors, but is defined as an independent exogenous variable as indicated in Section III.)

2. Private non-FDI capital inflow (*FIN$*)

$$FIN\$ = \mathrm{MAX}(Z, 0) + u,$$

$$\begin{aligned} Z = {} & 3,922.47 - 1,366 \cdot INTUS(-3) + 0.1941 \cdot IR(-1) - 1,198 \cdot DKRIS \\ & \quad (1.37) \qquad (-2.75) \qquad\quad (2.51) \qquad\quad (-5.38) \\ & + 54,260 \cdot (SFDIR/KR)(-1) + 1.341 \cdot CA\$(-3) + u, \qquad \text{(E-2)} \\ & \quad (2.10) \qquad\qquad\qquad (3.38) \end{aligned}$$

$R = 0.9129$, $RA = 0.8057$, $S = 404.54$, $d = 1.04$.

(Note: This equation was estimated by a restricted OLS. When the calculated value became negative, it was set at zero.)

3. Private non-FDI capital outflow (*FOUT$*)

$$\begin{aligned} FOUT\$ = {} & -15,736.9 - 20.20 \cdot (INT(-1) - INT(-2)) + 1,636 \cdot DKRIS \\ & \quad (-5.00) \quad (-4.82) \qquad\qquad\qquad (10.84) \\ & + 0.06856 \cdot SPOTH\$(-3) + 0.6010 \cdot CA\$(-1) \\ & \quad (4.04) \qquad\qquad\quad (2.81) \\ & + 44,730 \cdot (SFDIR/KR)(-1) + 9,228 \cdot (GDP(-1)/GDP(-2)) \\ & \quad (1.78) \qquad\qquad\quad (2.83) \\ & - 1,805 \cdot (D(97.08)) - 926.0 \cdot (D(40) + D(41) \\ & \quad (-7.03) \qquad\quad (-6.40) \\ & - D(48)) + u, \qquad \text{(E-3)} \end{aligned}$$

$R = 0.9697$, $RA = 0.9226$, $S = 226.17$, $d = 1.85$.

4. Private non-FDI capital balance (*PCOTHB$*)

$$PCOTHB\$ = FIN\$ - FOUT\$. \qquad \text{(E-4)}$$

5. Private capital balance (*PCAPB$*)

$$PCAPB\$ = PCOTHB\$ + FDI\$. \qquad \text{(E-5)}$$

6. Total capital balance (*TCAPB$*)

$$TCAPB\$ = PCAPB\$ + OCAPB\$. \qquad \text{(E-6)}$$

7. Outstanding stock of private non-FDI capital (*SPOTH$*)

$$SPOTH\$ = SPOTH\$(-1) + PCOTHB\$. \qquad \text{(E-7)}$$

8. Outstanding stock of private capital (*SPCAP$*)

$$SPCAP\$ = SPCAP\$(-1) + PCAPB\$. \qquad \text{(E-8)}$$

9. Outstanding stock of total capital (*STCAP$*)

$$STCAP\$ = STCAP\$(-1) + CAPB\$. \qquad \text{(E-9)}$$

10. Rupiah value of exports (*XR*)

$$XR/KR(-1) = 0.003503 + 1.043\cdot(YW/KR)(-1) \quad (1.23)\ (4.50)$$
$$+ 0.1301\text{E-}03\cdot(RATE/CPI)(-2) + 0.4091\cdot(IMR/KR)(-2) \quad (2.38)\ (3.38)$$
$$-0.008350\cdot(D(46) + D(47) + D(48)) + u, \quad (-4.04) \qquad \text{(E-10)}$$

$R = 0.9876$, $RA = 0.9721$, $S = 0.0028$, $d = 0.76$.

11. Rupiah value of imports (*IMR*)

$$IMR/KR(-1) = 32.33 + 315.5\cdot(FR\$/KR)(-2) - 0.3454\cdot(RATE/WPI)(-9) \quad (2.61)\ (2.41)\ (-2.29)$$
$$+ 59.82\cdot[(CPR + CGR + IR)/KR](-6) \quad (1.86)$$
$$- 66.46\cdot(GDPAG/GDP)(-8) \quad (-1.33)$$
$$- 9.347\text{E-}04\cdot(NEDIS)(INT)(-6) + u, \quad (-1.82) \qquad \text{(E-11)}$$

$R = 0.9668$, $RA = 0.9238$, $S = 5.047$, $d = 0.41$.

12. Dollar value of real exports (*X$*)

$$X\$/XR = 3.3751 + 0.8095\cdot DKRIS + 8.396\cdot POIL\$(-1) - 31.99\cdot CPIUS(-4) \quad (1.60)\ (6.24)\ (4.06)\ (-1.71)$$
$$+ 3.065\cdot CPI(-4) + 8.135\cdot TIME - 25.82\cdot TIME\cdot DKRIS \quad (12.11)\ (1.46)\ (-6.42)$$
$$+ 59.59\cdot(D(39) - D(44) - D(45) + D(47)) + u, \quad (6.24) \qquad \text{(E-12)}$$

$R = 0.9661$, $RA = 0.9167$, $S = 0.01900$, $d = 1.45$.

13. Dollar value of real imports (*IM$*)

$$IM\$/IMR = -4.2531 + 466.3\cdot DKRIS + 2.478\text{E-}04\cdot YW(-1) \quad (-2.04)\ (3.56)\ (3.60)$$
$$+ 0.02896\cdot CPIUS(-5)\cdot DKRIS + 2.545\text{E-}03\cdot CPI(-4) \quad (1.53)\ (8.92)$$
$$- 1.229\cdot TIME - 1.529\cdot TIM\cdot DKRIS + u, \quad (-2.14)\ (-3.90) \qquad \text{(E-13)}$$

$R = 0.9717$, $RA = 0.9326$, $S = 0.01974$, $d = 1.74$.

14. Definition of dollar-value trade balance (*TB$*)

$$TB\$ = X\$ - IM\$ + SDTB\$. \qquad \text{(E-14)}$$

15. Definition of dollar-value current balance (*CA$*)

$$CA\$ = TB\$ + SERB\$. \quad \text{(E-15)}$$

16. Definition of dollar-value total balance (*TOT$*)

$$TOT\$ = CA\$ + TCAPB\$ + ERO\$. \quad \text{(E-16)}$$

17. Definition of foreign currency reserve (*FR$*)

$$FR\$ = FR\$(-1) + TOT\$. \quad \text{(E-17)}$$

18. Manufacturing sector *GDP* (*GDPMA*)

$$\begin{aligned}(GDPMA/KR)(-1) = {} & -0.0002221 + 0.7210 \cdot (X\$/KR)(-1) \\ & \quad (-0.13) \qquad (3.01) \\ & + 0.3128 \cdot (IR/KR)(-1) + 0.2203 \cdot (IMR/KR)(-2) + u, \\ & \quad (4.16) \qquad\qquad (2.29)\end{aligned} \quad \text{(E-18)}$$

$R = 0.9884$, $RA = 0.9747$, $S = 0.002700$, $d = 0.60$.

19. Commerce sector *GDP* (*GDP*CO)

$$\begin{aligned}(GDPCO/KR)(-1) = {} & 0.002922 - 1.0870\text{E-}5 \cdot INT(-1) \\ & \quad (1.51) \qquad (-1.17) \\ & + 0.1619 \cdot (GDP/KR)(-1) - 0.05991 \cdot TIME + u, \\ & \quad (31.34) \qquad\qquad (-1.29)\end{aligned} \quad \text{(E-19)}$$

$R = 0.9991$, $RA = 0.9980$, $S = 5.2790\text{E-}04$, $d = 0.52$.

20. Other sector GDP (*GDPOT*)

$$\begin{aligned}GDPOT/POP = {} & 5.4341 - 0.05961 \cdot INT(-4) + 0.08252 \cdot (IR/POP)(-4) \\ & \quad (0.42) \quad (-1.19) \qquad\qquad (1.15) \\ & - 0.1998 \cdot TIME - 6.457\text{E-}04 \cdot NEDIS \\ & \quad (-1.25) \qquad\quad (-2.39) \\ & + 0.3783 \cdot (COPR/GDP)(-2) + u, \\ & \quad (2.35)\end{aligned} \quad \text{(E-20)}$$

$R = 0.8384$, $RA = 0.6535$, $S = 2.5770$, $d = 0.76$.

21. Real GDP (*GDPR*)

$$GDPR = GDPAG + GDPMA + GDPCO + GDPMO + GDPOT. \quad \text{(E-21)}$$

22. Real private consumption (*CPR*)

$$\begin{aligned}(CPR/GDP)(-1) = {} & 0.1049 - 5.508\text{E-}06 \cdot NEDIS + 0.8368 \cdot (CPR/GDP)(-1) \\ & \quad (1.20) \quad (-2.87) \qquad\qquad (5.98) \\ & + 0.1256 \cdot ((CPR/GDP)(-2) - (CPR/GDP)(-3)) \\ & \quad (1.01)\end{aligned}$$

$$+ 1.9970\text{E-}03 \cdot (CPI(-2) - CPI(-3)) + u, \qquad \text{(E-22)}$$
$$(3.06)$$

$R = 0.9133$, $RA = 0.8127$, $S = 0.01830$, $d = 1.41$.

23. Real government consumption (*CGR*)

$$CGR \cdot CPI/POP = 108.24 + 0.01596 \cdot (GDP \cdot CPI/POP)(-1)$$
$$(0.62) \quad (2.04)$$
$$+ 4{,}924 \cdot (SOCAPB\$ \cdot INT)(-2)$$
$$(1.99)$$
$$+ 0.7238 \cdot (CGR \cdot CPI/POP)(-1) + u, \qquad \text{(E-23)}$$
$$(8.58)$$

$R = 0.9871$, $RA = 0.9720$, $S = 96.74$, $d = 1.27$.

24. Real investment (*IR*)

$$(IR/KR)(-1) = -0.01704 + 0.4001 \cdot (SFDIR/KR)(-1) + 1.655 \cdot (IM\$/KR)(-2)$$
$$(-2.16) \quad (4.16) \qquad\qquad (4.67)$$
$$+ 0.08238 \cdot (GDP/KR)(-1) - 74.92\text{E-}06 \cdot (INT)(-1) + u,$$
$$(1.87) \qquad\qquad (-1.99)$$
$$\text{(E-24)}$$

$R = 0.9953$, $RA = 0.9893$, $S = 0.002400$, $d = 0.90$.

25. Real capital stock (*KR*)

$$KR = (1 - 0.005) \cdot KR(-1) + IR. \qquad \text{(E-25)}$$

26. Daily per capita *GDP* in rupiah (*YNDR*)

$$YNDR = GDP/POP/365/10{,}000. \qquad \text{(E-26)}$$

27. Daily per capita GDP in Dollar (*YND$*)

$$YND\$ = GDP/POP/365/1{,}000. \qquad \text{(E-27)}$$

28. Consumer price index (*CPI*)

$$CPI = -60.9862 + 101.8 \cdot (M1(-2)/M1(-4))$$
$$(-1.06) \quad (2.86)$$
$$- 67.74 \cdot (GDPMO(-1)/GDPMO(-2))$$
$$(-1.61)$$
$$+ 36.60 \cdot (RATE(-1)/RATE(-3)) - 6.723 \cdot (INT(-1)/INT(-2))$$
$$(6.37) \qquad\qquad (-1.76)$$
$$+ 0.002473 \cdot NEDIS + 0.4878 \cdot [(CP(-1) + CG(-1))/POP(-1)]$$
$$(2.53) \qquad (1.18)$$
$$- 1.356 \cdot (GDPAG(-2)/POP(-2)) + 12.59 \cdot DKRIS - 27.89 \cdot D(48) + u,$$
$$(-1.68) \qquad\qquad (2.69) \qquad (-3.82)$$
$$\text{(E-28)}$$

$R = 0.9534$, $RA = 0.8775$, $S = 10.26$, $d = 1.96$.

29. Interest rate (*INT*)

$$\begin{aligned} INT = {} & 174.103 - 153.2 \cdot (CPI(-1)/CPI(-2)) - 0.009915 \cdot (GDPMO(-1) \\ & \quad (2.75) \quad (-2.61) \qquad\qquad (-4.10) \\ & - GDPMO(-3)) + 0.002388 \cdot RATE(-2) - 1.517 \cdot (M2(-2)/GDP(-1)) \\ & \qquad\qquad (1.85) \qquad\qquad (-1.25) \\ & + 0.002280 \cdot NEDIS - 0.001344 \cdot TOTB\$(-2) + 38.46 \cdot DKRIS \\ & \quad (5.39) \qquad\quad (-1.43) \qquad\quad (13.46) \\ & - 22.26 \cdot D98.12 + u, \\ & \quad (-3.71) \end{aligned} \tag{E-29}$$

$R = 0.9885$, $RA = 0.9704$, $S = 4.122$, $d = 1.95$.

30. Narrow money supply (*M1*)

$$\begin{aligned} & \log(M1/GDP(-1)/CPI(-1))/(M1(-1)/GDP(-2)/CPI(-2)) \\ & \quad = 9.210 + 0.1187 \cdot \log\,(CPI(-2)/CPI(-5)) \\ & \qquad (1{,}417.08)\ (1.50) \\ & \quad - 0.05229 \cdot \log(RATE(-1)/RATE(-2)) \\ & \qquad (-1.90) \\ & \quad + 0.1715 \cdot \log(GDPMO(-1)/GDPMO(-4)) \\ & \qquad (5.47) \\ & \quad -0.02439 \cdot \log(INT(-2)/INT(-4)) + 0.1666 \cdot D(37) + u, \\ & \qquad (-1.82) \qquad\qquad (5.62) \end{aligned} \tag{E-30}$$

$R = 0.8569$, $RA = 0.6900$, $S = 0.002804$, $d = 2.24$.

31. Broad money supply (*M2*)

$$\begin{aligned} & \log(M2/GDP(-1)/CPI(-1))/(M2(-1)/GDP(-2)/CPI(-2)) \\ & \quad = 9.212 + 0.2000 \cdot \log(CPI(-2)/CPI(-5)) \\ & \qquad (1{,}323.89)\ (2.37) \\ & \quad - 0.05895 \cdot \log(RATE(-1)/RATE(-2)) \\ & \qquad (-2.00) \\ & \quad + 0.1525 \cdot \log(GDPMO(-1)/GDPMO(-4)) \\ & \qquad (4.55) \\ & \quad -0.03703 \cdot \log(INT(-2)/INT(-4)) + 0.2294 \cdot D(37) + u, \\ & \qquad (-2.58) \qquad\qquad (7.23) \end{aligned} \tag{E-31}$$

$R = 0.8748$, $RA = 0.7261$, $S = 0.003002$, $d = 1.95$.

(Note: *R* and *RA* are the multiple correlation coefficients before and after the correction of degrees of freedom, *S* is the standard deviation of equation error, *d* is the Durbin-Watson statistic. The number in parenthesis is the *t*-value. *D*(*j*) stands for the dummy of *j*-th month (January 1995 = 1).The value in the parenthesis shows the lag number.)

TABLE II

RESULTS OF THE FINAL TEST (MAPE)

Variable	Period		
	24 months (32–36)	32 months (38–42)	36 months (44–48)
GDE	0.90	3.40	2.23
CPR	2.43	5.99	6.29
CGR	8.77	3.94	2.35
IR	7.29	5.92	9.08
XR	5.26	6.11	7.69
IMR	18.25	4.59	6.70
GDPMA	6.95	3.15	8.50
GDPCO	2.57	9.32	4.78
GDPOT	4.73	9.94	5.56
KR	1.02	0.43	0.34
X$	4.65	7.08	7.69
IM$	21.67	2.97	6.41
FR$	4.53	3.85	3.01
RATE	6.96	0.95	1.15
STCAP$	0.33	0.43	0.74
SPCAP$	0.54	0.79	1.53
SPOTH$	0.71	1.10	2.25
FIN$	(0.30)	(0.55)	(0.66)
FOUT$	14.41	18.84	12.36
YNDR	0.90	3.40	2.23
YND$	7.54	4.01	2.26
CPI	1.81	1.55	1.36
INT	14.98	6.81	8.61
M1	2.19	3.18	1.75
M2	10.17	3.19	1.17

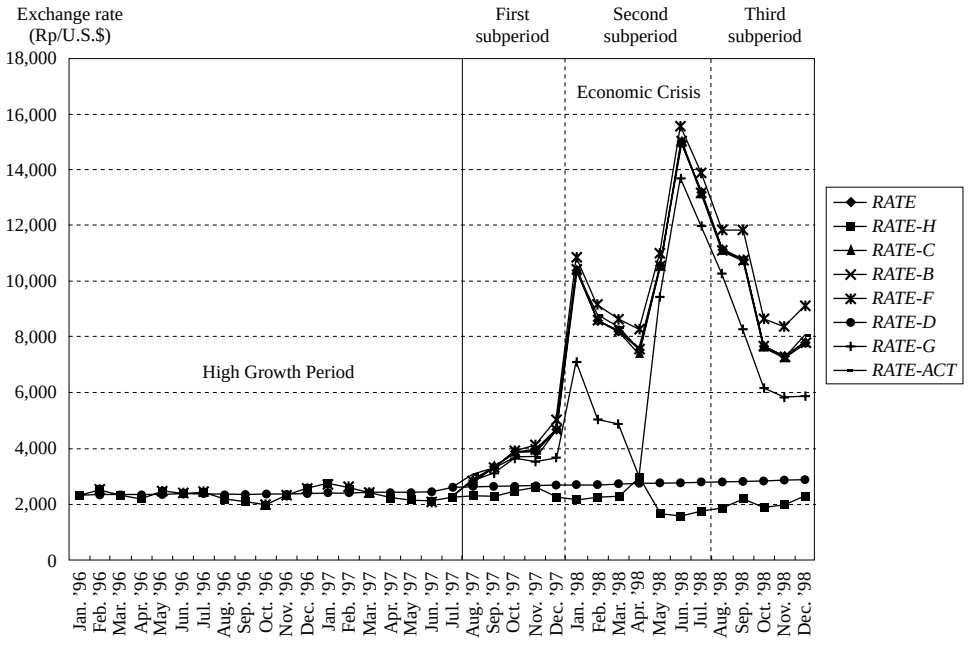
Source: Calculated by the author.

Note: The mean absolute percentage error (MAPE) is not significant when the variables can take a zero value. Therefore I omitted MAPE for balance variables (*PCAPB$, TCAPB$, TB$, CA$, TOT$*). The number in parenthesis is the ratio of the absolute average error to the standard deviation in the single equation estimation.

During the Krismon period, since many equations obviously incurred structural changes, I tried to describe these by using the Krismon dummy. For example, I used it for other (non-FDI) private capital outflows, which showed volatile changes toward the end of 1997. I implemented the final test for thirty-six months (January 1996–December 1998), and calculated the mean absolute percentage error (MAPE, %) for 32–36, 38–42 and 44–48 months. The results were shown in Table II.

The use of MAPE was not suitable for private non-FDI inflow (*FIN$*), which fell quickly to a very low level during the Krismon period, and became almost zero during the periods 32–36 and 44–48, but small positive values were predicted by the model. For the periods 38–42, zero values were predicted although inflows were small. MAPE was not applicable because the actual values were zero, I calculated

Fig. 4. Trend of Exchange Rate



the ratio of the average absolute errors to the standard deviation of the equation (U.S.$404.54 million). The ratio was less than 0.7, which confirmed that the final test error for the last five months was on the average less than the single equation estimation error. Also the non-FDI capital outflow (*FOUT$*) became very small during the Krismon period, therefore the relatively large MAPE (12 per cent) does not necessarily imply the existence of a seriously bad fit. After these observations, I concluded that since the estimated monthly model provided a reasonably good fit, it described the over-time tendency of the Indonesian economy fairly well even during the turbulent Krismon period.

Following figures show the trends of important endogenous variables. Each figure shows the trend of variable (*X*): actual values (*X-ACT*), estimated values by final test (*X-FIN*), and values obtained by several simulations (*X-B*, . . . , *X-H*). The specifications of simulations will be described later.

Figure 4 shows the trend of the exchange rate (*RATE*). The results of the final test described the actual trend very well even after January 1998, partly due to the introduction of noneconomic disturbances. It confirmed that the rate change was still dominated by six basic economic variables while it was adversely affected by political instability in January and June 1998.

Fig. 5. Trend of Non-FDI Private Capital Inflow

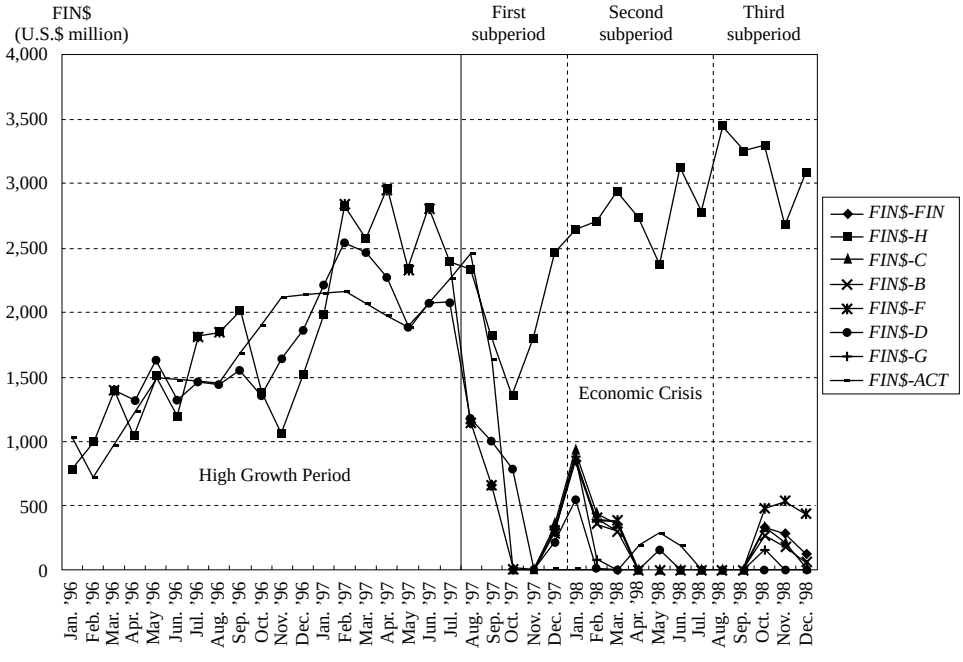
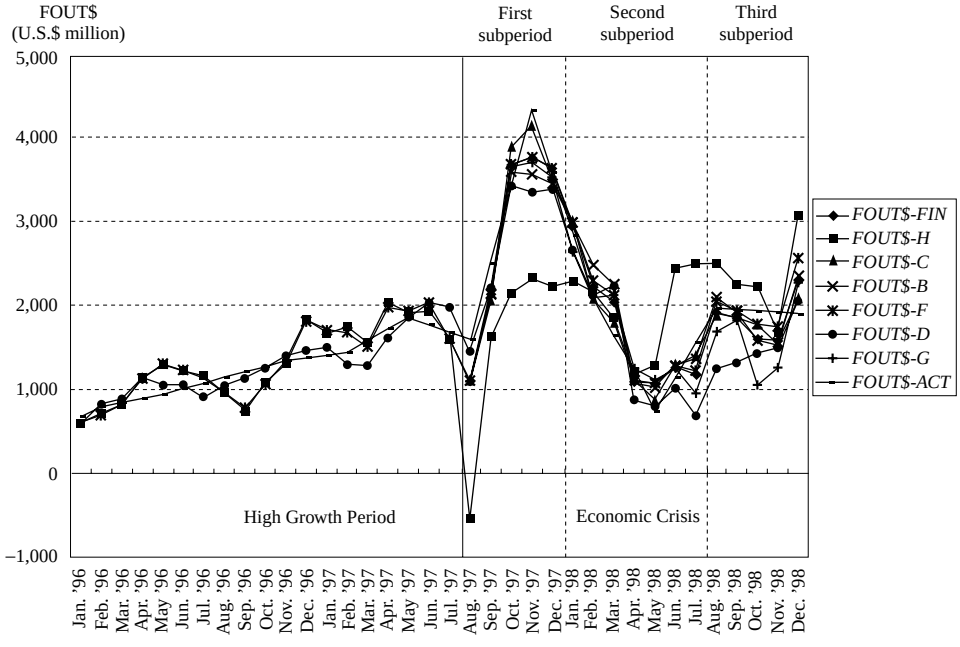


Figure 5 shows the trend of the private non-FDI capital inflow (*FIN$*). The level of domestic investment, FDI ratio, current balance exerted a beneficial effect, while the U.S. interest rate and Krismon dummy had an adverse effect. These variables explained 83 per cent of the variation of inflow which increased steadily until August 1997, then fell abruptly and became almost zero during the Krismon period. Because it took zero values, the equation was estimated by the restricted least square method. Although there was a minor recovery in January 1998, the final test values were very low during the Krismon period, and described the actual trend fairly well.

Figure 6 shows the trend of the private non-FDI capital outflow (*FOUT$*). Since part of the past non-FDI investment returns periodically, the non-FDI stock exerts a beneficial effect on it. The increment of interest rate had a negative effect. Other factors also influenced the investors' incentive of returning capital: FDI stock ratio, current balance, and GDP growth rate. They reflect the incentive of returning capital, ease of funding and expectation of investors. The Krismon dummy has a significantly positive coefficient, and shows the drastic change of the investors' attitude after the onset of the Asian currency crisis. Because the accumulation of past inflow increased, the outflow gradually increased from January 1996 until the summer of

Fig. 6. Trend of Non-FDI Private Capital Outflow



1997, and it suddenly jumped at the end of 1997. Thus, there was a large capital flight based on the change of regime of the exchange rate and changing expectations. The non-FDI stock decreased by U.S.$14 billion during the period of August 1997–January 1998. At the beginning of 1998, the outflow decreased to U.S.$1 billion, and then remained at about U.S.$2 billion. Except for the use of some dummies, the single equation estimate and the results of the final test described the actual trend fairly well.

Figure 7 shows the trend of the rupiah value of real exports (*XR*). Four variables affected it positively: world GDP, total capital stock, real exchange rate deflated by CPI, and real imports. Each represents the increase of foreign demand, capacity of supply, international competitiveness, and supply of parts and intermediate goods. Real exports continued to grow even until the summer of 1998, and suddenly collapsed at the end of 1998. Some export sectors like tin, copper, palm oil did not depend heavily on imported materials and benefited from the large devaluation and relatively low wages. As a result they recorded a boom and supported further growth of total exports. However, as the other main export sectors collapsed due to the shortage of intermediate goods and other factors, the total real exports dropped drastically at the end of 1998 while the real exchange rate still remained low.

Fig. 7. Trend of Real Exports

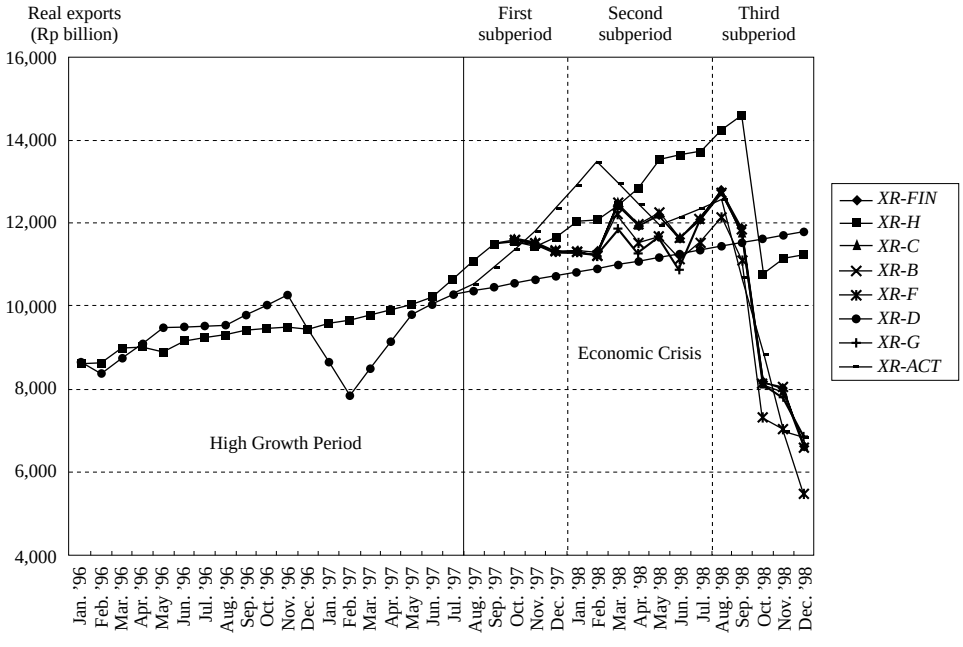


Figure 8 shows the trend of the rupiah value of real imports (*IMR*). The level of domestic demand (consumption plus investment), total capital stock, foreign currency holdings affected it positively. The first two represent the domestic demand, and the last reflects an adequate purchasing power. The real exchange rate deflated by WPI, agricultural GDP, and noneconomic disturbance multiplied by interest rate affected it negatively. They reflected the higher import price, larger supply of agricultural goods, and higher transaction cost during the turbulent period. The real imports increased at the end of 1997, decreased slowly until the summer of 1998, and then collapsed at the end of 1998. In 1998, they decreased by 50 per cent. The final test results accurately described such drastic changes.

Figure 9 shows the trend of dollar exports (*X$*). Equation (E-12) is a statistical equation, which actually explains the ratio of dollar exports to real exports in rupiah by several factors like dollar oil price, U.S. CPI, CPI, time, and Krismon dummy. The dollar exports slowly increased until December 1997, and then decreased by 10 per cent until December 1998 after volatile changes. The results of the final test described these changes fairly well.

Figure 10 shows the trend of dollar imports. Equation (E-13) also explains the ratio of dollar imports to real imports in rupiah. By definition, dollar imports equal

Fig. 8. Trend of Real Imports

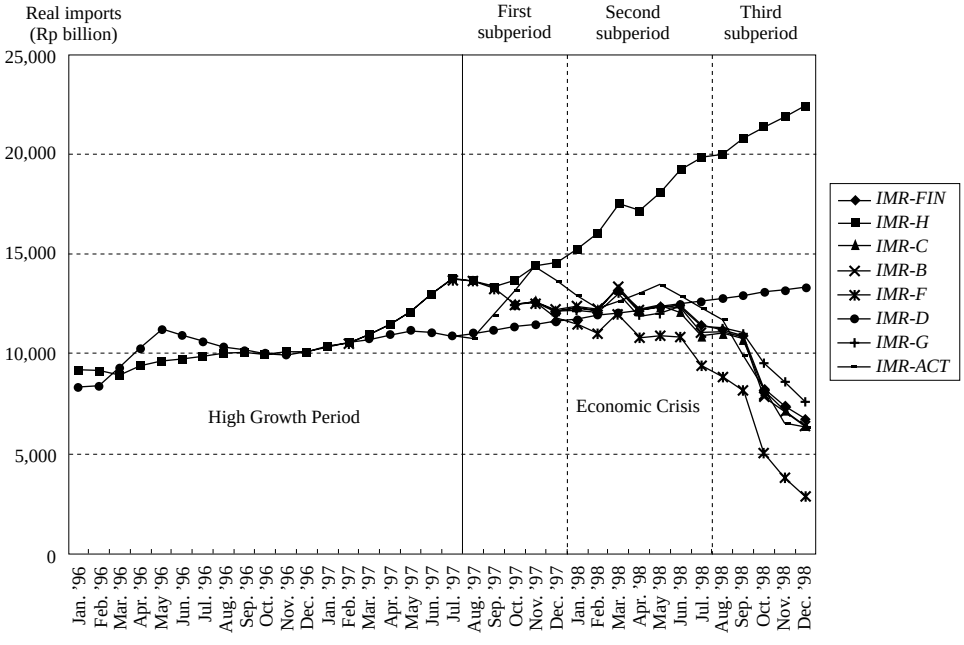


Fig. 9. Trend of Dollar Exports

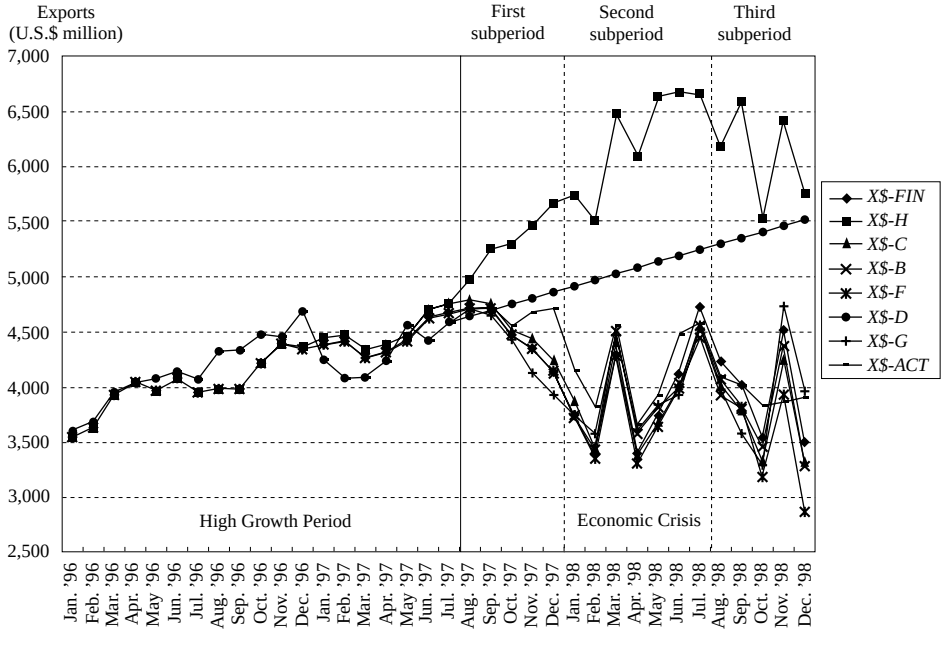
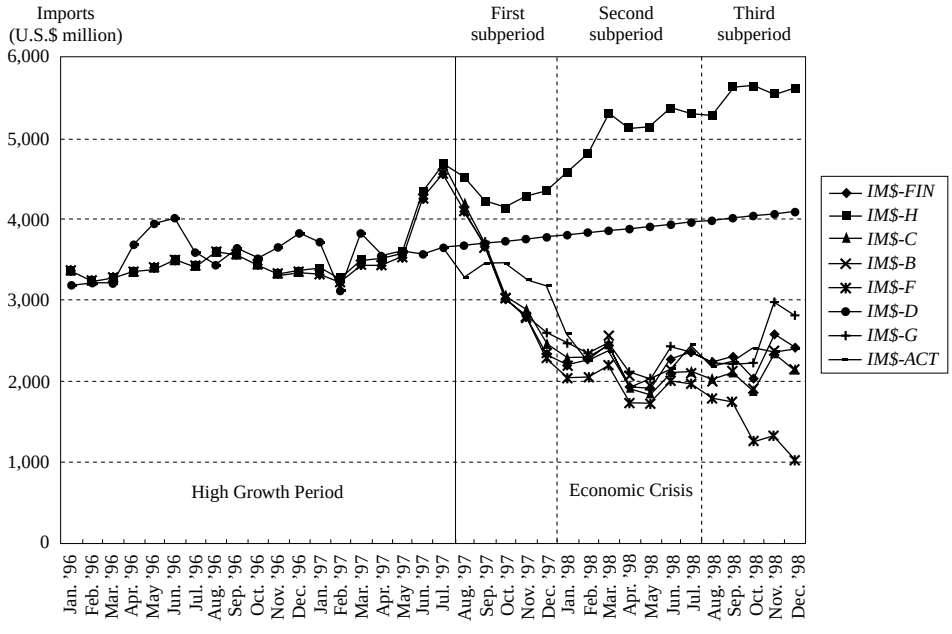


Fig. 10. Trend of Dollar Imports



the (real rupiah imports)·(import price)/(exchange rate). Therefore, if the pass-through from exchange rate to import price is complete, this ratio remains constant. However, actually, the pass-through effect is not 100 per cent due to several factors such as industrial structure, degree of monopoly, inertia, etc. This equation thus enables to explain the changes statistically. World GDP, CPI, Krismon dummy, and time act as explanatory factors. The dollar imports started to decline after July 1997, and decreased by 45 per cent until April 1998. Thereafter, they showed a minor recovery, although the level at the end of 1998 was still 30 per cent lower than the highest level in the past. The final test described this trend well, except for the jump in June 1997. The different trends in the rupiah real imports (Figure 7) and dollar imports (Figure 9) show how the pass-through effects differed in each subperiod.

Figures 11, 12, and 13 show the trends of the total balance of payment, current balance of payment and private capital balance. In this model, the dollar exports and imports as well as the private non-FDI capital transaction are endogenously explained. The trade balance is therefore defined by (dollar exports minus imports) plus an adjustment term (*SDTB$*), and the current balance is defined as the trade balance plus service balance (*SERB$*). The private capital balance is the sum of the private non-FDI balance and FDI balance, which is exogenous. The total capital balance is the sum of the private capital balance and official capital balance

Fig. 11. Trend of Total Balance of Payment

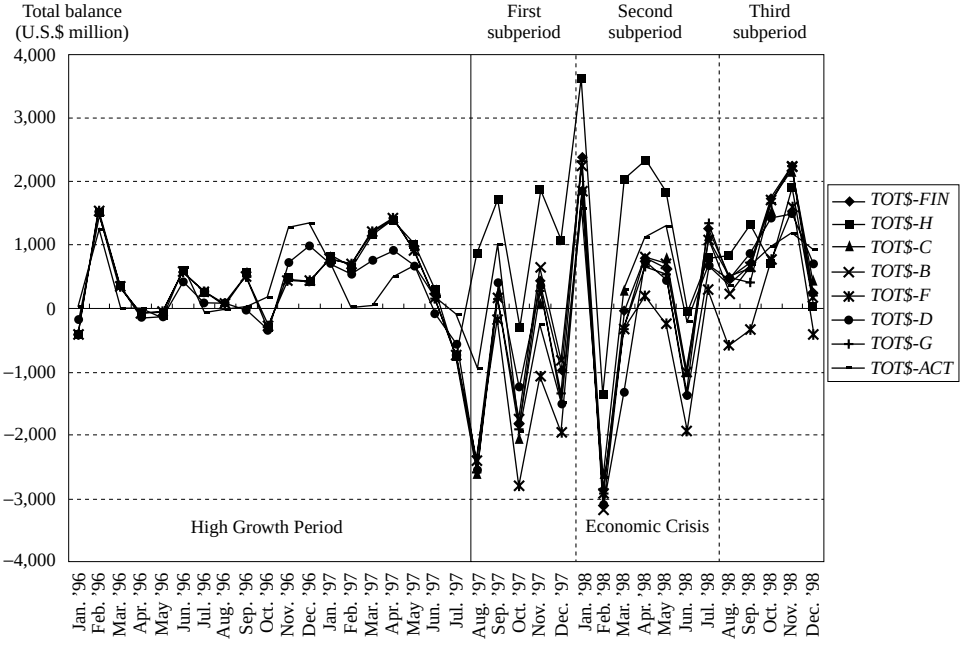


Fig. 12. Trend of Current Balance of Payment

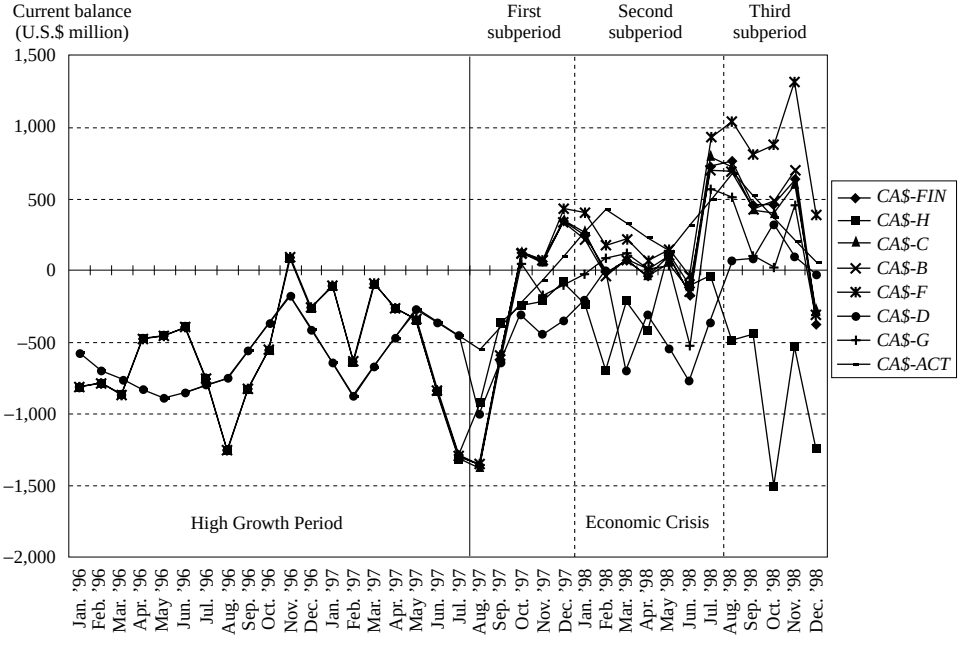
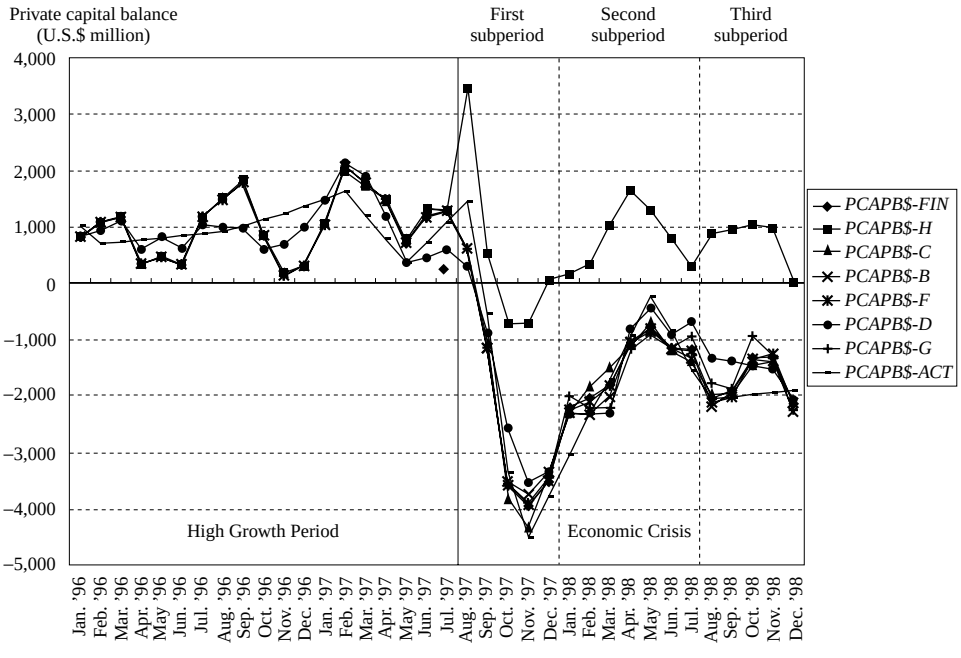


Fig. 13. Trend of Private Capital Balance



(*OCAPB$*), which is exogenous. Finally the total balance of payment (*TOT$*) is defined as the sum of the current balance, capital balance, and an error term (*ERO$*). The increment of foreign currency reserves (*FR$*) is equivalent to the total balance of payment. Therefore, the errors of the final test in Figure 11 or Figure 12 correspond to the errors of dollar exports minus imports or private non-FDI capital balance. Except for July–August 1997, the final test described traced the actual value in both figures fairly well. The errors of the final test in Figure 10 correspond to the sum of these two errors. The error was within U.S.$500 million in Figure 10 except for July–August 1997.

Figures 14 and 15 show the trends of outstanding stocks of total capital and private capital inflows. Each shows an increasing trend until August 1997, and then a rapid decrease during the Krismon period. Private non-FDI stock decreased by U.S.$32,000 million from U.S.$78,000 million in August 1997 to U.S.$46,000 million in December 1998. The decrease of the private capital stock shown in Figure 14 during the same period was U.S.$33,000 million. The difference of U.S.$1,000 million implies the existence of a small decrease of the FDI stock. Total capital stock decreased by U.S.$20,000 million during the Krismon period. The difference of U.S.$13,000 million implies the increase of the official capital stock due to the

Fig. 14. Trend of Stock of Total Capital Inflow

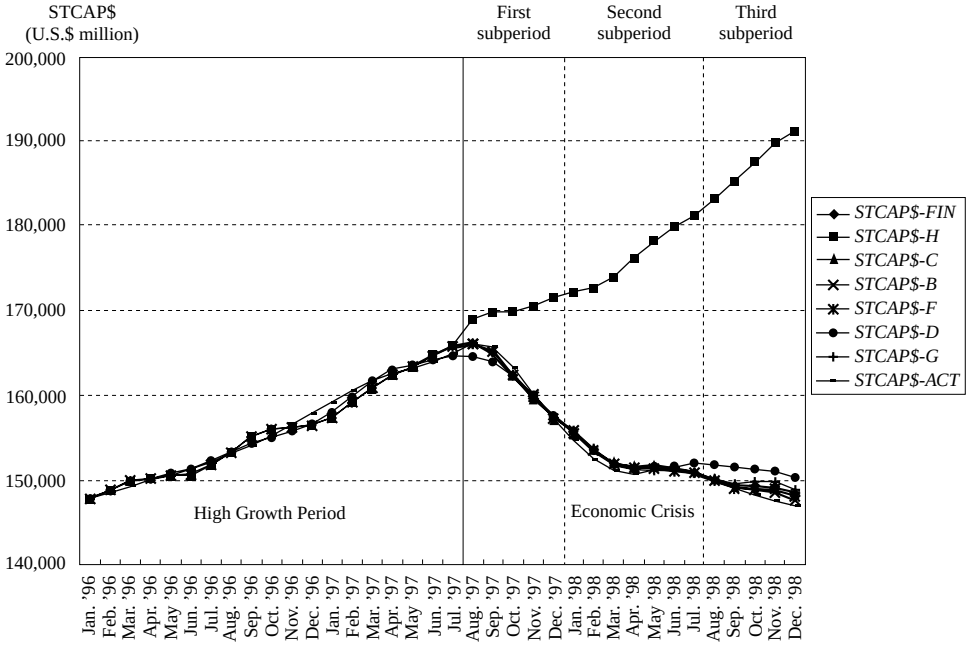


Fig. 15. Trend of Stock of Private Capital Inflow

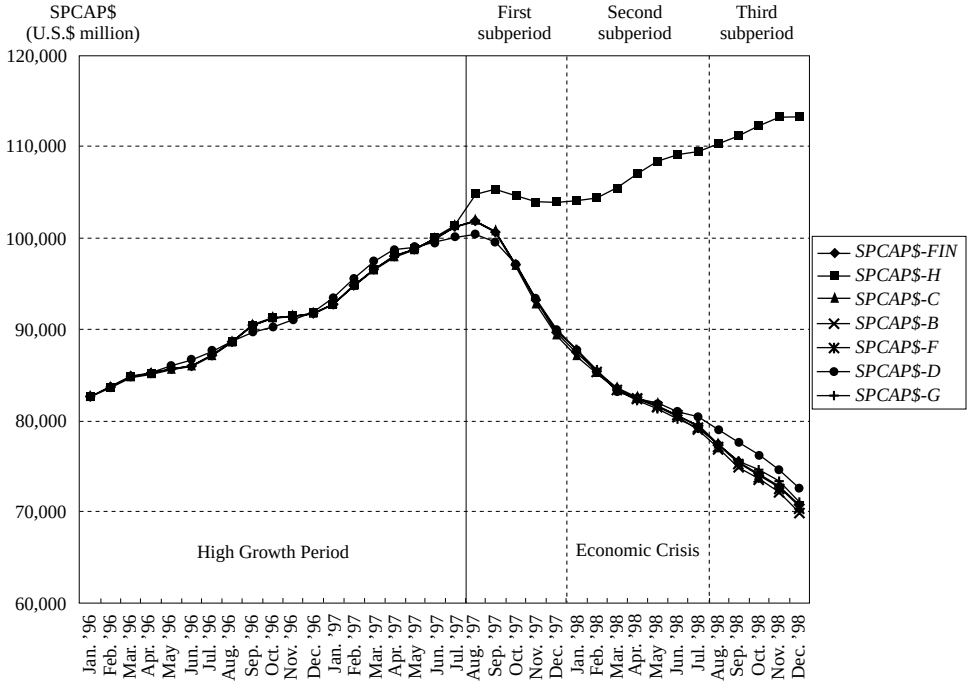
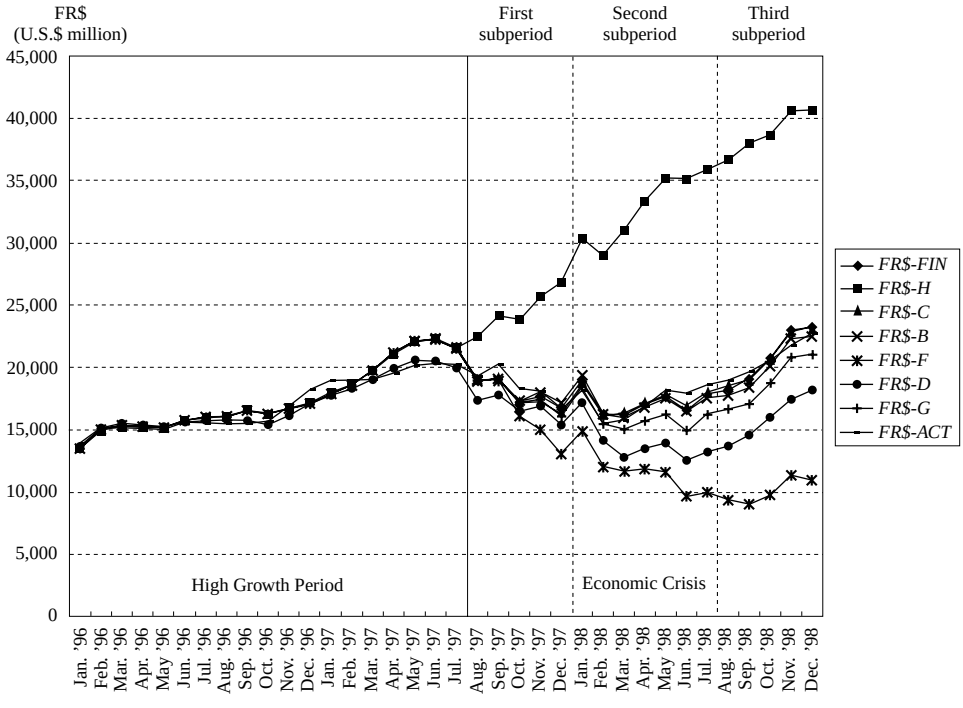


Fig. 16. Trend of Foreign Currency Reserves



rapid increase of economic assistance from the international community during the Krismon period.

Figure 16 shows the trend of foreign currency holdings (*FR$*). They increased gradually until July 1997, decreased during the first subperiod, and then recovered to U.S.$23,000 million by the end of 1998. The net increase of U.S.$3,000 million during the Krismon period implies that the official stock increased by U.S.$13,000 million, but U.S.$10,000 million was lost by other payments abroad.

Figure 17 shows the trend of private consumption expenditure (*CPR*). It increased gradually until the end of 1997, and drastically decreased until August 1998 before recovering slightly. The level at the end of 1998 was still 10 per cent lower than the highest level in the past. The estimated equation explained the propensity for private consumption by its lagged value and the change of CPI and noneconomic disturbances. Based on these three variables, the model described the actual volatile changes fairly well.

Figure 18 shows the trend of government consumption expenditure (*CGR*). The model failed to describe the seasonal variations until the end of 1997, but basically described the actual trend during the Krismon period well. CGR drastically decreased by more than 30 per cent from Rp 3,000 billion at the end of 1997 to Rp

Fig. 17. Trend of Real Private Consumption

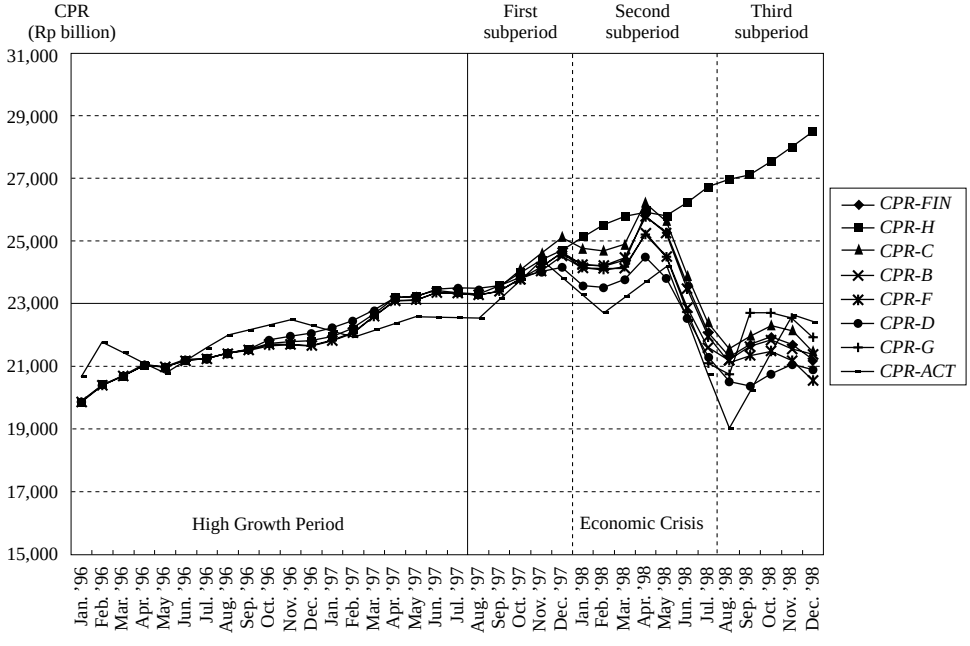
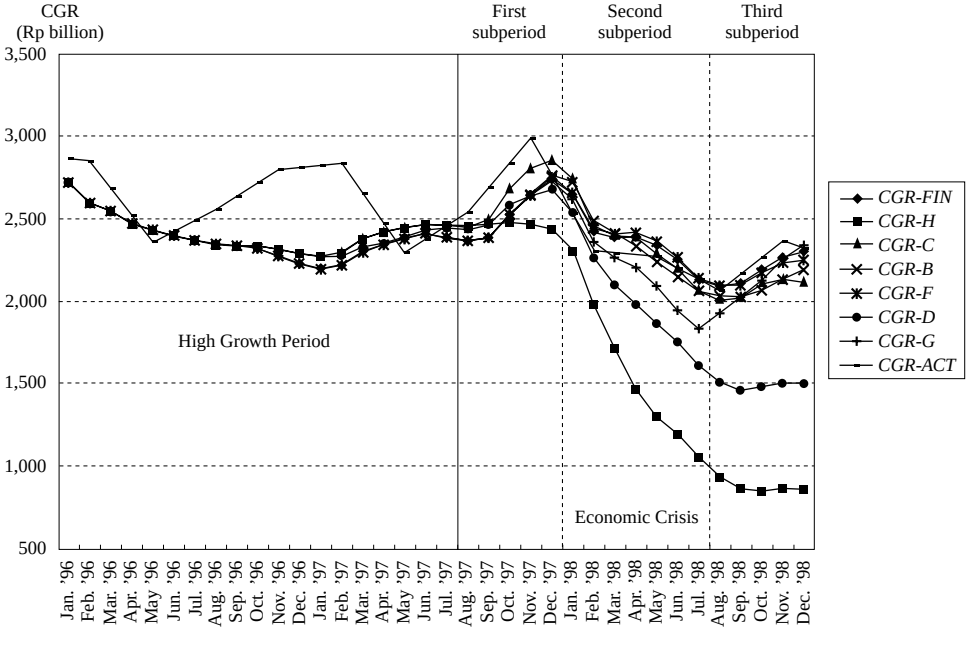


Fig. 18. Trend of Real Government Consumption



2,080 billion in August 1998 before recovering to Rp 2,300 billion by the end of 1998. The estimated equation actually explained the real per capita CGR based on its lagged value, real per capita GDP, and the total official debt multiplied by interest rate.

Figure 19 shows the trend of real investment (*IR*). It had grown before the Krismon period and reached Rp 12,000 billion in August 1997. Then it decreased by 50% in six months, and later it stagnated at a low level. The level at the end of 1998 was about half of the highest level in the past. The investment equation explains the growth of capital stock (investment over capital stock) by the GDP over capital stock, which is supposed to indicate the profit rate, interest rate, FDI ratio in total domestic stock, and dollar value of imports over capital stock. Actually the last one showed the highest *t*-value, and confirmed that imported raw materials and intermediate goods are essential to implement investment projects. As shown in Figure 10, the dollar value of imports collapsed during the Krismon period. This variable was one of the major factors of the rapid collapse of investment. Özler and Rodrik (1992) discussed the reaction function of workers based on data from thirty-two countries (1975–85), and introduced several political proxies to explain the propensity of private investment. In our model, noneconomic disturbances hindered the real and dollar imports, and indirectly suppressed the private investment.[6] In the model above, the investment determined the capital stock, which was introduced into the production function of the manufacturing and commerce sectors with positive signs, and exerted a strong growth-enhancing effect.[7]

Figure 20 shows the trend of the manufacturing sector GDP. It was near the historical highest level recorded in November 1996 after showing some volatile changes. However, it recorded a drastic decline of 20 per cent during the first six-month period of 1998, and remained stagnant afterwards. The equation explains the trend based on major demand components like investment and exports, and also on some supply-side factors like total capital stock and imports. The growth rate of the total capital stock declined during the Krismon period, and the values of all the other explanatory variables markedly decreased. The equation described the trend of the manufacturing GDP during the Krismon period fairly well.

Figure 21 shows the trend of the GDP (or GDE). The GDP of the agricultural and monetary sectors was treated as an exogenous variable. Their combined share in

[6] Perhaps not only the short-term fall but also its volatile fluctuations were harmful to investors' expectation. The harmful effect of the instability of export earnings on economic growth has been frequently discussed. See Love (1990).

[7] Blomstrom, Lipsey, and Zejan (1996) used a cross-sectional sample (101 countries, four quinquennial periods), and ran multiple regressions to explain the per capita GDP growth rate using country dummies. They stated that the causality mainly runs from growth to investment, and not vice versa, while our model shows a strong two-way positive relation. Perhaps we need to carefully scrutinize their conclusion country by country.

Fig. 19. Trend of Real Investment

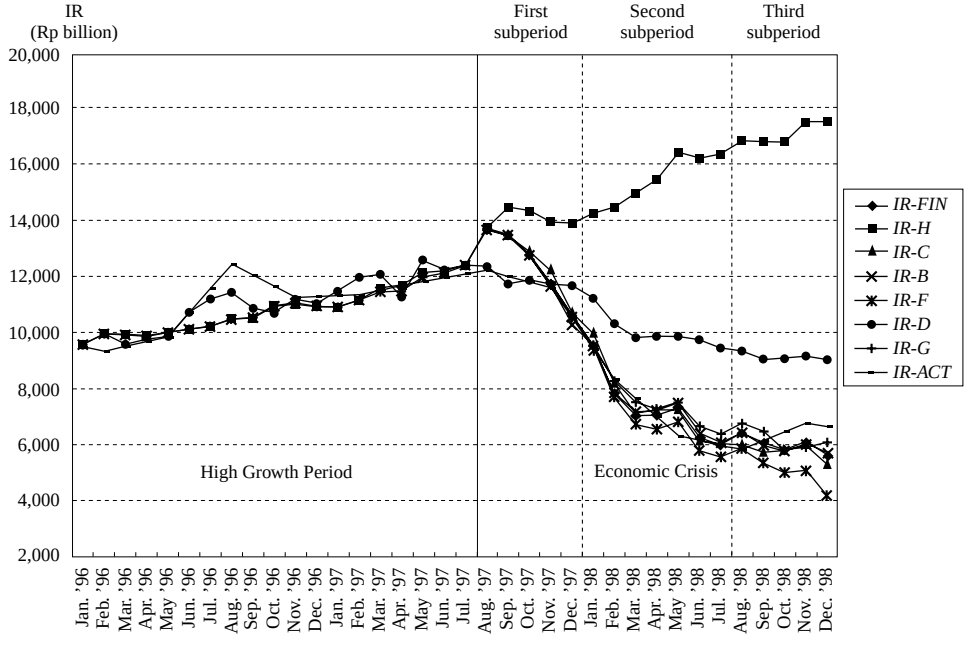


Fig. 20. Trend of Manufacturing Sector GDP

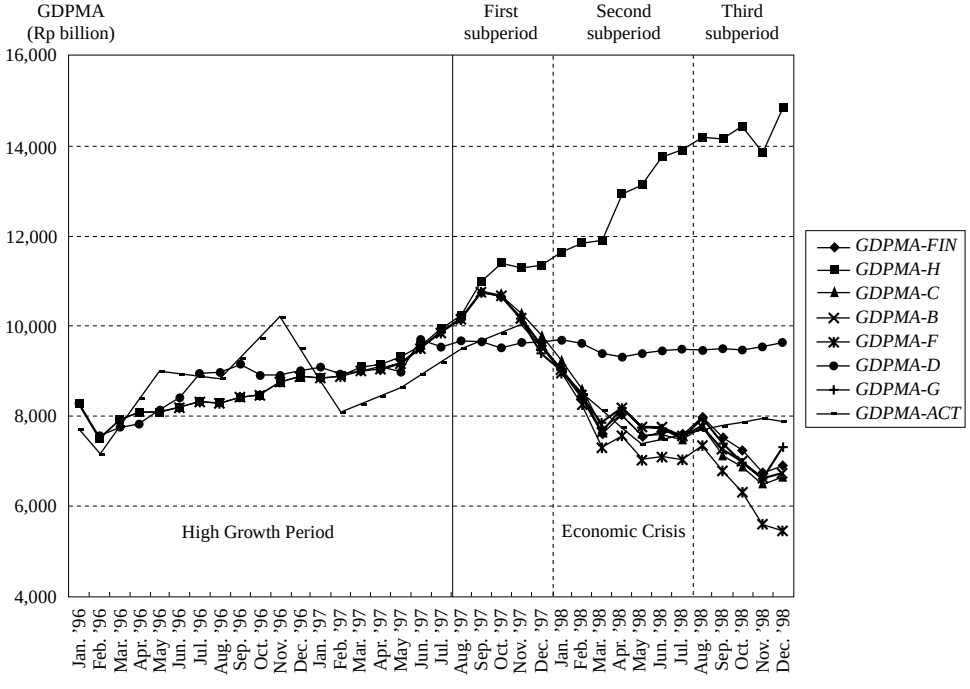
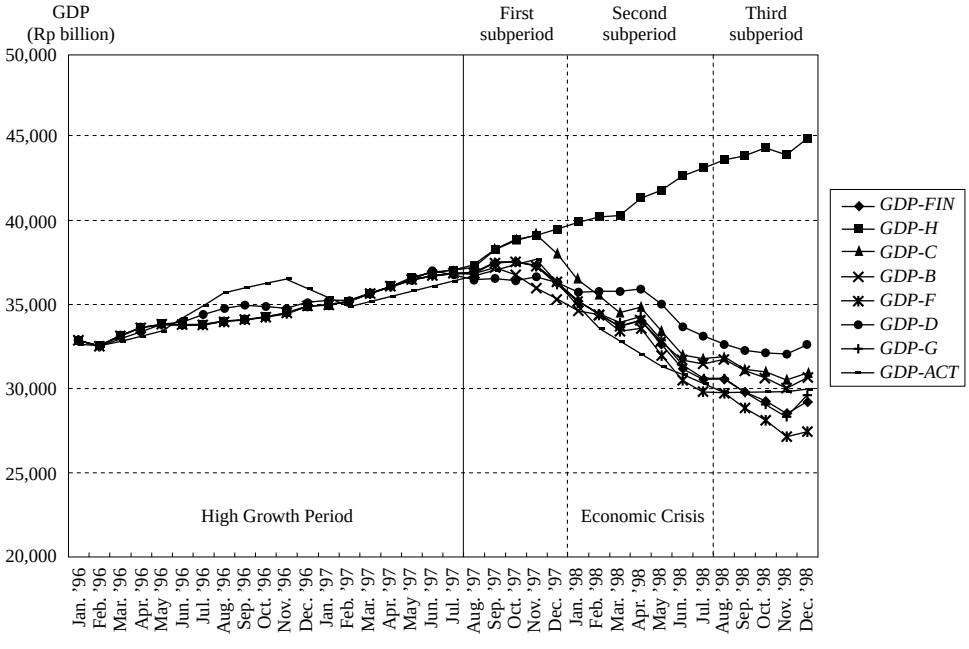


Fig. 21. Trend of Real GDP



the GDP was 32.67% (July 1997), 31.12% (November 1997), and 32.63% (December 1998). Therefore, the model endogenously explained 68–69% of the GDP. The GDP showed a drastic decrease during the second subperiod by 21%. The model fairly well explained such a major downfall.

Figures 22 and 23 show the trend of the daily per capita GDP in local currency (rupiah) and dollar terms. As the population growth rate in Indonesia is fairly high (1.6 per cent), it is important to analyze not only the trend of the absolute level of GDP, but also its per capita level, which is more relevant to the standard of living of the general population. Figure 23 shows that the per capita real rupiah GDP decreased quickly until August 1998, and remained constant during the third subperiod at a level which was 20 per cent lower than the historical high. Figure 24 shows a more drastic picture, as the per capita dollar GDP decreased from U.S.$2 to U.S.$0.5, i.e. to only one-fourth. Since the degree of dollarization differs depending on the country and period, the true decline of the purchasing power of the general population was somewhere between 20 per cent and 75 per cent.

Figure 24 shows the trend of the interest rate (money market rate). Before the Krismon period, it was quite stable between 12–15 per cent. But it was considerably manipulated to protect the economy from a rapid devaluation and serious inflation. In August 1997, it jumped to 62 per cent. It reached a value of 81 per cent in

Fig. 22. Trend of Real Per Capita Daily GDP in Rupiah

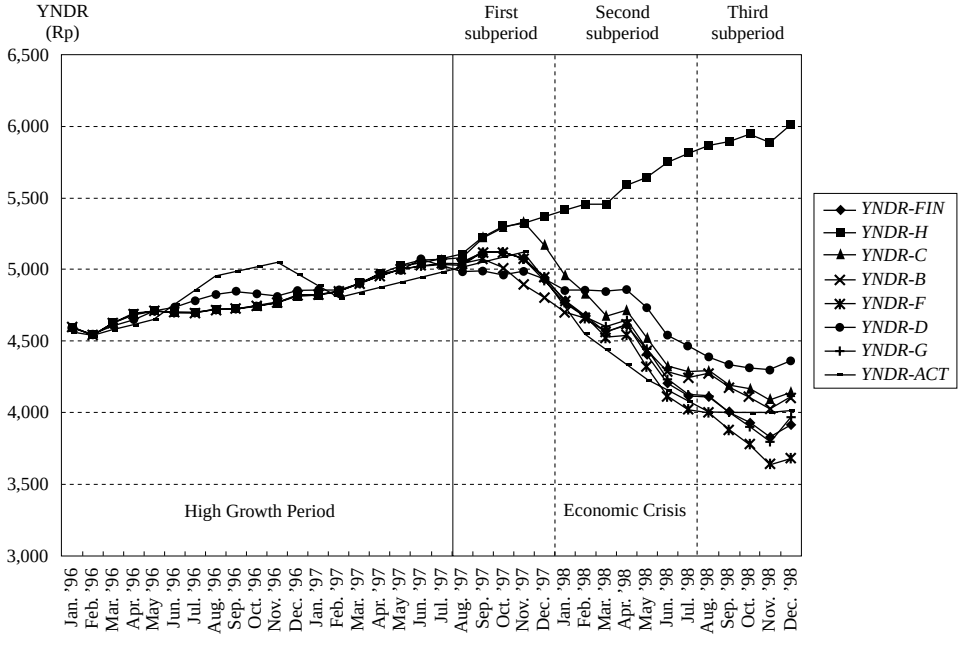


Fig. 23. Trend of Real Per Capita Daily GDP in Dollar

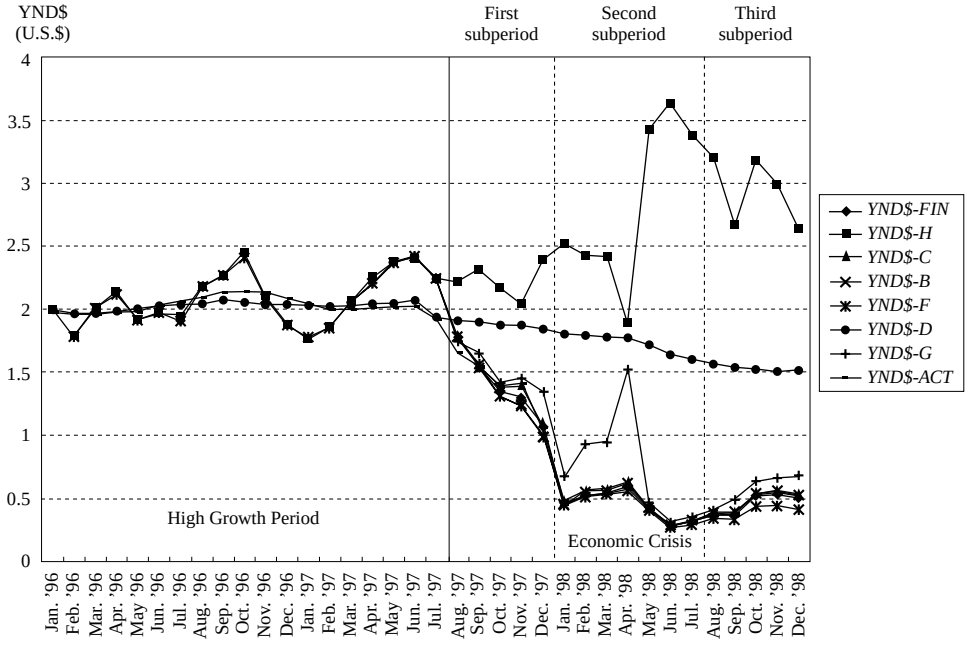
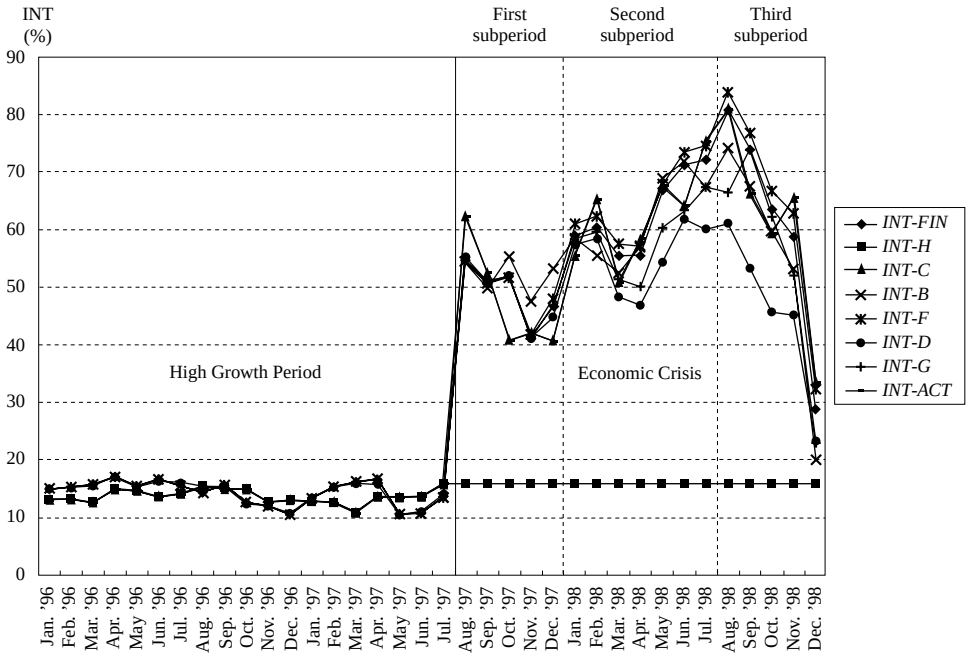


Fig. 24. Trend of Interest Rate

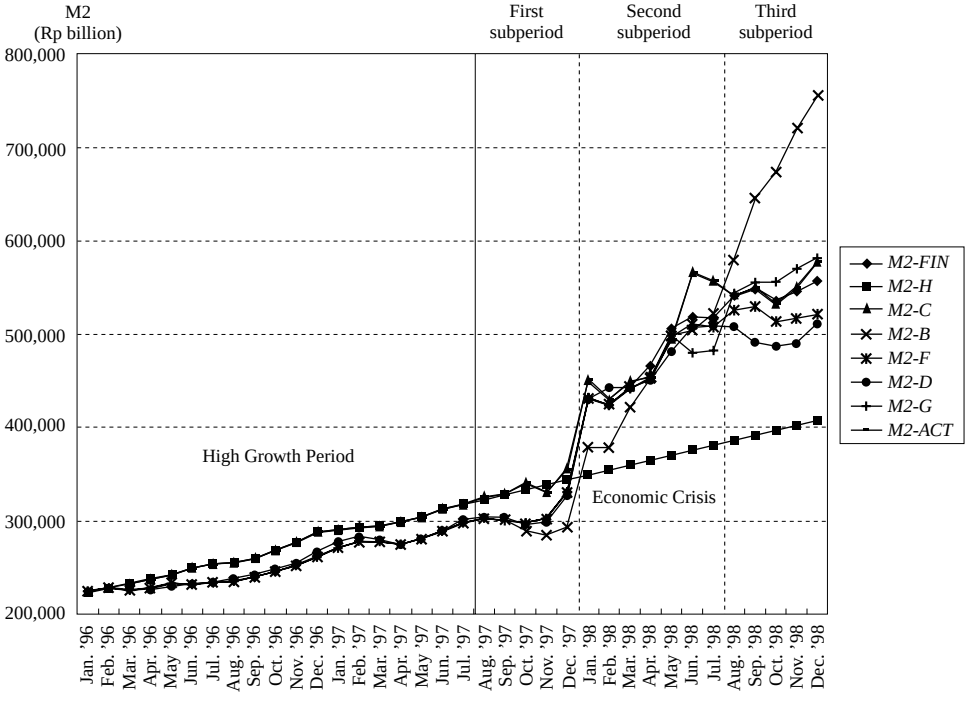


August 1998 when the exchange rate skyrocketed to around Rp 15,000 per U.S. dollar. The equation explained the interest rate based on the growth of the CPI, exchange rate, Krismon dummy, and noneconomic disturbances, increment of monetary GDP, M2 over GDP, and the total balance of payment. The last three variables showed negative coefficients. The model fairly well explained the actual tendency except for December 1998.

Figures 25 shows the trend of the money supply (M2). M1 abruptly increased during the second subperiod, and slightly decreased during the third subperiod. M2 showed a similar rapid increase during the second subperiod, but kept increasing during the third period. When the central bank controls the base money, if there are stable multipliers between the base money and M1 (M2), we can consider that the M1 (E-30) and M2 (E-31) equations are also the reaction functions of the central bank in a wider sense. Then they show how the central bank manipulates the money supply in response to the price variables in the market.[8] Therefore, the determina-

[8] Naturally it is very difficult to control the money supply. McLeod (1997) argued that the excess growth of base money was the major cause of chronic inflation before the Krismon period, and suggested the use of single target rate for base money for bringing inflation under control. During the Krismon period, since the multiplier may have become more unstable, we could not strictly interpret equations (E-30) and (E-31) as effective reaction function.

Fig. 25. Trend of Money Supply (M2)

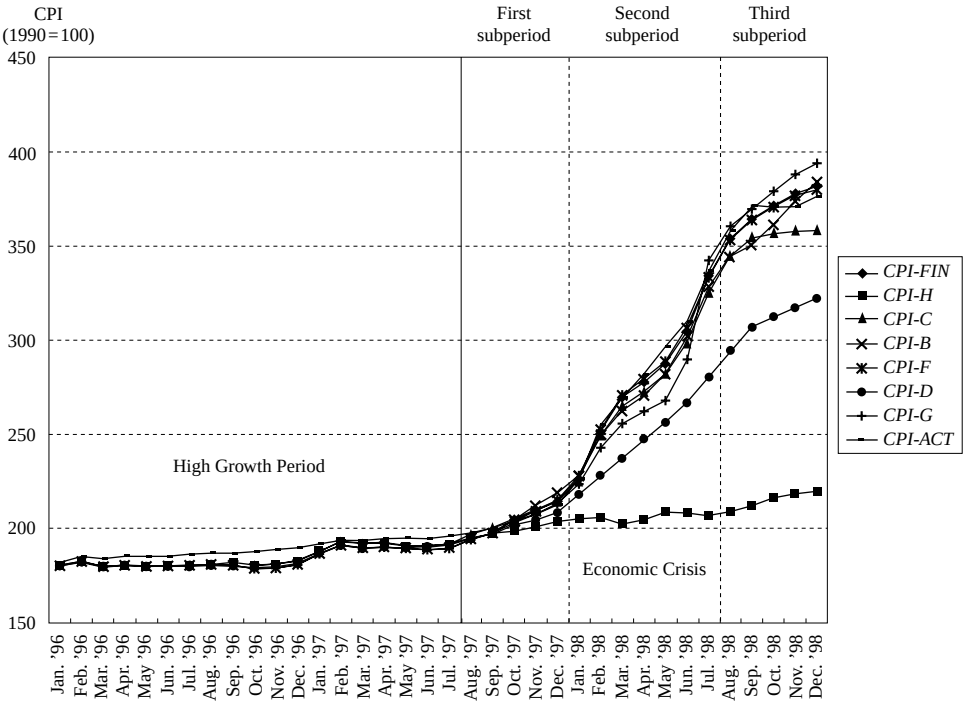


tion coefficients (73–76 per cent) are not too high compared with the other behavioral equations. Usually M1 is used to control inflation while M2 is used for another target of financial deepening or development. But interestingly enough, both equations shared a common specification although the size of the coefficient was different. The ratio of money supply over nominal GDP was explained by the growth of the monetary sector GDP, growth of CPI, growth of exchange rate, and growth of interest rate. The last two variables had negative coefficients.

Figure 26 shows the trend of the CPI. During the first subperiod, the CPI increased slightly, but it quickly increased by 60 per cent during the second subperiod, and ceased to increase during the third subperiod. The CPI equation (E-28) explained the CPI based on the money supply (M1) growth, growth of exchange rate, the ratio of private and public consumption over GDP, Krismon dummy, noneconomic disturbances, growth of the monetary sector GDP, growth of interest rate, agricultural GDP over population. The last three variables had negative coefficients. The model fairly well explained the actual trend except for December 1998.

Table II which shows the results of the final test for thirty-six months for all the endogenous variables, indicates that the model displayed a sufficient capacity for

Fig. 26. Trend of Consumer Price Index



describing the volatile changes during the Krismon period, as well as the interaction between real activities and price changes.

V. SIMULATION STUDIES

The simulation studies in this section confirmed that the economic crisis, i.e., collapse of real activities and inflationary burst in January–July 1998, occurred in three stages. First the Indonesian economy was exposed to various domestic shocks (volatile changes of agricultural and monetary sectors) and international shocks (quick devaluation of Thai and Korean currencies). These shocks and resulting economic difficulties led to a serious noneconomic (political and social) instability. In the end, the economic and noneconomic difficulties mutually aggravated each other, and induced a major overall crisis. Krismon was characterized by three basic features; (1) severe short-term changes, (2) interaction of real and monetary aspects, and (3) interaction between factors leading to economic and noneconomic instability.

Employing the estimated model, I conducted various simulation studies. The specifications were as follows:

Simulation-(*H*)*: Continuation of high growth—Estimation of the damage caused by Krismon*. The purpose of this simulation was to evaluate the damage inflicted to the Indonesian economy by Krismon. I assumed the continuation of past high growth during the Krismon period (August 1997–December 1998), and specified the following conditions during the Krismon period:

(i) The value of noneconomic disturbances (NEDIS) was zero.

(ii) The value of Krismon dummy which reflected the various structural changes after the Asian currency crisis was zero.

(iii) The trend of the following exogenous variables was linearly extrapolated based on the past trend (January 1996–July 1997) for the period August 1997 to December 1998: *GDPAGR, GDPMON, WPI, OCAPB$, FDIB$, RSFDI, CPIUJ, RATETK, YW*.

(iv) The levels of the following exogenous variables remained constant after July 1997: *INT, INTUS, POIL$, SERB$*.

This simulation enabled to determine quantitatively how a set of drastic changes of exogenous variables caused the whole Krismon in the course of one year.

I also performed various counter-factual simulations.

Simulation-(*B*)*: Monetary sector shock*. The monetary sector GDP was extrapolated based on the past trend (January 1996–July 1997) for the period August 1997–December 1998. The purpose of this simulation was to determine the impact of the volatile changes of the monetary sector by comparing the results with those of the final test.

Simulation-(*C*)*: Agricultural sector shock*. The agricultural sector GDP was extrapolated based on the past trend (January 1996–July 1997) for the period August 1997–December 1998. The purpose of this simulation was to determine the impact of the volatile changes of the agricultural sector by comparing the results with those of the final test.

Simulation-(*D*)*: External shock*. The trends of the following variables were extrapolated based on the past trend (January 1996–July 1997) for the period August 1997–December 1998: real imports, real exports, dollar imports, dollar exports, and exchange rate. The purpose of this simulation was to determine the impact of the changes in exports and imports on the general economic trend.

Simulation-(*F*)*: Official aid shocks*. The trend of the official capital inflow (*OCAPB$*) was extrapolated based on the past trend (January 1996–July 1997) for the period August 1997–December 1998. The purpose of this simulation was to determine the impact of the official capital inflow on the general economic trend.

Simulation-(*G*)*: Overseas shock*. The trends of the following variables were extrapolated based on the past trend (January 1996–July 1997) for the period August 1997–December 1998: *CPIUJ, RATETK, YW, POIL$*, and *INTUS*. The purpose of this simulation was to determine the impact of the overseas shocks on the general economic trend.

TABLE III

SIMULATED VALUES IN DECEMBER 1998

Variable	Final Test	Simulation (H)	Simulation (B)	Simulation (C)	Simulation (D)	Simulation (F)	Simulation (G)
GDP	29,232	44,877	30,641	30,946	32,584	27,464	29,609
CPR	21,177	28,487	21,382	21,490	20,905	20,544	21,919
CGR	2,299	861	2,188	2,115	1,502	2,249	2,337
IR	5,617	17,504	5,727	5,270	9,043	4,203	6,066
XR	6,635	11,225	6,583	6,638	11,785	5,463	6,851
IMR	6,739	22,433	6,386	6,376	13,346	2,878	7,634
GDPMA	6,894	14,837	6,721	6,645	9,631	5,444	7,288
GDPCO	4,385	7,042	4,648	4,677	4,999	4,148	4,379
GDPOT	8,176	10,260	8,060	8,319	8,176	8,094	8,164
KR	401,027	519,245	400,907	402,486	437,024	394,307	404,141
X$	3,500	5,761	3,277	3,321	5,516	2,868	3,955
IM$	2,422	5,614	2,136	2,147	4,094	1,028	2,812
FR$	23,238	40,634	22,482	23,233	18,179	10,931	21,015
INT	28.77	15.87	19.98	33.44	23.27	32.40	22.96
CPI	382	220	384	358	322	380	394
RATE	7,766	2,277	7,764	7,878	2,871	9,103	5,872
TOT$	245	34	171	426	698	–416	199
CA$	–374	–1,243	–312	–279	–30	387	-310
TB$	1,079	147	1,140	1,174	1,422	1,840	1,143
TCAPB$	–844	–185	–979	–758	–734	–2,266	–953
PCAB$	–2,151	21	–2,286	–2,065	–2,041	–2,135	–2,260
PCOTHB$	–2,145	27	–2,281	–2,060	–2,036	–2,129	–2,255
STCAP$	148,430	191,025	147,555	148,297	150,292	148,010	148,759
SPCAP$	70,730	113,325	69,855	70,597	72,592	70,310	71,059
SPOTH$	47,904	90,499	47,029	47,771	49,766	47,484	48,233
FIN$	123	3,083	67	42	0	436	0
FOUT$	2,268	3,056	2,347	2,102	2,036	2,566	2,255
YNDR	3,915	6,011	4,104	4,145	4,364	3,678	3,966
YND$	0.5042	2.6397	0.5286	0.5262	1.5201	0.4041	0.6754
M1	98,028	85,404	138,509	101,197	92,543	91,923	101,646
M2	556,902	406,942	755,412	577,381	510,896	520,815	580,893

Source: Prepared by the author.

The simulated values of the main variables in December 1998 are shown in Table III.

Figures 4–26 show the different trends of each variable in these simulation cases.

Simulation-(H) which shows the trend without the impact of Krismon, aimed at describing the extrapolation of past high growth. The level of the GDP in December 1998 was 53.52 per cent higher than the value in the final test. The values of the variables of the expenditure and production side (*CPR*, *CGR*, *IR*, *XR*, *IMR*, *GDPMA*, *GDPCO*, *GDPOT*, *X$*, and *IM$*) were also higher than the final test values. The values of the investment and dollar imports in particular were more than double the

final test values, confirming that a large drop in the values of these two variables played a vital role in the free fall of the economy. As the net inflow of private capital continued, the capital balance became positive, and the outstanding stock increased accordingly. Since the exchange rate remained constant at Rp 2,300 per U.S. dollar, the daily per capita GDP became 53 per cent higher in rupiah terms and almost 5.2 times in dollar terms. Thus, all the flow variables were remarkably higher than the final test values, but the implicit structural problem such as the accumulation of outstanding debt remained intact.

Based on the results of the simulation-(H), the damage caused by Krismon was estimated. The sum of the differences between the simulated values and the final test values of GDP between August 1997 and December 1998 amounted to Rp 138,268 billion, which was equivalent to 36.15 per cent of the 1998 GDP (Rp 382,414 billion). This represents the sum of the GDP foregone by Krismon, and reflects the direct damage caused by Krismon. During the Krismon period, the official aid stock increased by U.S.$13.27 billion, without which the economic downfall would have been far more serious. It was equivalent to 10.76 per cent of the 1998 GDP. When we added this component, the damage in a wider sense amounted to 46.91 per cent of the 1998 GDP.

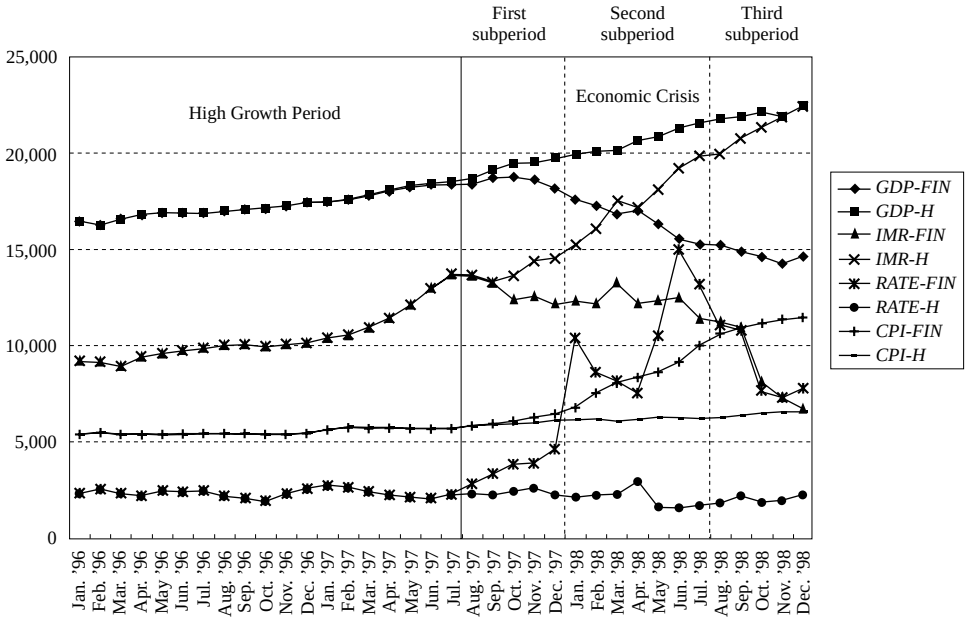
Figure 27 shows the trends of GDP, real imports (*IMR*), exchange rate (*RATE*), and CPI with (final test case) and without the Krismon shocks (simulation-H case). The real activities such as GDP and imports steadily increased without the Krismon shocks, but showed a drastic decline with the Krismon shocks. The price indices such as exchange rate and CPI showed stable trends without the Krismon shocks, but very volatile changes with the Krismon shocks. Therefore, we confirmed that both the free fall of real activities and volatile changes of price variables simultaneously occurred when the values of the exogenous variables changed from the specified trends in the simulation-H to the actual trends.

Simulation-(B) describes the situation when the monetary sector GDP steadily increased during the Krismon period. Compared with the final test case, this favorable expansion of the monetary sector led to an increase of the money supply (M1 and M2), and a decrease of the interest rate by 8.79 per cent. GDP, private consumption, and investment increased, while the private capital inflow decreased and outflow increased. The stock of foreign private capital decreased by U.S.$875 million and the foreign currency holdings also decreased. The impacts on the exchange rate and CPI were relatively minor.

Simulation-(C) shows the case in which the agricultural sector steadily grew. Because the agricultural sector showed a volatile growing pattern, the impact by this specification was mixed. The GDP increased by 5.86 per cent in December 1998, while the manufacturing sector GDP decreased. The interest rate and exchange rate increased while the CPI decreased. The dollar exports and imports decreased from the corresponding values in the final test.

The time pattern is complex, but if the agricultural and monetary sectors had

Fig. 27. Trends of Variables with and without Krismon Shocks



Note: *GDP* was divided by 2, and *CPI* was multiplied by 30 for convenience. *GDP* and *IMR* are expressed in billion rupiahs. Rate is defined as rupiah per U.S. dollar.

been steadily growing during the Krismon period, the GDP in December 1998 would have reached a value of 32,555, which is higher than that in the final test case by 10.68% (= 4.82% + 5.86%). Therefore, the volatility of these two sectors was an additional factor of economic stagnation during the Krismon period.

Simulation-(D) shows the economic situation when the external sector variables (real exports and imports, dollar exports and imports, and exchange rate) steadily expanded based on the past trends. In this case, real exports and imports increased by 77.61% and 98.04%, respectively. The dollar exports and imports increased by 57.60% and 69.03%, respectively. In general, the real activities expanded markedly; GDP by 11.46%, manufacturing sector GDP by 39.70%, and real investment by 60.99%. In general, the price variables (M1, M2, and interest rate) decreased. The CPI decreased by 15.71%. Thus the stable growth of the external sector exerted a highly beneficial impact on real activities, and contributed to the stable trends of price variables.

Simulation-(F) shows the case when the official aid did not essentially increase during the Krismon period. During the Krismon period, the international community increased the economic assistance, so that the stock of official capital increased by U.S.$13.3 billion from U.S.$64,428 million in July 1997 to U.S.$77,700 million

in December 1998. Undoubtedly, this economic aid prevented a more precipitous free fall of the economy. Simulation-(F) depicts the case without the international aid. Therefore, the net official capital inflow was zero during the Krismon period, and the outstanding stock remained constant. The results reveal a further worsening of the economy. The values of all variables decreased. As the foreign currency reserves droppd to a half, the level of imports decreased to a half, which resulted in a drastic decrease of the investment and manufacturing GDP. The GDP decreased by 6.04 per cent in December 1998, and the daily per capita GDP also decreased accordingly. Reflecting the worse economic situation, the exchange rate reached a value of Rp 9,103 per U.S. dollar in December 1998, which was higher than the value in the final test case by 17.21 per cent.

Simulation-(G) shows the case when the interest rate, exchange rate, CPI in other countries were stable, and did not adversely affect Indonesia. Based on this favorable international environment, the exchange rate decreased to Rp 5,872 per U.S. dollar by 24.4%, and the dollar exports and imports increased by 13.0% and 16.1%, respectively. The interest rate decreased by 5.81%, and the GDP and real investment increased by 1.28% and 8.00%, respectively. As the real activities expanded, the CPI increased by 3.14%, and the foreign currency reserves by U.S.$2.2 billion.

Thus, these simulations revealed the important role of many economic and noneconomic factors which played vital roles during the Krismon period. Noneconomic disturbance shocks and higher interest rates led to the exchange rate volatility and free fall of the economy, while the increase in foreign aid was somehow able to offset this trend.

The final test revealed that the GDP decreased from the historical highest value of Rp 37,533 billion in October 1997) by Rp 8,301 billion in December 1998. The simulations (B) and (C) showed that the GDP in December 1998 would have been higher than that in the final test case by 1,409 and 1,714 (billion rupiahs), respectively. The sum of these amounts to 37.62 per cent of the GDP decrease of Rp 8,301 billion. This implies that if the agricultural and monetary sectors could have expanded in the same way as during the growth period, the GDP decrease during the Krismon period would have been smaller by 37 per cent. Therefore, one-third of the decrease of the GDP during the Krismon period was due to the decline of the agricultural and monetary sectors, and two-thirds were due to the harmful Krismon shocks including noneconomic disturbances, exchange rate shock, declining dollar oil price, etc.

I conducted four additional simulations to determine how the effects of monetary policies and supply side shock changed over time.

Simulation-(I): Interest rate shock. The interest rate (money market rate) increased by 1 per cent which was equivalent to 6.65 per cent of the interest rate (15.01%) after January 1996. The purpose of this simulation was to reveal the over-time impact of the interest rate change on the overall economy.

Simulation-(*J*)*: Money supply shock.* The money supply (M1) rate increased by Rp 1,000 billion which was equivalent to 1.88 per cent of the money supply (Rp 53,014 billion) after January 1996. The purpose of this simulation was to reveal the over-time impact of the money supply change on the overall economy.

Simulation-(*K*)*: Exchange rate shock.* The exchange rate increased by 100 which was equivalent to 4.33 per cent of the exchange rate (Rp 2,308 per U.S. dollar) after January 1996. The purpose of this simulation was to reveal the over-time impact of the devaluation on the overall economy.

Simulation-(*L*)*: GDP shock.* The GDP increased by Rp 1,000 billion which was equivalent to 3.04 per cent of the GDP (Rp 32,870 billion) only in January 1996. The purpose of this simulation was to reveal the over-time impact of the GDP change on the overall economy.

The simulated value of the main variables in December 1998 are shown in Table IV.

Figures 28–31 show the over-time effects of the impact of these four shocks on the interest rate (money market rate, *MMRATE*), GDP, exchange rate (*RATE*), and money supply (M1).

Simulation-(I): In Figure 28, the initial impact on the interest rate, which was equivalent to 6.65% of the original level, caused an increasing divergence of the interest rate from the final test values in one year and a half, and then shrank to –2% in another fourteen months. The effects on the GDP, M1, exchange rate, CPI after three years were –0.24 %, –0.57 %, 0.19 %, –0.22 %, respectively. Generally the trend of divergence was stable, and did not change for three years.

Simulation-(J): In Figure 29, the initial increase of M1 by Rp 1,000 billion (1.88 % of M1) caused an increasing divergence, and the divergence amounted to 6.78% of the final test value. The effects on the interest rate, M1, exchange rate, CPI, GDP after three years were –4.44%, –0.37%, 2.74%, –0.22%, 1.49%, respectively. Generally the trend of divergence slightly increased.

Simulation-(K): In Figure 30, the initial divergence of the exchange rate by Rp 100 per U.S. dollar (4.33% of the original level) steadily decreased to less than one per cent after three years. The effects on the GDP, interest rate, exchange rate, CPI after three years were 0.63%, –0.86%, 0.09%, 1.00%, respectively. The divergence of the interest rate was positive for twenty-four months, and then became negative. The initial exchange rate shock itself converged while the impact on other variables slightly diverged.

Simulation-(L): In Figure 31, the initial once-for-all increase of the GDP quickly converged to zero after four months, but its impact on the monetary variables (interest rate, M1, and exchange rate) persisted. Therefore, the divergence of monetary variables once again created other diverging trends. After three years, the divergence remained: GDP (7.43%), interest rate (–2.28%), exchange rate (–0.16%), and CPI (5.68%).

TABLE IV

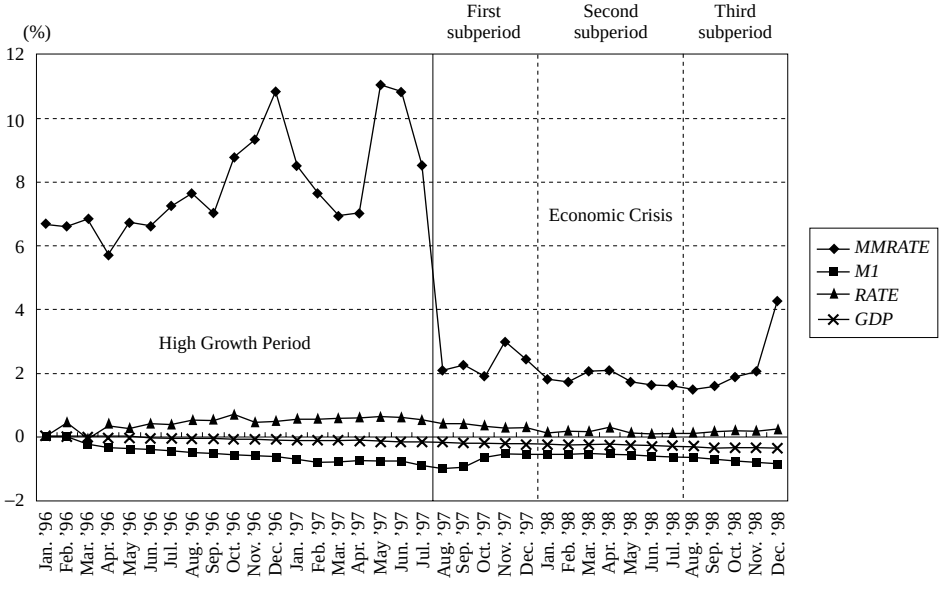
SIMULATED VALUES AND CHANGES IN DECEMBER 1998

Variable	Final Test	Simulation (I): Interest Rate	Simulation (J): M1	Simulation (K): Exchange Rate	Simulation (L): GDP
GDP	29,232	–113	437	185	367
CPR	21,177	–97	448	176	377
CGR	2,299	–16	174	65	144
IR	5,617	–60	275	107	226
XR	6,634	–14	51	47	40
IMR	6,739	–46	177	104	145
GDPMA	6,893	–50	259	115	214
GDPCO	4,384	–21	64	27	54
GDPOT	8,176	–41	113	42	98
KR	401,026	–1,266	3,409	1,630	2,872
X$	3,500	–25	175	77	145
IM$	2,421	–31	191	82	158
FR$	23,238	–46	253	325	202
INT	28.77	1.22	–1.28	–0.24	–1.07
CPI	382.01	–1.38	10.49	3.83	8.77
RATE	7765	15.78	–29.34	70.22	–23.59
TOTB$	244.63	–3.24	61.56	26.59	48.84
CA$	–373	6	–15	–4	–13
CAPB$	–843	–9	77	31	61
TB$	1,078	6	–15	–4	–13
PCAPB$	–2150	–9	77	31	61
POTHB$	–2145	–9	77	31	61
STCAPB$	148,429	–88	251	143	206
SPCAPB$	70,729	–88	251	143	206
SPOTH$	47,903	–88	251	143	206
FIN$	122	–4	60	26	49
FOUT$	2268	4	–16	–4	–12
YNDR	3915	–15	58	24	49
YND$	0.5042	–0.003	0.0095	–0.0013	0.0079
M1	98,028	–860	6,655	1,727	3,943
M2	556,902	–5,503	30,130	10,893	25,164

Source: Prepared by the author.

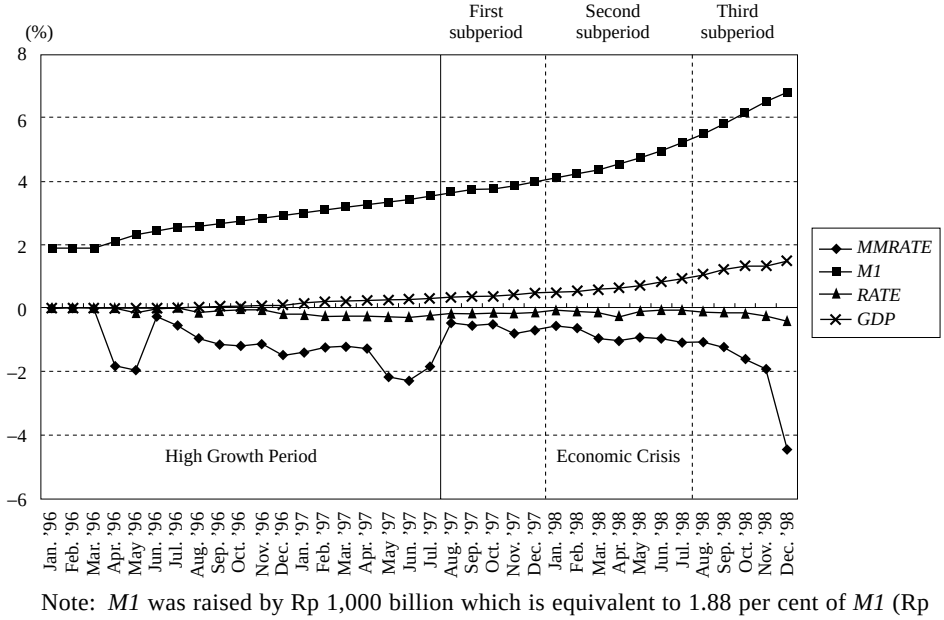
These experiments show that the effects of increasing interest rate, exchange rate, and a once-for-all supply shock on the GDP are generally converging, while an independent increase of M1 led to a diverging impact on the real and monetary variables. We assumed that since the basic structure of the Indonesian economy was very unstable during the Krismon period, some initial impact on important variables would have caused a diverging trend. However the simulations showed that since the basic economic structure was quite robust, many initial shocks could be absorbed very rapidly. The M1 shock was the only exception. An independent increase of M1 beyond the amount based on the reaction function led to a non-

Fig. 28. Simulation-(I): Interest Rate (MMRATE) Shock



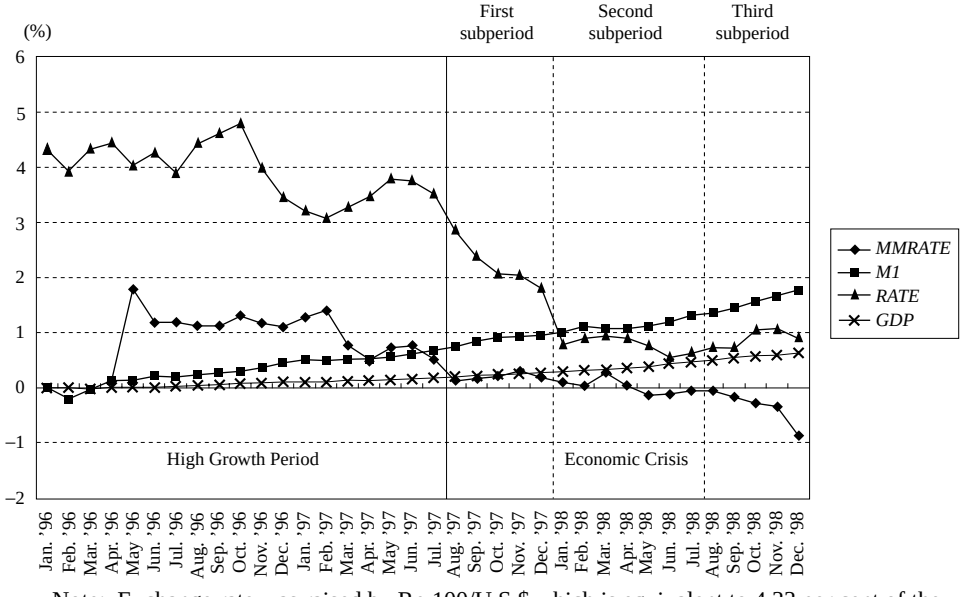
Note: Money market rate (*MMRATE*) was raised by 1 per cent which is equivalent to 6.65 per cent of the interest rate (15.01 per cent) after the thirteenth period. The trends of *M1*, exchange rate (*RATE*), and *GDP* show a divergence from the results of the final test in per cent.

Fig. 29. Simulation-(J): Money Supply (M1) Shock



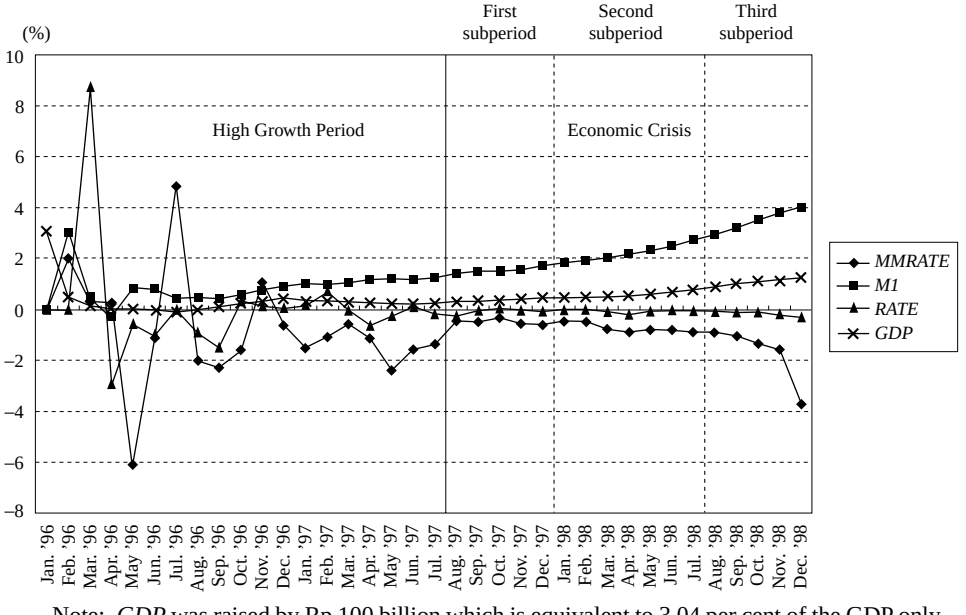
Note: *M1* was raised by Rp 1,000 billion which is equivalent to 1.88 per cent of *M1* (Rp 53,014 billion) after the thirteenth period. The trends of *MMRATE*, exchange rate (*RATE*), and *GDP* show a divergence from the results of the final test in per cent.

Fig. 30. Simulation-(K): Exchange Rate (RATE) Shock



Note: Exchange rate was raised by Rp 100/U.S.$ which is equivalent to 4.33 per cent of the exchange rate (Rp 2,308/U.S.$) after the thirteenth period. The trends of *MMRATE*, *M1*, and *GDP* show a divergence from the results of the final test.

Fig. 31. Simulation-(L): GDP Shock



Note: *GDP* was raised by Rp 100 billion which is equivalent to 3.04 per cent of the GDP only in the thirteenth period. The trends of *MMRATE*, *M1*, and exchange rate (*RATE*) show a divergence from the results of the final test in per cent.

converging impact on the economy, and required that the central bank proceed to a careful manipulation of M1.

VI. DECISION MODEL APPROACH

We can construct several decision models, and determine the necessary direction and size of monetary policies to achieve various policy targets. When a simultaneous equation system is constructed, this original model contains several endogenous and exogenous variables. When we are interested in a policy aiming at manipulating specific targets by set instruments, we specify the political target variables ($T_j, j = 1, \ldots, h$) from endogenous variables, and the same number of instruments ($I_j, j = 1, \ldots, h$) from exogenous variables. The remaining endogenous variables of the original model (F) are referred to irrelevant variables (R_m), and the remaining exogenous variables as daten (D_g).

$$F\cdot(T_j, R_m;\ I_j, D_g) = 0. \tag{6-1}$$

When the actual (or final test) values of the irrelevant variables and daten were inserted, equation (6-1) could be reduced to

$$F\cdot(T_j, I_j) = 0. \tag{6-2}$$

This is the decision model deduced from the original model, and it is suitable for analyzing the relation between targets and instruments, and calculating the necessary changes of instruments to achieve the set changes of targets. When the original model is a dynamic one, we can follow the next procedure. We repeat simulations by changing the values of each instrument ((ΔI_j), and observe the changes of targets (($\Delta T_j, j = 1, \ldots, h$) compared with the final test case (perhaps in the final period). Then we can summarize the results by h equations, which show the changes of targets when every instrument changed.

$$\Delta T_1 = a_{11}\Delta I_1 + \ldots + a_{1h}\Delta I_h, \tag{6-3}$$

$$\ldots \quad \ldots\ldots\ldots\ldots\ldots$$

$$\Delta T_h = a_{h1}\Delta I_1 + \ldots + a_{hh}\Delta I_h. \tag{6-4}$$

As the model is nonlinear, this is an approximate expression of the results of a combined experiment in which all the instruments changed simultaneously. In principle, these equations are linearly independent, and can be solved as follows:

$$\Delta I_1 = b_{11}\Delta T_1 + \ldots + b_{1h}\Delta T_h \tag{6-5}$$

$$\ldots \quad \ldots\ldots\ldots\ldots\ldots$$

$$\Delta I_h = b_{h1}\Delta T_1 + \ldots + b_{hh}\Delta T_h \tag{6-6}$$

When the values of targets ($\Delta T_j^*, j = 1, \ldots, h$) are specified, we can calculate the necessary changes of instruments ($\Delta I_1^*, \ldots, \Delta I_h^*$).

Two Targets and Two Instruments Case

Based on the preceding simulations, several decision models can be constructed. For example, we define the inflation (*CPI*) and growth (*GDP*) as two targets, and interest rate (*INT*) and M1 as two instruments.

(a) Based on simulations (I) and (J), the increments of *CPI* and *GDP* in the final period (ΔCPI, ΔGDP) are expressed as follows when the initial changes of the interest rate and *M1* (ΔINT, $\Delta M1$) are set at 1 per cent and 1, 000.

$$\Delta CPI = -1.3887\Delta INT + 10.49\Delta M1, \tag{6-7}$$

$$\Delta GDP = -113.18\Delta INT + 437.53\Delta M1. \tag{6-8}$$

From these, we obtain:

$$\Delta INT = 0.7548\Delta CPI - 0.01809\Delta GDP, \tag{6-9}$$

$$\Delta M1 = 0.1952\Delta CPI - 0.02321\Delta GDP. \tag{6-10}$$

When the targets are set at: $\Delta CPI = 0$ and $\Delta GDP = 292.32$ (1 per cent of GDP in December 1998), necessary amounts of manipulation are:

$$\Delta INT^* = -5.288 \text{ and } \Delta M1^* = -6.7847. \tag{6-11}$$

This implies the decrease of the interest rate and M1 by 5.2 per cent and 12.75 per cent, respectively.

(b) The time pattern of the GDP change is complex. Therefore, we can use the sum of the GDP changes in the period January 1996–December 1998 as the growth target (*SGDP*). Then the decision model (6-7) and (6-8) can be rewritten as:

$$\Delta CPI = -1.3887\Delta INT + 10.49\Delta M1, \tag{6-12}$$

$$\Delta SGDP = -2{,}117.63\Delta INT + 4{,}950.90\Delta M1. \tag{6-13}$$

From these, we obtain:

$$\Delta INT = 0.3227\Delta CPI - 0.0006838\Delta SGDP, \tag{6-14}$$

$$\Delta M1 = 0.1380\Delta CPI - 0.00009053\Delta SGDP. \tag{6-15}$$

Therefore, if price stability ($\Delta CPI = 0$) and growth ($\Delta SGDP$ = 1 per cent of GDP in December 1998, Rp 292.32 billion) are postulated, necessary changes of instruments (ΔINT^*, $\Delta M1^*$) are:

$$\Delta INT^* = -0.1998, \Delta M1^* = -0.02646. \tag{6-16}$$

This implies that the interest rate decreased by 0.19 per cent and M1 by Rp 26.46 billion in January 1996, corresponding to 1.33 per cent of interest rate, and 0.027 per cent of M1. Because the sum of the GDP in the period January 1996–December 1998 was Rp 1,221,093 billion, the required increment of *SGDP* was equivalent to only 0.023 per cent. Therefore, the required changes of instruments were minimal.

But such an experiment is useful to clarify the direction of manipulation although the time pattern of target must be carefully and adequately specified. Also it suggests that for the implementation of monetary policies (manipulation of M1 and interest rate), their long-run impact on the economy must be carefully considered, because the time pattern of over-time effects is complex, and sometimes the effects are diverging over time.

We can easily widen the scope to a three targets and instruments problem. An example is a three targets (GDP, CPI, and exchange rate) and three instruments (M1, M2, and interest rate) problem.

VII. CONCLUDING REMARKS

During the short one year and a half period of Krismon (August 1997–December 1998), the Indonesian economy was adversely affected by economic and noneconomic shocks and experienced a drastic, overall economic collapse. In this paper attempts were made to analyze the process of the economic crisis quantitatively in terms of main economic variables.

Krismon was characterized by three basic features: (1) short-term character, (2) vicious circle of political instability and economic free fall, (3) extensive interaction between real and monetary sectors. Considering these three features, I constructed an econometric model which reflected these features. (1) To cover the shortage of samples, I prepared monthly data, and analyzed a monthly econometric model (January 1996–December 1998).[9] (2) To explicitly describe the impact associated with political instability, I estimated the exchange rate function based on the data before the economic free fall, and defined a noneconomic disturbance variable, which showed the negative impact of political instability. (3) Including this noneconomic disturbance variable, I constructed an econometric model with thirty-one equations which combined the real and monetary aspects of the economy.

The modeling work revealed that the noneconomic disturbances, international environment (U.S. interest rate, world income, dollar oil price, Thailand and Korea exchange real rates, and FDI inflow) changes, and domestic fragility (volatile changes of agricultural and monetary sectors) mutually aggravated each other, and caused the real free fall and inflationary burst simultaneously. If these exogenous variables had continued to grow at the same pace as that during the past high-growth period, the real sector would have steadily grown and the price system would have shown the same stable trend as that in the past. Therefore, Krismon occurred due to the impact of changes of these exogenous variables.

The decrease of the GDP from the historical trend was divided into three compo-

[9] The data of exchange rate, CPI, WPI, interest rate, M1, M2, dollar exports and imports were directly available from the *Indonesian Financial Statistics* and *International Financial Statistics*. Only other data of GDP and the balance of payment were processed from the quarterly data.

nents. If the GDP had grown according to the historical trend, the GDP would have reached a value of Rp 44,877 billion in December 1998. But actually it fell to Rp 29,232 billion (final test case). The drop was Rp 15,645 billion. By simulation studies, three components were identified as follows:

Rp 15,645 b.	=	Rp 9,170 b.	+	Rp 3,352 b.	+	Rp 3,123 b.
(100%)		(58.61%)		(21.42%)		(19.96%)
(Decline from historical trend)		(Noneconomic disturbances & other domestic disturbances)		(External trade decline)		(Volatility of agricultural & monetary sectors)

If the official capital inflow had not increased and had followed the historical trend, the actual GDP would have further decreased by Rp 1,768 billion.

Such a modeling exercise is also useful to clarify the impact of policy variables like money supply and interest rate. I carried out some decision model analysis by selecting two targets (price stability and growth) and two instruments (interest rate and M1). The results should be useful for implementing future monetary policies.

The GDP fell by 20 per cent from November 1997 (Rp 3,766,811 billion) to December 1998 (Rp 2,995,898 billion), while the real daily per capita GDP fell by 22 per cent from Rp 5,130 to Rp 4,012. As the recent population growth rate is about 1.6 per cent, if the economic growth rate does not exceed this value, the standard of living of the people is likely to deteriorate further.[10] As the age cohort of five–ten years amounted to 22 million in 1996, which was historically the largest, the expected new inflow to the labor market is expected to exceed 4 million in the near future. Such a large increase of population and labor force will be a major additional burden for development policy. In this paper, the size of the population was explicitly considered although it was treated as an exogenous variable.[11] For future policy implementation, population pressure must be explicitly considered as a key development issue.

[10] The Central Statistical Office (BPS, February 21, 2000) announced that the economic growth rate was 0.23 per cent in 1999. The monetary sector (banking, lease, and business services) recorded a –8.67 per cent rate, although the agricultural sector grew by 0.67 per cent. This implies that the per capita GDP continuously fell also in 1999.

[11] The age structure is also important in its impact on fiscal expenditure. See Luski and Weinblatt (1998) and Miles (1999).

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