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An econometric model of the Indonesian monetary sector

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AN ECONOMETRIC MODEL OF THE INDONESIAN MONETARY SECTOR

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CHAPTER I. INTRODUCTION

Econometric models have long been considered as potential tools for the evaluation and selection of policy strategies. As a simulation of an economy, an economic model can be used to conduct various policy experiments. In other words, a policy-oriented econometric model is potentially useful to generate quantitative forecasts and to evaluate the effects of alternative policies. An econometric model is also useful for economic analysts to sharpen their judgments on the effects of various events in the economy.

The main short-run problems faced by the economic authorities in a developing country such as Indonesia is price stabilization, balance of payments equilibrium, and output growth. The balance of payments (BOP) is very crucial in an economy so widely open as Indonesia, where international trade is very substantial and where there is a completely free foreign exchange market and capital flows. Short-run economic stabilization became even more important after the breakdown of the Bretton Woods System in the early 1970s. The instability of major currency exchange rates has led to domestic price and balance of payments instability. The balance of payments instability, further, has undermined the ability of the central bank to control the money supply. As will be discussed in Chapter III, money supply is directly related to BOP. Accordingly, monetary policies should be analyzed within an open economy framework.

Discretionary policies available to the government in dealing with short-run economic stabilization problems include monetary, fiscal and price policies. This study concentrates on monetary policies only. A policy oriented monetary sector model should be useful for analyzing these policies.

Statement of the Problem

There have been many macroeconomic models constructed for the Indonesian economy (ECAFE, 1964, 1967; Onishi, 1964; Fukuchi, 1968; Gupta, 1977; Boediono, 1979; Aghevli, 1977; Schydlowsky, 1980; Nasution, 1982; Pamungkas, 1984). The Aghevli, Schydlowsky, and Nasution models are monetary-sector oriented, whereas the rest are general economic models. As will be discussed in the next section, the monetary sector in those models, however, is not detailed enough to capture the institutional setting typical to a developing economy such as Indonesia. Of importance is the failure of those models to incorporate the supply-side linkage of the monetary sector via working capital or capital formation.

In an economy where a capital market is virtually non-existent, the source of external financing for business activities is practically limited to bank loans. Bank loans, therefore, are crucial for investment (McKinnon, 1973; Shaw, 1973; Wijnbergen, 1982). The bank loan-investment channel may well be the most direct way for monetary policies to affect the real sector of the economy. None of the previous models consider the relationship between bank loans and investment. For those models, if monetary policies matter at all, it must be through the demand side, either through a reduced form aggregate demand or price equations.

The fact that money supply is directly related to the balance of payments makes it necessary to include external trade in a more comprehensive monetary sector model. At the least, major components such as merchandise imports and exports and private capital flows should be endogenized. Private capital flows become increasingly important, especially after the introduction of dollar deposits by Indonesian banks. Capital flows fluctuate heavily since there are no foreign exchange restrictions. Private capital flows, however, are uniformly assumed endogenous in all previous models. This, of course, may affect the

validity of the models, since private capital flows are directly dependent on both domestic and international economic situations.

Another important component of the monetary sector that has been neglected in previous models is the sterilization of the balance of payments. Sterilization is an attempt to reduce the effect of the BOP on themoney supply by reciprocally changing domestic credit. Some studies have shown that the Indonesian central bank indeed sterilizes the BOP (Arndt, 1979; Djiwandono, 1980; Arndt and Sundrum, 1984). This sterilization is conducted by increasing government deposits at the central bank.

This study is an attempt to construct a policy-oriented model for Indonesia. The model will be designed to capture the bank loan-investment nexus, which may be the more direct channel for monetary policies to affect real variables. The price channel through the excess demand for money will also be taken into account. Private capital flows will be endogenized along with trade in services. In addition, sterilization of the BOP will be captured too. The model will be used to analyze some policy experiments such as changing the exchange rate and central bank lending to commercial banks.

Literature Review

There is an abundant literature related to the subject of this study. This review will be limited to the most important and relevant studies. The review will be divided into two sections. The first section will deal with monetary-sector modeling for developing countries. This will provide a background for the conceptual framework for the study. Specific studies on the Indonesian economy will be discussed in the second section.

On monetary sector modeling of developing economy

Economic models have been widely used as standard tools for policy evaluation and economic forecasting in developed countries. The first large scale econometric model was

constructed by Tinbergen in the late 1930s (Tinbergen, 1939). As usual, this pioneering work had to survive strong resistance and skepticism from the established non-quantitative economic analysis tradition. Perhaps the most interesting debate was between Tinbergen and Keynes (Keynes, 1939; 1940; Tinbergen, 1940). Although Keynes was doubtful of the wisdom of using statistical techniques for economic analysis, he nevertheless encouraged more research into this new area.

The first dynamic macroeconomic models were used for testing economic theory and for business cycle analysis. The Keynesian revolution on the theory of output and employment after World War II shifted the emphasis toward policy prescription and forecasting.

The rapid development of the application of modern statistical inference to economic theory between 1940-1950 provided a solid momentum for quantitative economic analysis (Hicks, 1939; Haavelmo, 1943; Mann and Wald, 1943; Samuelson, 1947; Koopmans, 1950). The modern era of econometric models received its greatest impetus from the work of Klein-Goldberger in the early 1950s (Klein, 1950; Klein and Goldberger, 1955). With the availability of refined data bases, and the support of advanced computers, an increasing number of large econometric models were constructed, especially in the 1960s (Klein et al., 1961; Liebenberg et al., 1966; Evans and Klein, 1967; De Leeuw and Gramlich, 1968; Duensenberry et al., 1965).

Following the trend in the developed countries, interest in the economic modeling of developing countries began in the 1960s. As with the first introduction of econometrics in developed economies, there were early debates as to whether the econometric modeling of developing economies was worthwhile (Vernon, 1966; Conrad, 1968). Vernon argued that the multivalent nature of national objectives, the absence of reliable data, and the high opportunity cost of skilled labor would make econometric modeling not worthwhile.

However, he did not reject the potential usefulness of econometric models for policy analysis in the future. Conrad, on the other hand, thought that Vernon was unnecessarily pessimistic and impatient. Conrad pointed out that econometric models need not pretend to specify unambiguously national objective functions. Rather, they offer the possibility of trade-offs among objectives that must somehow be reconciled. He gave specific, real field-examples of how econometric modeling provided useful and worthwhile policy recommendations in Pakistan and Argentina. With regard to the data base and skilled labor, he argued that these are basically a matter of time. Continuing and coordinated international efforts through the United Nations and the International Monetary Fund (IMF) should help eliminate the data problem.

Perhaps one of the most important roles of econometric modeling for developing countries is that it provides an accumulation of knowledge and interest for more rational economic planning and policies. The widespread acceptance of the usefulness of some form of systematic economic analysis as a basis for government policies in recent years is very encouraging (Chenery, 1975). Economic decision makers are also increasingly drawn from professionals with sufficient education and ability to conceptualize problems. This core of economic leadership should be more receptive toward the use of econometrics for policy analysis.

A large number of economic models have been constructed for less developed countries. The theoretical foundation for the earlier models had been the Harrod-Domar aggregate growth model, static and dynamic programming, the Chenery two-gap analysis, and Lewis-Fei-Ranis labor surplus model (Harrod, 1939; Domar, 1946; Chenery and Strout, 1966; Eckaus and Parikh, 1968; Adelman and Thorbecke, 1966; ECAFE, 1967; UNTACD, 1968; Fei and Ranis, 1964; Agarwala, 1970). All of these models considered only real variables. The models are designed to analyze constraints to achieve high economic growth.

Production functions are characterized by some rigid input-output coefficients. Prices are usually neglected. The entire fiscal-monetary-income-balance of payments nexus is ignored. These models, therefore, are not suitable for short-run price, income, and balance of payments stabilization analysis.

In the shortrun, the real problem faced by the economic leadership of developing countries is stabilization of prices, income, and balance of payments. Consequently, the second generation econometric models for developing countries have emerged to analyze economic stabilization problems. The theoretical foundations of these models are either Keynesian, monetarist, or a synthesis of the two. The Keynesian model emphasizes aggregate demand, and is characterized by its detailed elaboration of the aggregate expenditure identity for income determination (Marwah, 1969; Evans, 1970; Encarnacion et al., 1972). The monetarist model, on the other hand, emphasizes the role of monetary aggregates (Otani and Park, 1976), aggregate income is usually determined through a reduced-form equation that is a function of the money stock. The price level is a monetary phenomenon and inflation, therefore, is mainly determined by money supply growth or excess money supply.

Keynesian and monetarist models were originally designed for developed countries, where capital markets are well-developed. Monetary saving and investment, consequently, are two distinct processes. Bank loans are not the only sources of external finance for firms. Firms can also generate funds by selling equity or promissory notes. Moreover, these countries have a very strong productive industrial complex that is capable of producing much more output than it actually does. Their main problem, therefore, is to find enough effective demand to absorb this output. Econometric models that emphasize the aggregate demand side should be appropriate for these countries (Klein, 1965).

Less-developed countries, however, are commonly characterized by a very thin capital market, a low capital endowment, an infant industrial base, and a high dependence on external capital and essential inputs. All of these limit productive capacity. The relatively large population size creates enormous demand pressures. Clearly, less developed countries face supply-side much more than demand-side constraints. A more appropriate econometric model for developing countries, therefore, should be one which emphasizes the supply side for aggregate income determination (Klein, 1965, 1971; Behrman, 1971, 1977).

The supply-side emphasizing model is even more compelling in modeling the monetary sector of developing economies. In an economy where equity and commercial paper markets are practically non-existent, the main source of external finance for business activities is bank loans. Bank loans are very important for fixed and working capital financing (McKinnon, 1973; Kapur, 1976; Kumar, 1983; Buffie, 1984; Wijnbergen, 1983a,b). Consumption loans are virtually absent due to government restrictions. The bank loans-investment nexus is one of the important channels through which monetary policies affect real variables. This may be the reason why monetary policies in less developed countries are transmitted to the real sector faster than in developed countries (Park, 1973).

Another important aspect of monetary-sector modeling is the interrelationship between the balance of payments and money supply. As will be shown Chapter III, the BOP is directly related to the monetary base, and hence to the money supply. In a wide-open economy like Indonesia, the BOP could fluctuate so much that it threatens domestic economic stability. The central bank may reduce the effect of the BOP on the money supply by reciprocally changing domestic credit. This is called sterilization (Argy and Kouri, 1974; Cumby and Obstfeld, 1983). Sterilization, however, cannot be done indefinitely in a country with a continuous BOP deficit or surplus. In particular, sterilization is not feasible if domestic and foreign currencies are perfect substitutes (De Grauwe, 1983).

Sterilization has important implications for monetary policy modeling. The domestic credit used for sterilization will depend on the BOP. This relationship may be represented by a policy reaction function (Argy and Kouri, 1974, Cumby and Obstfeld, 1983; Ujie, 1978).

On modeling the Indonesian monetary sector

The first known macroeconomic models of the Indonesian economy are the ECAFE MODEL NO. I (ECAFE, 1964) and the Onishi Model (Onishi, 1964). These two models use the same theoretical foundation, which is the "gap" model with the Harrod-Domar fixed capital-output ratio in the aggregate production function. The models concentrate on the international trade gap only. Domestic saving, money, and prices are not considered. The models are used for the forecasting of the aggregate production growth rate either with imports only (Onishi), or with both imports and exports as its main constraints. Obviously, the models are not designed for policy analysis. The models are too simple for representing an economy realistically.

To improve its first model the ECAFE constructed ECAFE MODEL NO. II, which is much more detailed than the previous one (ECAFE, 1967). This model is designed to simulate the Indonesian economy in the 1960s, which was characterized by economic stagnation and accelerating inflation.

The major improvements in the ECAFE MODEL NO. II are the introduction of prices and money. Following the pure monetarist hypothesis, inflation is assumed a monetary phenomenon. The price level is assumed a function of the money-income ratio. The money supply, on the other hand, is a linear function of the government budget deficit. This money supply determination, however, may be mispecified. It is the change in the money supply (flow), not its level (stock), that should be directly related to the government deficit (flow).

The balance of payments and monetary system loans to the private sector are not considered in this model.

Following ECAFE MODEL NO. II, Fukuchi developed two versions of econometric models for the Indonesia, ICU MODEL NO. I and ICU MODEL NO. II (Fukuchi, 1968). The two models are basically the same except that ICU MODEL NO. II is more disaggregated and that the foreign exchange reserve is endogenized. Their structures are similar to the ECAFE MODEL NO. II. The only modifications in these models are disaggregation of investment by industries and a revision of the money supply as a function of the accumulated government budget deficit.

After a decade of stagnation, the economic modeling of the Indonesian economy started again in the late 1970s (Gupta, 1977; Aghevli, 1977; Boediono, 1979; Schydlowsky, 1980; Nasution, 1982; Pamungkas, 1984). The Gupta and Pamungkas models are based on the same theoretical framework. Both are designed to analyze interrelationships among economic growth and equity, employment, and poverty. Production function are assumed to follow a Harrod-Domar incremental capital-output ratio. Investment is constrained by resource availability, and domestic and foreign savings, in the spirit of the two-gap model. Many of the key parameters and variables are assumed values, not derived from actual data. The monetary sector is barely considered. The only role of money is for price determination. The most interesting aspect of the Gupta-Pamungkas models is their integration of equity, employment, poverty, and economic growth. The reliability of their conclusions, however, are heavily dependent on the accuracy of their subjective assumptions on various parameters and variables.

The Boediono model may be the most consistent and elaborate of all large-scale econometric models of Indonesian economy. This model consists of two parts, macro and micro. The macro model is of the Keynesian type with an emphasis on aggregate demand

components. The micro model consists of 40 industrial sectors. Each sector has supply and demand functions. The model is a Walrasian System constructed following the Johansen approach (Johansen, 1960; 1974). The macro model can either be solved independently or linked to the micro model.

The most interesting part of the Boediono model is its micro model and its linkage with the macro model. The link, however, is only partial—that is, only through gross national product. Unfortunately, due to data problems, only the parameters for the demand functions are directly estimated. All other parameters are determined subjectively or borrowed from other studies.

The monetary sector of the macro model is relatively simple. There is no demand function for money. Money supply is determined using the multiplier approach. Investment and capital flows are assumed exogenous. There is no consideration of balance of payments sterilization.

The Schydlowsky model is a Keynesian model. All behavioral equations, except the tax function, are merely constant ratios of two variables. Tax, on the other hand, is a linear function of two variables, aggregate income and imports. Due to data problems all parameters are determined subjectively. By exploiting the aggregate income identity the system is then solved to obtain various standard Keynesian multipliers.

The interesting feature of Schydlowsky model is its monetary sector. Even though the behavioral relationships are too simple (merely fixed proportions), this model may be the most complete in elaborating the monetary sector. The money supply is linked to statutory institutions and government deficits, in addition to the BOP. The monetary sector, however, is linked to the real sector only through the demand side. That is, credit increases both private and government expenditures. There is no specific link between bank credit and investment. The accumulation of financial assets, mainly time and saving deposits, is

considered a leakage from income streams and thus reduces aggregate demand. This, of course, neglects the role of monetary deposits for bank loan expansion. Another limitation of the model is its assumption that domestic prices are directly related to foreign prices following the price-unification hypothesis. By assuming foreign prices as given, the domestic price level is also given in this model. This, clearly, is unrealistic.

The Aghevli and Nasution models are monetary-oriented. Both emphasize the monetary sector and its interrelationship with the external sector. The Nasution model is basically an extension of the Aghevli model. Whereas Aghevli assumes gross national product as exogenous, Nasution endogenizes it by adding a reduced form aggregate demand function. Aggregate demand is a function of domestic prices, the exchange rate, world prices, the interest rate, and time trend. Thus, there is no direct relationship between real income and bank credit. Bank loans to the private sector are not specifically considered. Central bank credit to the private sector, however, is linked to the money supply via the monetary base. Sterilization of the BOP is neglected and capital flows are assumed exogenous.

Objectives

The general objective of this study is to develop a monetary-policy oriented model of the Indonesian economy. The model will take into account the role of bank loans for capital formation, which is considered to be crucial in an underdeveloped capital market. Private capital flows and trade in services will be endogenized. The central bank attempt to sterilize the BOP effect on money supply will be integrated into the model. These aspects have been neglected in all previous models of the Indonesian economy.

Specifically, the objectives of this study are as follows:

1. A descriptive survey Indonesian monetary institutions and policies.

2. An investigation and modeling of the channels through which monetary policies might affect inflation and real variables. In addition to the well-known wealth and price channels, the role of bank loans will also be considered.
3. An investigation and modeling of the balance of payments components, as disaggregated as they possibly can be, and their relationships with the money supply.
4. Check the performance of individual behavioral equations and the complete integrated model.
5. Use the model to simulate the effects of exchange rate and central bank credit policies.

CHAPTER II. DESCRIPTION OF INDONESIAN GENERAL ECONOMIC AND MONETARY SECTOR DEVELOPMENT

After the political upheaval of 1965-1966, a new regime, commonly known as the New Order, emerged in the leadership of General (later President) Suharto. Prior to that time Indonesia was under economic disorder, plagued by hyperinflation and recession. Accordingly, as soon as the new government had consolidated its power in March 1966, an economic stabilization plan was launched in October 1966. After stabilizing price successfully, vigorous general economic development programs have been conducted through a series of Five-Year Economic Plans starting from April 1969. Financial intermediation revived as inflation was brought under control and attractive savings incentives were offered by the government. Many major structural changes have taken place since then. The development of some selected key economic variables, such as economic growth, government expenditure and finance, money supply, and balance of payments will be reviewed in the chapter. Since it will be useful as background for this study, financial institutions and policies will also be reviewed.

General Economic Development

One of impressive economic achievements of the New Order regime is its success in turning the economy from stagnation to one of the world's fastest growing economies. Between 1970-1974 the economy grew at 8.57 percent per year (Table 1). During this period, the highest growth occurred in the mining sector due to the oil boom. Construction was high as the result of heavy government projects along with private business and industrial development. Trade was also high as business activities were facilitated by the rapid economic growth and availability of transportation, communication services, and electric power.

Table 1. Contributions of each sector to overall growth (%) (Source: McCawley, 1985)

Sector	1970-74	1975-79	1980-83	Average
Food	1.02	0.53	1.13	0.87
Non-food agriculture	0.89	0.51	0.18	0.55
Mines	1.45	0.48	-0.19	0.63
Manufacturing	1.22	1.52	1.28	1.34
Electricity	0.06	0.08	0.10	0.07
Construction	0.72	0.59	0.54	0.62
Trade	1.63	1.08	1.25	1.33
Transport	0.48	0.65	0.43	0.52
Banks	0.17	0.23	0.22	0.20
Rent	0.34	0.32	0.21	0.29
Government	0.51	0.90	0.85	0.75
Services	0.13	0.08	0.07	0.09
Total	8.57	6.94	6.06	7.23

During 1975-1979, the period the economic growth rate fell to 6.94 percent per year, primarily as a result of a slow down in oil exports. The agricultural sector growth rate also fell, primarily as a result of poor harvest of food crops. The only sector that experienced a significant increase in its growth rate was manufacturing, made possible by various factors: (1) high domestic demand, especially government spending, made possible by huge revenues from the oil boom; (2) a large government investment in the manufacturing sector, such as fertilizer, iron and steel, and oil refineries plants; (3) large foreign investment attracted by favorable general economic conditions; and (4) technological progress.

After a brief increase in 1980-1981, the world oil price began to fall in 1982. To keep the price from a dramatic fall, OPEC asked its members to reduce production through a quota system. As the result, Indonesian oil exports began falling in 1982. As can be seen from Table 1, the mining sector growth rate was negative during the 1980-1983 period. Along with the reduction in oil exports, overall domestic demand has also fallen since 1982. Since Indonesian manufacturing has a narrow export base (Hill, 1984), the domestic demand slow down has led to recession in the manufacturing sector. The non-food agricultural sector growth rate also fell substantially. The only sector that gained a significant increase in its growth rate was the food sector. This was primarily due to a good rice harvest. Overall economic growth during the 1980-1983 period was still quite high at 6.01 percent per year.

Without doubt, oil has been very important for the economy, not only as a major component of the gross domestic product, but also as the major source of government revenue and foreign exchange. The recent post oil boom, nevertheless, indicates that the economy still can achieve a high economic growth rate during an oil recession. The manufacturing, construction, trade and transportation sectors have become increasingly important.

The high economic growth rate, however, has not been accompanied by a satisfactory employment absorption. During the 1971-1980 period, total employment only grew at 2.9 percent per year (Table 2), whereas total output of the economy grew at 7.7 percent per year. The most disappointing sector is manufacturing. Employment absorption in manufacturing only grew at 4.1 percent per year, whereas its real output grew at 12.8 percent per year. The rate of growth of employment in manufacturing was the lowest among all sectors except agriculture. One possible reason for the low employment absorption of the manufacturing sector is that the development strategy for the sector has been import-

substitution oriented. Import-substitution industries tend to be highly capital intensive and have a narrow domestic resource base.

Table 2. Employment by sector, 1971-80 (Source: Scherer, 1982)

Sectors	1971 Number (1000 persons)	1971 Share (%)	1980 Number (1000 persons)	1980 Share (%)	Annual Growth 1971-80 (%)
Agriculture	24963.9	65.9	28040.4	55.5	1.0
Mining	90.6	0.2	369.4	0.7	16.5
Manufacturing	2949.6	7.8	4360.7	8.6	4.1
Utilities	38.1	0.1	84.6	0.2	8.9
Construction	740.6	2.0	1573.1	3.1	8.4
Transport and Communication	919.2	2.4	1467.8	2.9	5.0
Trade	4143.8	10.9	6611.4	12.1	5.0
Banking	95.5	0.3	232.5	0.5	10.1
Services	3939.7	10.4	7739.3	15.4	7.5
Other	1603.6[a]		712.8[a]	—	—
Total	39474.5	100.0	51191.5	100.0	2.9

[a]Other is distributed proportionally among other sectors.

Another disappointing aspect of recent economic development is income inequality. The gap between the rich and the poor is increasing, especially in urban Java where most of modern development takes place (Hughes and Islam, 1981).

In addition to economic growth, another remarkable achievement of the New Order regime is its ability to control inflation. Indonesia experienced a severe hyperinflation in 1960s (Table 3). In 1966, when the regime took power, inflation was 986 percent per annum. As can be seen from Table 3, the inflation rate is closely associated with the money-supply growth rate. In the period 1961-1966 the inflation rate was even higher than the money-supply growth rate. This may indicate that the public had lost trust in the ability of the government to control inflation.

Excessive money-supply growth in 1961-1966 was due to huge government deficits. Large and increasing government expenditures were needed to finance the restoration of order after disturbances caused by regional rebellions, confrontation with Malaysia, and extensive uneconomical "special projects." Sufficient government revenue, on the other hand, could not be generated due to overall economic stagnation, export reduction, and high inflation. The result was huge budget deficits. Since government bonds did not exist, all budget deficit had to be financed through direct borrowings from the central bank. The money supply was directly related to budgetary deficits.

The situation became increasingly worse as the tax collection system broke down due to the hyperinflation. Accelerated inflation induced taxpayers to avoid or delay paying taxes. Inflation, in combination with foreign exchange shortages and controls, led to black market exchange rate and trade smuggling. Since trade taxes were the major sources of government revenue, smuggling also worsened the budget deficit problem. Government expenditures also increased with inflation. In essence, the economy was trapped in a hyperinflationary cycle. Deficit created inflation which further increased the deficit and inflation. An excellent

Table 3. Inflation, money-supply growth, and sources of changes of the money supply (Sources: 1957-1965, Arndt, 1971; 1966-1983, Bank Indonesia, Indonesian financial statistics)

Year	Inflation %	Money Supply (M1)	Sources of Changes of Money Supply (Million Rp)				
			Credit to Government	Change in Foreign Assets	Credit to Public Enterprises	Credit to Private Sector	Other Credit
1957	54.9	41.0	0.0058	-0.0010	0.0001	0.0022	-0.0015
1958	18.0	55.6	0.0095	0.0006	0.0013	-0.0009	-0.0001
1959	13.2	18.7	0.0034	0.014	0.0053	0.0011	-0.0182
1960	20.0	37.2	-0.0008	0.0045	0.0033	-0.0012	0.0072
1961	95.2	41.1	0.0234	-0.0068	0.0031	0.0071	-0.0070
1962	155.9	101.0	0.0536	-0.0094	0.0128	0.0051	0.0061
1963	128.8	93.8	0.1228	-0.0110	0.0236	0.0100	-0.0179
1964	135.3	156.3	0.3456	-0.0102	0.0819	0.0324	-0.0380
1965	592.2	282.5	1.4185	-0.0036	0.3952	0.2374	-0.1406
1966	985.7	763.5	12.608	-0.256	-0.005	5.972	1.574
1967	174.8	131.8	24	-12	--	25	-5
1968	55.1	121.3	3	13	22	40	-6
1969	17.0	58.0	-11	4	30	88	-7
1970	12.3	33.9	-12	16	-3	146	-50
1071	4.4	28.2	55	11	16	102	-44
1972	6.5	48.0	-51	212	-3	183	-116
1973	30.9	41.0	-425	75	67	408	-215
1974	34.0	40.1	-132	364	295	147	-209
1975	19.0	33.3	-253	-589	926	298	143
1976	19.8	28.2	-384	345	450	357	-115
1977	11.0	25.1	-208	568	35	284	-180
1978	6.8	24.0	-341	718	900	587	-1187
1979	21.9	36.1	-741	1654	371	557	-427
1980	18.5	47.6	-1909	3101	487	1178	-440
1981	11.8	29.8	-524	238	592	1756	-36
1982	9.5	9.8	530	-1528	732	2217	-593
1983	11.8	6.3	-1056	1069	-85	2223	817

analysis of the budget deficit-inflation cycle in Indonesia can be found in Aghevli and Khan (1977).

Realizing that the budgetary deficit was the primary cause of inflation, the New Order regime launched its economic stabilization program by instituting a budget-discipline policy. Government expenditures were controlled by centralizing the government budget and abandoning non-economic and special projects. Government expenditures were closely monitored and regularly evaluated. Under stand-by arrangements, the IMF limited government expenditures to less than ten percent of the national income. The tax collection administration was also improved. Emphasis was placed on increasing custom duty collection, direct tax revenues, and excise and sales taxes. With additional help from foreign aid, the government has been able to balance its budget since 1968. The balanced-budget principle became a political commitment for the government.

De facto, however, the government has systematically maintained a budget surplus. The balanced-budget principle only means that in a formal bookkeeping report government expenditure equals its revenue. The evidence of budget surplus is hidden with "tactical" expenditures such as paying "debt" to the central bank, creating a special deposit at the central bank, and substituting budget expenditures for expenditures normally financed by central bank credit. Foreign aid is considered as government revenue. As can be seen from Table 3, the government has a systematically increasing claim against the banking sector since 1969.

De facto budget-surplus policy is, in part, an effort to sterilize the effect of the balance of payments on the money supply (Arndt and Sundrum, 1984; Arndt, 1979). As Table 3 shows, the increase in government deposits in the banking system is closely associated with the increase in foreign assets of the banking system. By increasing

Table 4. Balance of payments (Millions SDR) (Source: IMF, Balance of payment statistics)

	1975	1976	1977	1978	1979	1980	1981	1982	1983
Current Account	-913	-788	-40	-1136	755	2197	-520	-4830	-5888
Exports									
Oil	4174	5267	6210	5879	7404	12007	16082	14366	12824
Other goods	1499	2195	3006	2922	4314	4713	3751	3514	4682
Services	113	139	142	232	308	343	1305	1380	1140
Imports									
Goods	-4504	-5906	-6401	-6695	-7152	-9680	-14082	-16170	-16559
Services	-2217	-2496	-3018	-3485	-4141	-5228	-7790	-8040	-8072
Unrequited transfer	22	13	21	11	23	42	212	121	97
Capital Account	292	1735	869	1193	625	935	2058	5291	5771
Direct investment	392	298	201	223	175	141	113	205	270
Other private capital	-1796	-159	-194	99	-462	-609	64	1554	1773
Official capital transfer	1696	1596	862	871	912	1403	1881	3532	3728
Net Error and Omissions	-85	-158	-47	-107	-312	-1356	-1438	-1920	433
Total change in Reserves	-706	789	782	-50	1068	1776	100	-1459	316

government deposits at the banking system when a balance of payments surplus occurs, the overall change in money supply will be smaller.

Having been able to control the government budget, the money-supply growth rate dropped dramatically from 765.5 percent in 1966 to 131.8 percent in 1967. Inflation also dropped dramatically from 985.7 percent in 1966 to 174.8 percent in 1967. Inflation has been practically under controlled since 1969.

Even though the money supply growth rate was relatively very high at between 24.0-58.0 percent during 1969-1981 period (compared to 3-5 percent proposed by Friedman (1968) for developed economies), inflation was relatively low, between 6.5 to 34.0 percent during the same period. This apparently less inflationary money phenomenon may be explained by the fact that the primary sources of the money supply increase have been credits to the private sector and to public enterprises for productive purposes. By directing bank credits into productive activities, the economy has been able to tolerate a high money supply grwoth rate, since the demand for money would increase due to the increase in production. An increase in demand for money due to a reduction in expected inflation may also have contributed to this high tolerance for money supply growth.

Indonesia's balance of payments during the 1975-1983 period is presented in Table 4. Current account has always been in deficit except in 1979 and 1980 when it was in surplus due to sudden jumps in non-oil exports, especially rubber and timber. The balance of merchandise trade has always been in surplus, whereas the balance of service trade has been in deficit. This is due to huge investment income transfers abroad by foreign oil companies. The merchandise export is dominated by oil exports. Oil exports had continuously increased until 1981. The oil export then fell due to the decline in world oil prices and the export limitation policy of the OPEC cartel. Imports, on the other hand, are

continuously increasing. As the result, the current account deficits has been very large since 1982.

It is interesting to note that trade in services is increasingly important. Naturally, imports of services will be increasing with oil exports as oil investment income transfers increase. Also of interest is the development of services exports. Export of services was more than 1.5 billion U.S. dollars or more than one-third of all non-oil merchandise exports in 1981. Unfortunately, the export of services has been overlooked in all studies of the Indonesian economy. Most of the exports of services are in the form of investment income and travel (tourism) services.

Capital account has always been in surplus. The biggest component of the capital account is net capital inflows of foreign borrowings. Government foreign borrowing was excessively high in 1975-1976 since capital was needed to bail out Pertamina (the national oil company) debt. It has also increased dramatically since 1982 as falling government oil revenues and the budget deficit must be financed by foreign borrowings.

The second biggest component of the capital account is non-direct investment capital flow. This mainly consists of portfolio investment. The first significant private capital inflow occurred in 1972 as the combined result of the liberalization of the foreign exchange market, a good outlook for the balance of payments and a high domestic interest rate. A large amount of this fund is invested in short term dollar deposits offered by Indonesian banks. These deposits are responsive to interest rate differentials and expected devaluation (Arndt and Suwidjana, 1982; Boediono, 1985). This may be the explanation of the very high fluctuation of non-direct investment private capital flows (Table 4). And this may be also why it is imperative to model its behavior in modeling the balance of payments sector.

Financial Institutions

The focus of this study is monetary policy analysis. Accordingly, financial institutions discussed here will be limited to those which are important for the conduct of monetary policies. For Indonesia, this would include Bank Indonesia as the central bank, commercial banks, and non-bank financial institutions. The non-bank financial institutions are limited to non-depository and non-insurance companies. The capital and money markets will also be discussed, although they may not be important yet, because of their potential in the future.

Bank Indonesia

Bank Indonesia is the central bank in Indonesia. Its historical development has been very much influenced by its origin. Bank Indonesia was originally a Dutch-owned commercial bank, The Bank of Java. The Bank of Java operated as a semi-governmental institution during the Dutch colonization era. In addition to commercial activities, it also performed some central banking functions. These functions, however, were limited to those activities essential for colonial government operations, particularly export related businesses. The partial central banking functions included issuing bank notes, advancing funds to the Colonial government, and administering gold and foreign exchange. However, it did not perform other central banking functions such as controlling credit expansion, holding reserves of commercial banks, or serving as a lender of last resort (Emery, 1970).

Shortly after the Revolutionary War, the New Indonesian government nationalized the Bank of Java and changed its name to Bank Indonesia on December 6, 1951. The first Central Banking Act was passed in 1953, which outlined the organization and functions of the central bank. According to this Act, the management of Bank Indonesia shall consist of a Monetary Board, a Managing Board, and an Advisory Board. The Monetary Board

formulated general monetary policies, provided the Managing Board with advice on the bank's policies in other matters as the public interest required, and fixed interest rates. Bank Indonesia, therefore, was merely executing the policies outlined by the Monetary Board. The members of the Monetary Board are certain ministers and the Governor of Bank Indonesia with the Minister of Finance as acting chairman. The Advisory Board members are appointed from the science community to advise the Monetary Board.

In accordance with the Central Bank Act of 1953, the government (President) issued government ordinance No 1 of 1955 that gave Bank Indonesia, in the name of the Monetary Board, the right to supervise credit institutions.

After the New Order regime took power, it pledged to reform the government system according to the National Constitution of 1945. It was argued that according to the National Constitution, all governmental policies are in the hands of the President. Hence, it is the President, not the Monetary Board or its kind, that should formulate monetary policies. Accordingly, a Presidential decree was issued in 1966 which put the central bank as one of the highest non-departmental institutions. With this, the Governor of Bank Indonesia is responsible to the President.

A series of banking laws were passed in the 1966-1968 period. Among the important provisions are reconfirmation of the role of Bank Indonesia as the central bank and supervisor of all commercial banks, and establishment of the Economic Stabilization Council which formulates all economic policies. The Economic Stabilization Council is chaired by the President. The Governor of Bank Indonesia is one of its members. The role of the Monetary Board is now limited to advising to the President. Its duties are (1) to assist the government in planning and formulating monetary policies by proposing policy guidelines to maintain monetary stability, increase employment, and increase the welfare of the people, (2) to lead and coordinate implementation of monetary policies. The Monetary Board is chaired

by the Minister of Finance and its members are the Minister of Trade and Cooperatives, and the Governor of Bank Indonesia.

In summary, Bank Indonesia is not an independent body. It is a part of the government agencies. Nonetheless, it performs the common central banking activities which include: (1) issuing currency; (2) controlling commercial bank credits; (3) controlling and managing the country's gold and foreign exchange reserves; (4) controlling the interest rate structure; (5) banker to the government and financial institutions; and (6) supervising financial institutions.

Commercial Banks

The banking sector in Indonesia is dominated by state banks. There are five state commercial banks, one national development bank and 26 regional development banks, and one national savings bank. State commercial bank domination can be seen from their share in lending, fund mobilization and assets (Table 5). State commercial banks hold more than 70 percent of loans, deposits and assets. In the second distant is national private banks, and then foreign banks.

Table 5. Banks share of loans, funds and assets in 1983 (%) (Source: Bank Indonesia, Report of the financial year 1982/1983)

Banks	Loans	Funds	Assets
State commercial banks[a]	74.8	70.7	77.0
National private banks	11.9	13.2	11.2
Regional development banks	3.2	3.5	3.2
Foreign banks	6.5	12.6	8.6

[a]Including national development bank.

Each state bank is governed by a board of supervisors and a board of directors. All members of these boards are appointed by the government, and are drawn from government employees and the Armed Forces. The Board of Supervisors holds meetings occasionally to discuss major matters such as approving the budget of the bank (Nasution, 1982).

Government involvement in commercial banking is designed such that it is easier for the government to execute its monetary policies in an environment where the money and capital markets are virtually inexistent. State banks are development agents and not merely profit oriented banks. They must carry out government policies. For example, prior to June 1983, during the financial controlled era, state banks had to charge interest rates on deposits and loans as determined by the government. They also had to allocate their loans to particular sectors of the economy as indicated by government decisions. In addition, state banks function as intermediaries to channel the central bank direct credits to various sectors hidden under the name of refinancing facilities. In return, the state commercial banks have enjoyed various government protections and subsidies, such as deposit interest subsidies (prior to June, 1983), cheap refinancing facilities, bankers to government agencies, deposit guarantees, debt bail out, budget allocation for capital participation, and interest paid by the central bank on excess reserves held with the commercial banks themselves (Arndt, 1979).

Private banks have not been able to increase their market shares in competition with state banks. This can be explained by the fact that state banks receive enormous subsidies and special treatment from the government, as previously discussed, and that the government places severe obstacles on the private banks' expansion (McLeod, 1984). These expansion restrictions include restrictions on physical (branch) expansion and ability to obtain a foreign exchange license. National private banks are prohibited (except in "special circumstances") from opening new branches in larger cities such as Jakarta, Bandung, Semarang, Surabaya, Medan, Palembang, and Ujung Pandang, where demand for banking services is high.

Foreign banks are only allowed to operate in Jakarta. Inability to provide foreign currency facilities effectively preclude the non-foreign-exchange banks from providing services required by larger corporate clients.

In summary, the financial sector in Indonesia is dominated by state banks. It is apparently designed so as to help the government to carry out its economic policies. This domination is very crucial for monetary policies where money and capital markets have not developed. Overprotection of these state banks, however, could inhibit the development of private banks and healthy competition.

Non-bank financial institutions

A non-bank financial institution is a non-bank and non-insurance financial institution, the main activity of which is mobilizing funds by issuing commercial paper (Bank Indonesia, Report of the financial year 1982/1983).

The non-bank financial institutions movement practically began in the early 1970s. It was part of the government's campaign to induce the development of money and capital markets. As usual, the government took the initiative and was directly involved in the process. Bank Indonesia or the state banks are the majority shareholders in almost all of the non-bank financial institutions. All of the state commercial banks have investment finance affiliates.

Basically, there are two types of non-bank financial institutions: (1) development finance and (2) investment finance. Development finance corporations are mainly engaged in extending medium and long-term credits, and joining equity participation in other companies. Their funds are mainly mobilized by issuing medium and long-term commercial paper. Investment finance corporations are mainly engaged in brokerage and the underwriting of

commercial paper. Their funds are mobilized by using commercial paper. They are not allowed to accept deposits nor to extend loans.

In reality, investment finance corporations extend a large amount of loans disguised under the name of investment (McLeod, 1984). Actually, they have been used by the state commercial banks (and Bank Indonesia) as means to extend credits to various sectors and activities which otherwise are impossible because of government regulations. In addition, since there is no control on interest rates charged by non-bank financial institution, the interest rate charged by the investment financial corporations is higher than the official rate.

Non-bank financial institutions grew rapidly. Their numbers increased from only one in 1972 to 13 in 1980. Their total assets also increased from Rp 75 billion in 1976 to Rp 947 billion in 1983.

Capital and Money Markets

Both capital and money markets are still in the early stages of development in Indonesia. Government bonds do not exist in a free market. This is partly due to the government's commitment to keep a balanced budget and to the fact that the government can always borrow from the central bank should there be a budget deficit. As has already been discussed in the previous section, the central bank is a part of government.

A stock market actually has existed since the Dutch colonization era. It was temporarily closed in 1942-1952 due to the World War II and the war of independence. It was reopened again in 1952. The stock market was practically dormant in the early 1960s, and eventually closed in 1968, due to the nationalization of Dutch companies and hyperinflation. It was activated again in 1977 with the opening of the Jakarta Stock Exchange. Prior to this reopening the government established three organizations to guide and regulate the stock exchange, namely: (1) the Capital Market Policy Council, to assist the

government in formulating policies and regulations regarding stock markets; (2) the Capital Market Operations Board, to control and operate the capital market in conformity with government policies and to evaluate companies which intend to go public; (3) the National Investment Trust (P.T. Danareksa) to facilitate the participation of small investors in the stock market.

P.T. Danareksa practically creates or guarantees the existence of the stock market. This is done through the following arrangement. P.T. Danereksa has the option of taking up to 50 percent of the newly issued shares of companies going public. Against these shares, P.T. Danareksa issues small nominal value of bearer certificates and sells them to the public through branches of state banks throughout the country at no transaction cost. The buyers of the certificates can resell their holdings to P.T. Danareksa at any time at the prevailing market price through the same network. The holders of the certificates receive dividends equal to those paid on the shares they represent.

Generous tax incentives are given to both investors and companies that sell their equity to the public. Investment is tax deductible and free from property tax. The yields and the capital gains are also tax exempt. Companies that have some portion of their equity in public hands are entitled to various tax privileges.

The practice of issuing back-to-back certificates is being phased out in favor of the mutual fund concept. The first mutual fund certificates (Series A) were issued in April-June 1981. The fund comprised shares in five listed companies as well as short-term money market assets. The fund certificates are attractive because of two interesting features. First, the certificates may be sold to P.T. Danareksa at any time at a price based on the current value of the portfolio, but in any case no less than the nominal issue price of the certificates. Second, P.T. Danareksa guarantees to pay a dividend not less than the interest rate on a state bank time deposit of 12-months maturity. These provisions mean the fund certificates are

almost as liquid as demand deposits, and yet carry a return at least as high as time deposits at no risk (McLeod, 1984).

Companies, however, have been reluctant to sell their equities. This, partly, is due to a strong desire to avoid the dilution of ownership, the fact that sufficient amounts of credits can be obtained from state banks and non-bank financial institutions at low interest rates, and that public disclosure requirements associated with listing are disadvantageous for companies which traditionally negotiate their tax liabilities with tax officials.

The money market is still very thin. This in part is due to the non-availability of high quality negotiable debt, such as government bonds. The number of large and sound private companies is very small. The market for commercial paper, therefore, is very limited. If secondary trading in commercial papers ever occurs, it will largely be confined to repurchase by the issuers (McLeod, 1984).

The most active money market is that for interbank funds transactions. The interbank money market was introduced in April 1974. Originally, it was intended for commercial banks, members of the Jarkarta clearing house. Later, non-bank financial institutions also became involved. Under initial arrangements, illiquid banks borrowed from liquid banks on a short-term basis of no more than seven working days to meet their clearing obligations. The instrument later was expanded to include promissory notes and certificates of deposits (Nasution, 1982).

Another major step toward a more sophisticated capital and money markets was the introduction of Bank Indonesia interest-bearing certificates (Sertifikat Bank Indonesia) in 1984. This certificate plays the same role as the government bonds, that is, to facilitate open market operations. The initial denominations of the certificates are quite large, Rp 50 million, Rp 250 million and Rp 1 billion. Bank Indonesia sells the certificates to commercial banks and non-bank financial institutions only. The certificate may then be traded among banks,

financial institutions, and the general public as well. It is still too early to evaluate the performance of these certificates.

Monetary Policies

As it has been mentioned earlier, the Indonesian capital and money markets are still in an early stage of development. Bank Indonesia certificates, which are expected to play the same roles as government bonds play in most developed countries, were introduced in 1984. Open market operations, therefore, are not feasible in such a situation.

Prior to the financial liberalization of June 1983, money supply control had been conducted using direct controls, namely overall and selective credit ceilings. Other conventional money supply control instruments, such as a reserve requirement and discount rate have been ineffective due to inconsistencies among various policies. Deposit and loan rates were also controlled. The government lifted all these direct controls in June 1983. This study covers the situation prior to the financial liberalization only. Monetary policies discussed in this section, thus, will be focused on the situation prior to the liberalization era. Nonetheless, the liberalization policies will also be reviewed at the end of the chapter.

Direct credit controls

Direct credit controls include overall and selective credit ceilngs. An overall credit ceiling is a limitation of the total credits advanced by monetary institutions. In other words, there is an upper limit of total credits. A selective credit ceiling, on the other hand, is a limitation on how the credits should be allocated among various economic sectors and activities.

An overall credit ceiling is intended to control the aggregate money supply. Selective credit controls may be used as a means of subsidizing certain sectors and directing the distribution of economic development.

Historically, credit control is one of the oldest monetary policy instruments used in Indonesia. The first known credit-ceiling policies were imposed on credit extended by the foreign exchange banks in 1953. More restrictive credit controls were imposed during the 1958-1966 hyperinflationary period. These policies, however, failed to control inflation due to the excessive government deficits.

Credit ceiling policies were introduced again on April 6, 1974, as part of a policy package to fight reemerged accelerating inflation. The banking system was very liquid at that time, mainly due to the oil export boom. The reserve requirement was not adequate to prevent the excessive expansion of bank credits. It should also be clear that since 1966, there had been some form of credit ceiling required by the International Monetary Fund's (IMF) stand-by agreement. But this, however, was merely a commitment by the central bank to limit overall credit expansion (Arndt, 1979).

The credit ceiling system was operated as follows (Arndt, 1979). At the beginning of each year, the central bank set ceilings, expressed in Rp billion but translatable into percentage increases, to the expansion of credit permitted to each bank for each priority sector. The central bank negotiated the ceilings with each bank in determining its credit allocation. The credit ceiling allocation is based on the credit realization of the bank in the past and its plan for the forthcoming year. The ceilings were subject to periodical upward revisions, adjustments in special circumstances, and requests from individual banks.

Between 1974-1976 the ceilings were determined on a quarterly basis. Due to the difficulties of implementation and control, the ceilings were changed to annual basis. Each bank, however, had to observe its ceilings on monthly basis (Nasution, 1982). Failure to maintain its credit within the ceilings would result in a fine.

Most banks had on the average kept their credit expansion within their ceilings. This is true, at least, on paper. The periodical adjustments of the ceilings may also have contributed to this apparent compliance.

The credit ceilings were the main instrument of controlling the money supply during 1974-1983 period. The ceilings rendered reserve requirements ineffective for money supply control.

Central bank credits

Although the central bank may have had difficulty reducing the money supply due to the lack of instruments to do so, increasing the money supply was is not a problem at all. The central bank can always increase the money supply by direct lending to the private sector, or indirectly by increasing advances to commercial banks. Central bank credits directly affect the monetary base, and, hence, the money supply.

Central bank direct credit to the private sector goes primarily to state enterprises. Although its share in over all banking system credit is decreasing, its absolute value is still significant and increasing. In 1970, direct credit lending was only Rp 97 billion or 26.8 percent of total banking system credit to the private sector, whereas in 1983 the value increased to Rp 2356 billion or 15.4 percent of total banking system credit to the private sector.

Credit to commercial banks may be divided into two types: emergency liquidity credits, and refinancing for 'special programs'. Emergency liquidity credit, commonly called the discount window facility, is given to commercial banks facing liquidity problems. Commercial banks are discouraged from frequent use of this facility.

The refinancing facility consists of central bank credit to state commercial banks for the purpose of financing government "special programs," such as agricultural credits to small

farmers and investment and capital credits to indigenous businesses. The portion of the refinancing matching fund varies according the sector priority. The interest rates charged to the commercial banks also vary, depending upon lending rates which are determined by Bank of Indonesia. In any case, the interest rates are very low because this facility is partly intended to subsidize the state commercial banks (Arndt, 1979; Nasution, 1982).

In addition to subsidizing state commercial banks, the main purposes of the refinancing facility are: (1) directing credits to certain priority sectors; (2) subsidizing the borrowers by charging a low loan rate; (3) an indirect way for Bank Indonesia to advance credits to the private sector.

Credit from Bank Indonesia has become the most important source of funds for commercial banks. The commercial banks have become very dependent on this, which makes it difficult to stop it or even to reduce it without a liquidity crisis in the banking system. A significant reduction of the refinancing credit might lead to unacceptable losses to state commercial banks, since the credit contains a subsidy element. Moreover, since lending to priority sectors such as small farming and indigenous business involves political issues, it may even be necessary to increase the amount of credits from year to year. The central bank, therefore, may have locked into this refinancing system. This excessive refinancing facility has become an "open window" through which state commercial banks have access to reserve money at their discretion (Arndt, 1979). This reduces the ability of the central bank to control reserves for money-supply management.

Interest rates

Prior to June 1983, both deposit and loan rates at state commercial banks were controlled by the government. The interest rates at private and foreign commercial banks

have always been freely flexible. The banking system, however, is dominated by the state commercial banks, as already discussed in the previous section.

Soon after inflation was brought under control, a comprehensive saving scheme to mobilize domestic funds was launched in October 1968. Attractive deposit rates ranging from 18 percent per year for a 3-month time deposit to 72 percent per year for a 12-month time deposit were offered by the state commercial banks. The deposits were guaranteed by the government. It was the first time ex-post real deposit rates were positive. The deposit rates were frequently adjusted downward as inflation rates fell. Upward adjustment for increasing inflation has never been tried. As the result, the ex-post real interest rate for a 12-month time deposit was negative again during the re-emergence of inflation between 1973-1976 and between 1979-1983. This is one indication of financial repression as hypothesized by McKinnon (1973). That is, government control of the deposit rate may have inhibited depository institutions development.

Loan rates at the state commercial banks were very complicated. Different loan rates were assigned to different economic categories. There were about 60 categories at the latest classification.

The average loan rate at the state commercial banks could very well be lower than the cost of mobilizing the funds (deposit rates plus transactions costs). To cover this loss, the government subsidized the state commercial banks through deposit rate subsidies and refinancing facilities. Deposit rate subsidies were commonly given for longer term deposits.

The main purpose of interest rate policy was to mobilize deposits and to keep financial costs low in various priority sectors. It was not intended for discretionary money supply control.

The first step toward interest rate liberalization was taken in January 1978, with the liberalization of interest rates paid by state commercial banks for deposits of less than 6

months maturity. All deposit and loan rates have been freed since June 1983, except loan rates for commercial credits to farmers and small business.

Reserve requirement

Originally, the reserve requirement was introduced to protect depositors by ensuring some minimum level of bank liquidity. Later, the reserve requirement has also been used as monetary policy instrument (Luckett, 1984).

Although theoretically possible, the reserve requirement is not used for the day-to-day management of the money supply. The main problem with the reserve requirement is its inflexibility. A small change in the reserve requirement can cause a huge change in the money supply. Administratively, on the other hand, small changes could be bothersome. More importantly, when small changes in the reserve requirement necessitate substantial shifts among commercial bank assets, commercial banks would need some time for this adjustment. Frequent change in reserve requirement, therefore, could be disruptive.

Portfolio adjustments to accommodate the reserve requirement changes are costly to commercial banks. The reserve requirement itself is a cost since it earns little or no interest. A continuous increase in the reserve requirement would not be feasible.

The same is true for Indonesia. The reserve requirement has never been used for dynamic money supply management. The first reserve requirement was imposed at 30 percent of current liabilities in May 1957. Since then, the reserve requirement has only been changed once to 15 percent on December 30, 1977. This reduction of the reserve requirement was actually not intended to the increase money supply because the reserve requirement was redundant and ineffective as an instrument for controlling bank credit expansion. Commercial banks already had continuous excess reserve due to the credit ceiling restrictions. This, of course, was costly. A reduction of the reserve requirement

would enable the bank to get some interest income from the higher excess reserve deposit at the central bank. Bank Indonesia offered to pay 6 percent interest on excess reserves held with it up to an amount equal to the required reserves, to discourage the commercial banks from transferring their funds abroad (Arndt, 1979).

Exchange rate

The exchange rate has been widely used as a means for balance of payments adjustment. It is obvious that the exchange rate is very important for international trade since it directly affects the relative price of tradeable goods. The exchange rate is basically the relative price of two monies. That is, it is the price of foreign money in terms of domestic money. Naturally, an exchange rate change means a change in the relative price of these monies, and from simple demand theory, the quantity demanded of the monies would also change. The change in the quantities demanded of these monies will trigger capital flows. The exchange rate, therefore, affects the current and capital accounts of the balance of payments. Since the balance of payments is theoretically identical with the change in foreign exchange reserves of the central bank, which is part of the monetary base, the exchange rate is also important for monetary policy. More on this can be found in Bergstrand (1984, 1985).

Prior to 1966, the exchange rate system in Indonesia was complex and restrictive. There were many buying and selling rates for various categories of transactions. Moreover, the exchange rate structure was frequently changed (at least once a year since 1955). At each time of change, the name of the exchange devices were also changed (Kanesa-Thasan, 1966; Corden and Mackie, 1962). The exchange rate policy was used not only for balance of payments adjustment but also for generating revenue to the government. Unfortunately, the

exchange rate restrictions caused trade smuggling and a foreign exchange black market which might have actually reduced the government's revenue.

The exchange rate system was simplified in October 1966 as part of the New Order government program to stabilize price and to liberalize the economy from the previous "guided economy" campaign. Between 1966-1968, exchange rates for most exports and imports were allowed to float in a free exchange market. The exchange rate increased quickly, the main rate changed from Rp 85/U.S. $ in 1966 to Rp 326/U.S. $ in 1969. To reduce the inflationary effects of further devaluation, the government intervened and fixed the exchange rates in 1969. The exchange rates were unified in April 1970.

Since the breakdown of the Bretton Woods System in the early 1970s, all major currencies have been freely floating. Under such a situation, the government feels that pegging to single currency such as the U.S. dollar may not be appropriate anymore. The exchange rate system, then, changed to a managed basket peg in November 1978. The exchange rate is adjusted daily based on a basket of currencies of major trading partners. The currencies and weights used to determine the exchange rate, however, are not made public by the government.

In reality, however, the exchange rate system is leaning toward a more stable (fixed) exchange (Gray, 1982). The government does not follow the weighted basket exchange rate closely. Clearly, the exchange rate is a policy variable for the government.

The June 1983 Financial Liberalization Policy

As was discussed in the previous section, interest rates and bank credit used to be directly controlled by the government. A dramatic policy change on June 2, 1983, lifted most of the controls. The major provisions of the June financial liberalization policy are: (1) State banks are free to determine their own fixed and lending rate except for certain priority

borrowers such as farmers, small holders, small scale enterprises and private estates, (2) Credit ceilings and refinancing facilities are abolished except for priority categories. (3) The 20% withholding tax on dollar denominated deposit was abolished.

With the liberalization policy the central bank no longer had the means to control the money supply, other than, perhaps, persuasion. A step to facilitate open market operations was, then, taken by the introduction of new discount facilities and Bank Indonesia bearer certificates. The discount window is intended to help banks with temporary liquidity problems. There are two discount facilities, (1) a short term discount for assistance ranging from a few days up to two weeks. This assistance is renewable, at rising interest rates, up to a total of four weeks. (2) a long term discount for assistance up to two months, with a possible extension up to a maximum of four months. This is intended to help banks with a liquidity problem due to their inexperience in managing assets in a flexible interest rate environment (Rosendale, 1984).

The Bank Indonesia certificate (Sertifikat Bank Indonesia=SBI) is similar to government bonds in most other countries. Trading the SBIs would form a market in which open market operations can be conducted to implement monetary policies. Originally, the interest rates were determined by Bank Indonesia. As sales shifted to an auction system, the interest rates were then determined by market forces.

As expected, the liberalization policy has led to very volatile interest rates. This is especially due to the removal of refinancing facilities from Bank Indonesia which caused drastic liquidity losses to the banking system. In addition, a more flexible exchange rate caused the transfer of rupiah deposits into dollar deposits. The bank liquidity shortage culminated with the September crisis in 1984 when the interbanks' call-money interest rate reached 90 percent.

CHAPTER III. CONCEPTUAL FRAMEWORK AND THE MODEL

As mentioned earlier, the essence of this study is to model the interrelationships among investment, gross domestic product, monetary aggregates, and the balance of payments. The simplified structure of the model is presented in Figure 1.

The demand for monetary assets will determine the banking system credits for a given price level and gross national product. The balance of payment and banking system credits determine the money supply for a given gross domestic product. The integration between the monetary sector and the external sector (balance of payments), therefore, will determine the price level for a given gross domestic product. From the previous chapter, it should also be clear that interest rates and the exchange rate are exogenous, being controlled by the government during the period of this study (1976 quarter one to 1983 quarter one). The adjustment variable in the financial markets, then, is the price level. The real sector, real investment and production functions, will close the model to obtain estimates for gross domestic product and real investment.

Balance of Payment and Money Supply

Since it is crucial for this study, the interrelationship between the balance of payments and the money supply will be shown in this section. The money supply functions will also be derived.

Money is a liability of the banking system (monetary authorities and commercial banks) to the private sector. Money supply, then, can be determined using information from the banking system's consolidated balance sheet.

The monetary authorities (central bank, and treasury central banking activities, such as notes and coins issuance) balance sheet is presented in Table 6. From the table, we get the following identity:

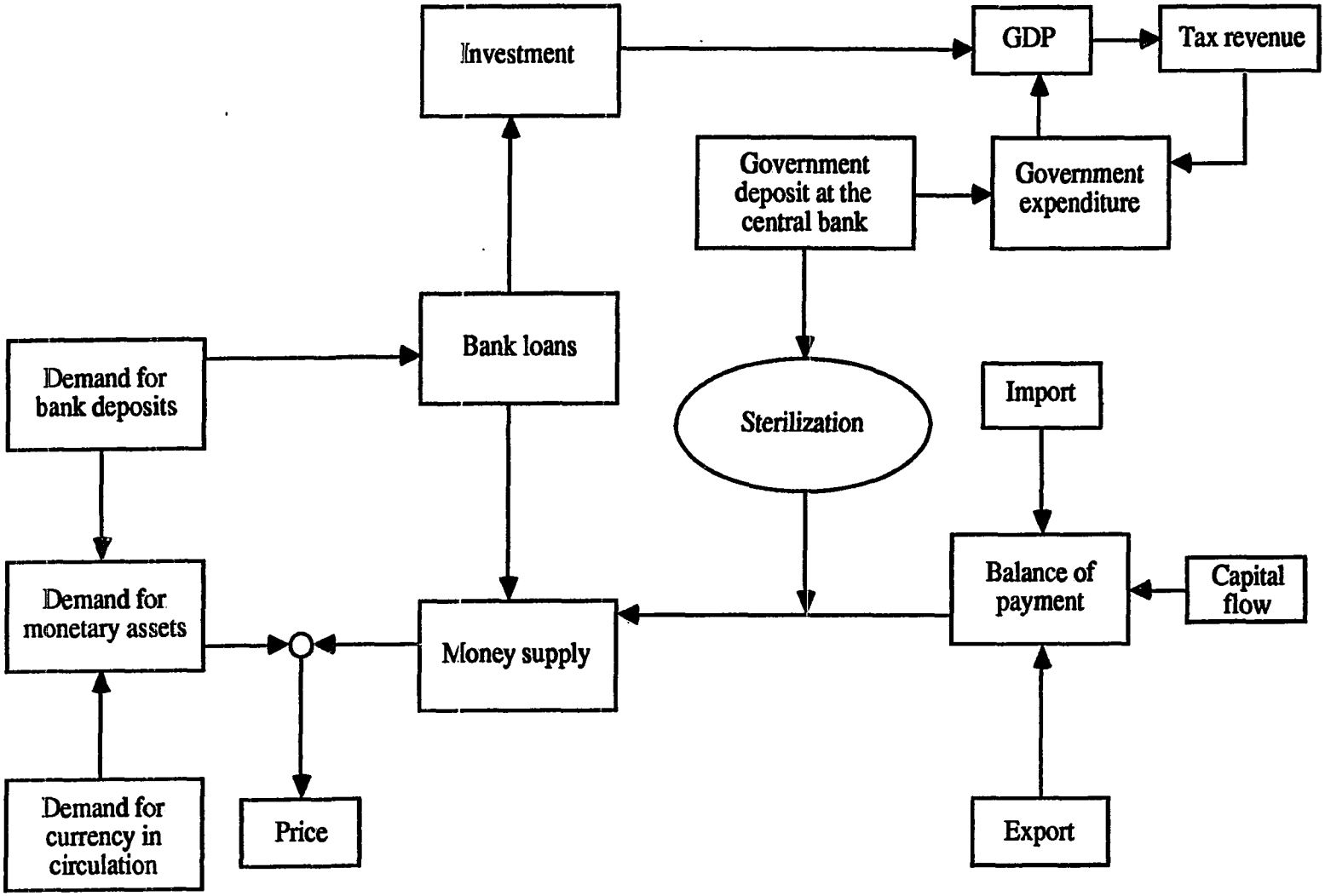

Figure 1. Conceptual structure of the Indonesian Monetary Sector Model

Table 6. Monetary authorities' balance sheet

Assets	Liabilities
Foreign assets (CFA)	Currency in circulation (CC)
Claims on government (CGC)	Bank reserves (RES)
Claims on private sector (CDC)	Private sector deposit (DDC)
Claims on deposit money banks (CBC)	Foreign currency and other deposit (FDC)
Other assets (COA)	Government deposit (CGD)
	Foreign liabilities (CFL)
	Capital (CCAP)
	Other liabilities (CAL)

Table 7. Balance sheet of deposit money banks

Assets	Liabilities
Foreign assets (BFA)	Demand deposit (DDB)
Claims on government (BGC)	Saving and time deposit (ST)
Claims on private sector (BPC)	Foreign currency deposits (FDB)
Other assets (BOA)	Borrowing from central bank (CBC)
Reserves (RES)	Foreign liabilities (BFL)
	Government deposits (BGD)
	Capital (BCAP)
	Other liabilities (BAL)

$$CC + DDC + FDC = (CFA-CFL) + (CGC-CGD) + CDC + CBC + COA - RES - CCAP - CAL \quad (1)$$

The deposit money banks' (commercial banks') balance sheet is given in Table 7. From the table, we have the following identity:

$$DDB + ST + FDB = (BFA-BFL) + (BGC-BGD) + BPC - CBC + BOA + RES - BCAP - BAL \quad (2)$$

From (1) and (2), we get the consolidated balance sheet of the monetary system:

$$CC + (DDB+DDC) + ST + (FDB+FDC) = NFA + NGC + CDC + BPC + OTHER \quad (3)$$

where: DD = DDB + DDC = Demand deposit

FD = FDB + FDC = Foreign currency (dollar) deposit

NFA = CFA + BFA - CFL - BFL = Net foreign assets of the banking system

NGC = CGC + BGC - CGD - BGD = Net government borrowing

CDC = Central bank direct credit to the private sector

BPC = Commercial bank loans to the non-government sector

OTHER = COA + BOA - CCAP - BCAP - CAL - BAL .

The left-hand side of equation (3) is actually the broadly defined money supply (M3):

$$M3 = CC + DD + ST + FD \quad (4)$$

Equation (3), therefore, can be rewritten as:

$$M3 = NFA + NGC + CDC + BPC + OTHER \quad (5)$$

Clearly, the net foreign assets of the consolidated monetary system is not affected by foreign capital borrowing. Foreign capital borrowing by the monetary system will increase both the asset and liability sides, leaving the net position unchanged. The net foreign assets of the monetary system changes only because of an unbalanced current account and capital inflows into the non-bank sector. This is called the balance of payments. The balance of

payments is identical with the change in the monetary authorities' net foreign assets. Hence, the change in the net foreign assets of the monetary system should be equal to the balance of payments.

The change in net government borrowing from the monetary system reflects the additional funds required to fill the budget deficit. Changes in central bank direct credit and commercial bank loans will reflect the flow of central bank direct credit and commercial bank loans to private sector, respectively.

With these clarifications, we are now ready to look at the sources of change in the money supply. Rewriting equation (5) in its differential form we get:

$$(1 - L)M3 = BOP + DGB + DCP + FBP + RESM \qquad (6)$$

where: L = Lag operator

DGB = (1-L) NGC = Flow of government borrowing from the central bank

DCP = (1-L) CDC = Flow of central bank direct credit

FBP = (1-L) BPC = Flow of commercial bank loans to the private sector

BOP = (1-L) NFA = Balance of payments surplus

RESM = Residual.

Capital gains due to changes in the exchange rate have been included in RESM.

Assuming that the OTHER components are constant in the short run, then there are three sources of change in the money supply: changes in foreign assets, credit to government, and credit to the private sector. Foreign assets are usually not under the control of the monetary authorities. In most developing countries, money supply control policies are usually directed through controls in credit to the government and credit to the private sector. To reduce the money supply, for example, credit to the government may be reduced through budget austerity programs or tax increases to reduce budget deficit. Credit to the private sector is usually controlled through a credit ceiling.

For empirical studies, the money supply is commonly specified through its relationship with the monetary base. The reason for this is that the central banks usually control the money supply by controlling the monetary base or the money multiplier.

In an open economy, the monetary base is directly related to the balance of payments. This can be easily shown by rearranging the monetary authorities' balance sheet identity (1):

$$BASE = CC + RES = NFER + NGL + CBC + CDC + RESB \qquad (7)$$

where: BASE = Monetary base

NFER = CFA - CFL = Net foreign exchange reserve

NGL = Net government liability to the central bank

RESB = COA - CCAP - CAL .

The balance of payments is identical with the change in the net foreign assets of the monetary authorities.

The monetary base can be linked to the money supply either through the familiar multiplier approach (Luckett, 1984) or behavioral equation (Brunner and Meltzer, 1968). The multiplier formula is:

$$M2 = \frac{1+K}{RD + K + X + T \cdot RT} BASE \qquad (8)$$

where: M2 = Broad money

K = Currency-demand deposit ratio

T = Time - demand deposits ratio

X = Excess reserve - demand deposit ratio

RD = Required reserve ratio for demand deposit

RT = Required reserve ratio for time deposit.

The main problem with the multiplier formula is the possibility that the multiplier is not stable. Accordingly, each ratio, K, T, and X, should be specified with a behavioral

equation (Aghevli, 1977; Nasution, 1982). A simpler way to specify the money supply may be by formulating a behavioral equation (Brunner and Meltzer, 1968; Argy, 1985).

Reserves may be divided into two components, required reserves and excess reserves. For consistency with the next derivation, both broad money and reserves will be defined in real terms:

$$M2R = CCR + DDR + TDR \quad (9)$$

$$RESR = RA\ (DDR + TDR) + ERR \quad (10)$$

where: M2R = Broad money in real terms

CCR = Currency in circulation in real terms

DDR = Demand deposits in real terms

TDR = Time deposits in real terms

ERR = Excess reserves in real terms

RESR = Reserves in real terms

RA = The average required reserve on total deposits.

The desired holding of excess reserves is assumed to be a function of total deposits and opportunity cost. The demand for real currency is a function of expected inflation and real gross domestic product.

$$ERR = e_0 - e_1\ INT + e_2\ (DDR+TDR) \quad (11)$$

$$CCR = c_0 - c_1\ IFE + c_2\ GDPR \quad (12)$$

where: INT = Interest rate

IFE = Expected inflation

GDPR = Real gross domestic product.

From (10) and (11), total reserves may be rewritten as:

$$RESR = e_0 - e_1\ INT + R(DDR+TDR) \quad (13)$$

where: $R = RA + e_2$

Clearly, R must be less than one because not all additional deposits would be deposited at the central bank as reserves.

By rearranging (9), (12), and (13), one can easily find that

$$M2R^s = 1/R(c_0R - c_0 - e_0 + BASER + c_1 (1-R) IFE$$
$$- c_2 (1-R) GDPR + e_1INT) \quad (14)$$

where: BASER = CCR + RESR = Monetary base in real terms.

Equation (14) is the long-run money-supply function consistent with desired excess reserve and the demand for currency. Clearly, the long-run money supply is positively related to the monetary base, expected inflation and interest rate, but negatively related to gross domestic product.

Due to various constraints, particularly government credit controls, the long run money supply may not be achieved at any moment of time. Assuming that the adjustment process toward the long run money supply is adaptive, the money supply may be written as:

$$M2R_t = m(M2R_t^s - M2R_{t-1}) + M2R_{t-1} \quad (15)$$

The adjustment coefficient, m, is dependent on the government is credit controls. The primary purpose of the credit controls is to reduce inflation. Therefore, the speed of adjustment would be negatively related to inflation. That is, the credit control would be more restrictive when inflation is increasing. As credit falls, excess reserves will increase and the money supply will fall. The demand for money increases with gross domestic product. The speed of adjustment would be positively related to real gross domestic product if the government accommodates the increase in the demand for money. Hence, the speed of adjustment is assumed a function of expected inflation and real gross domestic product:

$$m = m_0 - \frac{m_1 IFE}{M2R^s_t - M2R_{t-1}} + m_2 \frac{GDPR}{M2R^s_t - M2F_{t-1}} \qquad (16)$$

From (14) - (16), the money supply function may be written as:

$$M2R_t = 1/R(m_0(c_0R - c_0 - e_0) + m_0 BASER_t + m_0 e_1 INT_t$$
$$+ (m_0c_1 - m_0c_1R - m_1R)IFE_t + (m_0c_2R - m_0c_2 + m_2R)GDPR_t$$
$$+ (1-m_0)M2R_{t-1}) \qquad (17)$$

The sign for both expected inflation and real gross domestic product become ambiguous. If m_1 is large enough, the coefficient for expected inflation will be negative. If m_2 is large, the coefficient for real gross domestic product will be positive.

For empirical estimation, the opportunity cost of holding reserves will be represented by the foreign interest rate. There are no government bonds, and the capital market is still underdeveloped. Expected inflation will be represented by the current inflation rate.

Mathematical Presentation of the Model

This section discusses the specification of the Indonesian monetary sector model. The discussion includes derivation of each behavioral equation, its independent variables, and expected directional relationship with the independent variables. The summary of the model is presented in Table 8. All equations are in general form. The actual form will be determined by empirical results.

Equations (18)-(21) are demand functions for currency in circulation, demand deposit, saving and time deposits, and foreign currency (dollar) deposits, respectively. Traditionally, the demand for real financial assets is assumed to be a function of the return

Table 8. Mathematical structure of the Indonesian monetary sector model (See Appendix I for variable names)

CCR = CCR(IFE, GDPR, LAG(CCR), S1, S2, S3)	(18)
DDBR = DDBR (IFE, GDPR, LAG(DDBR), S1, S2, S3)	(19)
STR = STR(IFE, DRN, MAR, LAG(STR), S1, S2, S3)	(20)
FDBR = FDBR(EDE, D, LIB, MAR, LAG(FDBR))	(21)
M2R = M2R(IFA, LIB, BASER, GDPR, LAG(M2R), S1, S2, S3)	(22)
LOANR = LOANR(IFA, (DDBR + STR + FDBR + BGD/CPI + CBC/CPI), GDPR, LAG(LOANR))	(23)
NOXPD = NOXPD(PWNO/CPI, GDP)	(24)
EXSVD = EXSVD(FNP, LAG(EXSVD))	(25)
IMPD = IMPD(PWIM/CPI, GDP)	(26)
OITID = OITID(OXPD, LAG(OITID))	(27)
TIPD = TIPD(IMPD, GDP-TAX)	(28)
OIMSVD = OIMSVD(IMPD, LAG(OIMSVD))	(29)
TPCR = TPCR(EDE, LIB,(OXPD + NOXPD - IMPD/ CPI, GDPR, LTSLR)	(30)
DGC = DGC(BOP, DIF(CBC), DIF(CDC), DIF(OCDC))	(31)
PWNO = PWNO(CPIW*EXC, LAG(PWNO))	(32)
PWIM = PWIM(CPIW*EXC, LAG(PWIM))	(33)
INVR = INVR(DIF(GDPR), (DIF(LOAN + CDC) + FDID)/CPI, LAG(INVR))	(34)
GDPR = CDPR(KPS, GES/CPI)	(35)
TAX = TAX(GDP, LAG(OXPD))	(36)
M2R = CCR + DDBR + STR	(37)
CPI = LAG(CPI) + IFA	(38)

Table 8. (continued)

$$BOP = OXPD + NOXPD + EXSVD + TPCR*CPI + FDID + AID - IMPD - TIPD - OITID - OIMSVD + RESB \quad (39)$$

$$BASE = BOP - DGC + DIF(CBC) + DIF(CDC) + DIF(OCDC) + LAG(BASE) \quad (40)$$

$$GDP = GDPR*CPI \quad (41)$$

$$MAR = CCR + DDBR + STR + FDBR \quad (42)$$

$$LOAN = LOANR*CPI \quad (43)$$

$$GES = TAX + AID - DGC + RESG \quad (44)$$

from holding the asset, its opportunity cost, and a scale variable. The scale variable may be considered as a proxy variable for transaction needs or as a constraint on holding the asset. The most commonly used scale variables are income and wealth. For Keynesians who argue that the motive of holding money is for transactions and speculation, then the national income would be the appropriate variable to proxy the volume of transactions. Monetarists, on the other hand, argue that money is a financial asset that produces services. Total wealth would be the constraint of holding various assets (Friedman, 1956). Whether income or wealth should be used in the financial assets demand function is really an empirical matter. Income may be more appropriate for assets which are primarily used for transactions whereas total wealth may be more appropriate for assets which are used primarily as a store of value. For currency in circulation and demand deposits, income should be more appropriate for scale variables, since they are primarily used for transactions. Dollar deposits are not readily applicable for transactions. They are primarily used to earn interest. Total financial wealth may be more appropriate as a constraint on holding dollar deposit. Saving and time deposits are not directly applicable for transactions purposes, but may be more liquid than dollar deposits. Either income or total financial wealth may be appropriate as a scale variable for saving and time deposits.

Alternative financial assets such as securities are not available. The inflation rate is very high. Expected inflation, therefore, would represent the opportunity cost of holding domestic monetary assets. Expected inflation is expected to be negatively related to the demand for each of the monetary assets. For dollar deposits, expected inflation would be reflected in expected devaluation. Expected devaluation is measured as the average change in the real exchange rate. The real exchange rate is defined as

$$RER = EXC * CPIW/CPI \tag{45}$$

where: RER = Real exchange rate

EXC = Exchange rate

CPI = Consumer price index

CPIW = Trade-weighted foreign price index

Equation (45) is differentiated to get the percentage change in real exchange rate:

$$DEVR = ADE + INF - IFA \quad (46)$$

where: DEVR = Change in real exchange rate (%)

ADE = Actual devaluation (%)

INF = Foreign inflation (%)

IFA = Domestic inflation (%)

An increase in the real exchange rate reflects an undervaluation of the currency. Revaluation returns the exchange rate towards its original value. Assuming that the government is committed to maintain the real exchange rate, expected devaluation may be proxied by the negative average change in the real exchange rate:

$$EDE = -(DEVR + LAG(DEVR) + LAG2(DEVR) + LAG3(DEVR))/4 \quad (47)$$

where: EDE = Expected devaluation.

Expected devaluation represents the expected capital gain from holding dollar deposits. Expected devaluation, therefore, should be positively related to the demand for dollar deposit. The opportunity cost of holding dollar deposits would be the foreign dollar deposit interest rate, such as the London eurodollar deposit rate. Data for the interest rate on dollar deposits are not available. Demand for dollar deposit is expected to be positively related to expected devaluation and total monetary wealth, and negatively related to eurodollar deposit rate. A dummy variable for the adoption of the managed basket peg is also included. It is expected to have a positive sign since the exchange rate is changed more frequently.

Currency in circulation and demand deposits do not have interest earnings. Their demand functions, therefore, are expected to be negatively related to expected inflation, and positively related to gross domestic product. Dummy variables are also included to capture seasonality. The demand for saving and time deposit is expected to be negatively related to expected inflation and positively related to deposit interest rates and gross domestic product. Seasonal dummies are also included. A lagged endogenous variable is also included in each equation following the familiar partial adjustment process. The coefficient for the lagged endogenous variable should be positive and less than one.

Equation (22) is the money supply function. The function is derived and explained in the previous section (17). Dummy variables are included to capture seasonality.

Commercial bank loans to the private sector are specified by equation (23). The function is derived on the assumption that the loan is supply determined, but constrained by government credit controls. As mentioned earlier, the credit control is dependent on inflation and real gross domestic product. Credit controls would be tightened during a high inflation. Real gross domestic product represents demand pressure. The government may accommodate the increase in demand for credit as real production is increasing.

The loan supply is a function of loanable funds which consists of bank deposits and central bank advances. There are four banks deposits: demand deposits, time and saving deposits, dollar deposits, and the government deposit. In real values, the supply may be written as:

$$LOANR^S = e_0 + e_1\, TTDR \qquad (48)$$

where: $LOANR^S$ = Desired loan supply in real terms

TTDR = Total loanable funds in real terms.

A loan rate is not included in the supply function since it is determined by the government. The loan rate structure is very complicated. The loan rate is very low.

Due to government restrictions, commercial banks can not lend as much as they wish. The actual loan, therefore, is assumed to be the result of some partial adjustment process.

$$LOANR = C(LOANR^S - LAG(LOANR)) + LAG(LOANR) \quad (49)$$

The speed of adjustment C, is a function of government credit controls. Specifically, it is assumed to be a negative function of inflation because the government controls would be tightened during a high inflation, and a positive function of real gross domestic product because the government may accommodate the increase in loan demand:

$$C = c_0 - (c_1 IFA - c_2 GDPR)/(LOANR^S - LAG(LOANR)) \quad (50)$$

Real commercial bank loans, therefore, can be written as:

$$LOANR = e_0 c_0 + e_1 c_0 TTDR - c_1 IFA + c_2 GDPR + (1-c_0) LAG(LOANR) \quad (51)$$

Equation (24) is the merchandise non-oil export function. It is positively related with the relative price of exports to the consumer price index, and with gross domestic product which represents the capacity to export. Oil export is assumed exogenous since it's determined by world demand and OPEC regulations. Export of services is represented by Equation (25). Export of services primarily consists of tourism and investment income. It is, therefore, highly dependent on the economic situation in developed countries. Export of services is expected to be positively related with the index of industrial production in OECD countries (Organization for Economic Cooperation and Development). Disaggregated data for export of services are not available.

The merchandise import function is represented by Equation (26). Naturally, merchandise imports will be positively related to gross national product to satisfy the increase in both consumption and factor-of-production needs. With regard to relative prices, however, the sign is ambiguous. An increase in the relative price of imported goods will

decrease real imports. The value of imports, however, could increase if the demand for real imports is inelastic.

The import of services is divided into three categories: oil investment income transfer, travel and insurance payments, and other imports of services. Oil investment income transfer, equation (27), will clearly be positively related with oil exports. Travel and insurance payments includes passenger services, merchandise freight and insurance fees paid to other countries. Travel abroad depends on disposable income, whereas merchandise freight and insurance fees depend on merchandise imports. Travel and insurance payments, therefore, are expected to be positively related to disposable income and merchandise import. The travel and insurance payment function is presented in equation (28). Other imports of services are expected to be positively related to merchandise imports. Other import of services are given in equation (29).

Net private capital flows, excluding direct investment, are represented by equation (30). Direct investment is assumed exogenous since it may be dependent on long run economic and political situations in both domestic and foreign countries. Various incentives to attract direct foreign investment is difficult to incorporate in an econometric model. Other private capital flows are mainly portfolio investment which is very responsive to a short run economic situation. It fluctuates highly. Hence, it is crucial for economic stabilization.

Non-direct investment capital flows are expected to be negatively related with expected devaluation and foreign interest rates, the balance of trade, and the previous stock of foreign liabilities. Gross domestic product would have an ambiguous sign. Devaluation and foreign interest rate increases would induce domestic residents to buy foreign securities because of their higher returns, and foreigners to divest themselves of domestic securities. The net capital inflow, therefore, will fall. The balance of trade may affect net capital flows through trade credits. Trade credits are especially important for short-run capital flows

(Branson, 1968; Laffer, 1975; Kenen, 1978). These include credits advanced by foreigners to finance imports, and credit advanced by domestic residents to finance exports. An increase in gross domestic product would trigger economic activities and improve foreigners' confidence in the economy. This would increase the need for foreign capital and makes foreigners more willing to lend their capital. In this case, gross domestic product is positively related with net capital inflows. On the other hand, an increase in national income may increase investment abroad and reduce the need for foreign borrowing. In this case, gross national product is negatively related with net capital inflows. An already high amount of foreign liabilities should inhibit further borrowings. Hence, the previous stock of foreign liabilities is negatively related with net capital inflows.

The central bank reaction function to sterilize the effect of the balance of payments on the money supply is represented by equation (31). Sterilization is conducted using the government deposit at the central bank. A similar technique of sterilization is used in other countries like Chile and Brazil (Miller and Askin, 1976). During a balance of payments surplus the government increases its deposit at the central bank. A major portion of the government revenue comes from the oil export tax. Depositing part of the revenue at the central bank prevents it from flowing into the domestic economy, which could cause inflation. The government deposit at the central bank, therefore, is expected to be positively related to the balance of payments. The government deposit at the central bank may also be used to neutralize the effects of other events affecting domestic credit or the money supply. For instance, the government's deposit may be increased if the central bank credit to commercial banks, direct credit to private sector, or other credit is increasing. Accordingly, the government's deposit at the central bank is positively related to the change in central bank claims against commercial banks, against the private sector, or changes in other domestic credits.

Price linkages between domestic and foreign prices of exports and imports will close the external sector. These linkages provide a direct connection between the exchange rate and both exports and imports, as it should be. This direct linkage is missing in some previous models (Nasution, 1982; Aghevli, 1977).

The wholesale price of non-oil exported goods should be positively related with the foreign price index denominated in domestic currency, that is, the weighted foreign price index multiplied by the exchange rate. This relationship is given by equation (32). Similarly, the wholesale price of imported goods should be positively related with foreign prices denominated in domestic currency (33).

The investment function is given by equation (34). This function is essentially a modified flexible accelerator model, to incorporate the institutional characteristics of a developing economy. The neoclassical investment model developed by Jorgenson (1969) may not be appropriate due to various market imperfections such as in the financial and labor markets. For a developing economy like Indonesia, emphasis should be given to financial and resource constraints on capital formation.

The flexible accelerator investment model is derived from two equations. The first is that desired real capital stock (KPS^d) is proportional to real output (GDPR)

$$KPS^d = a\ GDPR \tag{52}$$

The second one is that the change in actual real investment (INVR) is proportional to the difference between the desired ($INVR^d$) and previous actual investment:

$$INVR - LAG(INVR) = b(INVR^d - LAG(INVR)) \tag{53}$$

Following Coen (1973), underlying economic conditions may affect the investment function through the accelerator b. That is, various economic variables may affect the response of investors to the gap between desired and actual investment. One of the main constraints on investment in a developing country is the availability, rather than the cost, of financial

resources (McKinnon, 1973). Specifically, since other sources of external business financing are practically non-existent, the constraint is banking credit. In an open economy, direct foreign investment may also make a significant contribution to this investment function. Real interest rates on bank loans are very low due to government controls. Accordingly, the acceleration coefficient, b, is assumed to be a function of bank credits and foreign direct investment:

$$b = b_0 + b_1(CREDR + FDIR)/(INVR^d - LAG(INVR)) \qquad (54)$$

where: CREDR = real banking system credit to private sector

FDIR = real direct foreign investment

From (52)-(54), the private investment function can be obtained as (see equation 34)

$$INVR = b_1(CREDR+FDIR) + ab_0\Delta GDPR + (1-b_0)LAG(INVR) \qquad (55)$$

Gross domestic product is determined through a production function with capital stock and government spending as inputs (equation 35). Labor is assumed in surplus. (There is no figure on the actual employment.) Government spending is included since it may provide some infrastructure that also contributes to production. Capital stock is defined as accumulated investment. Clearly, both capital stock and government spending should be positively related to gross domestic product.

Government domestic revenue (basically tax revenue) is presented in equation (36). The revenue should be positively related to gross national product. A large amount of government revenue comes from the oil tax. The revenue, therefore, should be positively related to oil exports. Since collections from the oil tax may not be immediate, the oil tax variable is lagged in the tax revenue function. The rest of the equations are identities or definitions to make the model determinate.

CHAPTER IV. EMPIRICAL ANALYSIS

This chapter discusses the estimation and validation of the model. In the estimation section, coefficient estimates and their statistical and theoretical properties will be discussed equation by equation. The tracking performance of the integrated model will be discussed in the validation section. The tracking performance indicates how well the model represents the actual data.

Estimation

The structural model, described in Chapter III, is nonlinear. Some of the behavioral equations are in exponential form (linear in logarithm), whereas some others are in linear form. Some of the identities or definitions are also in multiplicative form. All of these render the model a system of nonlinear equations. Accordingly, the estimation technique used for estimating the parameters is non-linear three stage least squares, N3SLS (Amemiya, 1974; 1977). The parameters are estimated using data from 1976 quarter one to 1983 quarter one. Data sources and transformations are given in Appendix II.

One common problem in the estimation process is autocorrelation. If there is no lagged dependent variable the autocorrelation problem may be checked using the Durbin-Watson (DW) Statistic. D W statistic, however, is biased toward rejecting the existence of autocorrelation if there is a lagged dependent variable. Testing for autocorrelated disturbances in regressions with a lagged-dependent variable requires a large sample to be valid theoretically. Although this study has only 25 net observations (excluding lags), the estimation is conducted as if there were autocorrelation. The autocorrelation correction will be retained if the autocorrelation coefficient is significantly different from zero based upon a t-test..

The autocorrelation coefficient is included in an equation using the following procedure:

$$Y_t = X\beta + U_t$$

$$U_t = bU_{t-1} + e$$

$$E(e) = 0$$

Direct estimation of β is biased because the residual, U, is autocorrelated. Fortunately, with little rearrangement, an estimable form can be found as:

$$Y_t = X\beta + b\,LAG(Y_t - X\beta) + e_t$$

Coefficients β along with the autocorrelation coefficient b can be estimated simultaneously, using the non-linear least squares method.

Since there are not enough observations, lagged dependent variables are not included in the instrumental variables for the first stage of the N3SLS. Trials with principal components instruments were also conducted but did not give satisfactory results.

The functional form and independent variables included in each equation were determined after conducting some experiments. The behavioral equation is selected based on the sign and significance of the coefficients, and the degree of the coefficient of determination (R^2). The estimated coefficients, t-statistics (in parentheses), R-square, and Dubin-Watson Statistic for each of the equations are shown in Table 9. Variables names, descriptions, and their units are given in Appendix I.

Equations (1)-(4) of Table 9 represent demand functions for monetary assets. The statistical properties of these equations are good, with more than 90 percent of the variation in the demand for monetary assets explained by their respective equations. All coefficients have the correct sign and are significant at the 5 percent level except the intercept for currency in circulation and some of the seasonal dummies. It should also be mentioned that the scale

Table 9. Estimated model of the Indonesian monetary sector

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(1) LOG(CCR) = -0.13248 - 0.0128IFA + 0.23735 LOG(GDPR)
(-1.12) (-6.33) (4.17)

+ 0.66148 LAG(LOG(CCR)) - 0.02627 S1 + 0.05195 S2
(9.26) (-1.60) (3.38)

+ 0.1945 S3
(1.26)

$R^2 = 0.9645$ DW = 2.227

(2) LOG(DDBR) = -0.59028 - 0.01217 IFA + 0.27293 LOG(GDPR)
(-3.29) (-2.70) (4.35)

+ 0.81778 LAG(LOG(DDBR)) + 0.02692 S1
(19.04) (1.1)

+ 0.07380 S2 + 0.03467 S3
(2.95) (1.42)

$R^2 = 0.9735$ DW = 2.183

(3) LOG(STR) = -0.29178 - 0.00945 IFA + 0.00928 DRN + 0.14548 LOG(MAR)
(-2.89) (-4.27) (3.21) (5.17)

+ 0.84012 LAG (LOG(STR)) + 0.02643 S1 + 0.04978 S2
(20.12) (2.30) (4.24)

+ 0.01589 S3
(1.35)

$R^2 = 0.9722$ DW = 1.675

(4) LOG(FDBR) = -1.86271 + 0.03205 EDE - 0.02488 LIB + 0.88761 D
(-3.07) (4.57) (-4.08) (7.40)

+ 0.66420 LOG(MAR) + 0.29729 LAG(LOG(FDBR))
(3.40) (2.77)

$R^2 = 0.9369$ DW = 2.027

Table 9. (continued)

(5) M2R = -4.36627 - 0.26433 IFA + 0.76622 BASE/CPI + 0.80394 LAG(M2R)
(-4.57) (-4.82) (7.72) (26.98)

1.055139 S1 + 1.45631 S2 + 0.48094 S3
(3.45) (4.66) (1.56)

R^2 = 0.9927 DW = 2.535

(6) LOANR = 0.038238 + 0.12755(DDBR + STR + FDBR + BGD/CPI + CBC/CPI)
(0.70) (4.36)

- 0.18158 IFA) + 0.88521 LAG(LOANR)
(-3.46) (19.74)

R^2 = 0.9896 DW = 1.931

(7) LOG(NOXPD) = 3.76269 + 1.56332 LOG(PWNO/CPI) + 1.56332 LOG(GDP)
(10.01) (18.18) (2.31)

R^2 = 0.9103 DW = 1.425

(8) LOG(EXSVD) = -12.30556 + 2.67588 LOG(FNP)
(-2.39) (2.43)

+ 0.90541 LAG(LOG(EXSVD))
(19.850)

R^2 = 0.9679 DW = 1.724

(9) LOG(IMPD) = -3.02993 + 0.15001 LOG(PWIM/CPI) + 1.13530 LOG(GDP)
(-6.29) (0.41) (19.22)

R^2 = 0.9228 DW = 1.887

(10) LOG(OITID) = -1.94675 + 0.72356 LOG(OXPD) + 0.36338 LAG(LOG(OITID))
(-3.42) (4.44) (2.75)

R^2 = 0.9638 DW = 2.065

(11) TIPD = 16.00833 + 0.11875 IMPD + 0.00204 (GDP - TAX)
(6.22) (43.35) (2.49)

R^2 = 0.9986 DW = 2.152

Table 9. (continued)

(12) LOG(OIMSVD) = -0.78819 + 0.43227 LOG(IMPD) + 0.55820 LAG(LOG(OIMSVD))
(-0.77) (1.69) (2.86)

R^2 = 0.8145 DW = 1.747

(13) TPCR = -1.30964 - 0.04032 EDE - 0.15692 LIB - 0.28446 LAG((OXPD + NOXPD - IMPD)/CPI) + 0.07749 GDPR - 0.02977 LTSLR - 0.44141 LAG(RES[a])
(-2.95) (-2.31) (-4.51) (-6.36) (6.85) (-4.53) (-2.53)

R^2 = 0.6465 DW = 2.147

(14) DGC = -49.7886 + 0.80784 BOP + 0.80406 DIF(CBC) + 0.6661 DIF(CDC) + 0.89009 DIF(OCDC) - 0.74917 LAG(RES[a])
(2.42) (15.40) (8.95) (6.59) (11.58) (-4.57)

R^2 = 0.8499 DW = 1.832

(15) LOG(PWIM) = -2.00382 + 0.40508 LOG(EXC*CPIW) + 0.56767 LAG(LOG(PWIM))
(-13.51) (14.836) (19.35)

R^2 = 0.9986 DW = 1.806

(16) LOG(PWNO) = -7.20298 + 1.00528 LOG(EXC*CPIW) + 0.34791 LAG(LOG(PWNO)) + 0.78871 LAG(RES[a])
(7.304) (8.842) (3.963) (6.9089)

R^2= 0.9129 DW = 0.497

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[a]RES = Residual of corresponding regression (actual minus predicted value).

Table 9. (continued)

(17) INVR = 0.16561 DIF(GDPR) + 0.13839(DIF(LOAN + CDC) + FDID)/CPI
(17.32) (2.63)

+ 0.98028 LAG(INVR)
(69.52)

$R^2 = 0.9697$ DW = 2.900

(18) LOG(GDPR) = 2.56486 + 0.11397 LOG(KPS) + 0.33368 LOG(GES/CPI)
(34.56) (5.30) (10.09)

$R^2 = 0.9394$ DW = 2.440

(19) TAX = -310.83 + 0.17367 GDP + 0.38761 LAG(OXPD) - 0.52165 LAG(RES[a])
(-3.07) (5.78) (2.97) (-3.67)

$R^2 = 0.9466$ DW = 2.238

(20) M2R = CCR + DDBR + STR

(21) KPS = Σ INVR

(22) CPI = LAG(CPI) + IFA

(23) BOP = OXPD + NOXPD + EXSVD + TPCR*CPI + FDID+ AID - IMPD - OITID -
OIMSVD + RESB

(24) BASE = BOP - DGC + DIF(CBC) + DIF(CDC) + DIF(OCDC) + LAG(BASE)

(25) GES = TAX + AID - DGC + RESG

(26) MAR = CCR + DDBR + STR + FDBR

(27) GDP = GDPR*CPI

(28) LOAN = LOANR*CPI

(29) M2 = M2R*CPI

variable used for the demand functions for saving and time deposits (3) and dollar deposits (4) is total real monetary assets. These two assets are held mainly for their returns.

The deposit interest rate is a significant determinant of the holding of saving and time deposits. This confirms that the interest rate is very important for domestic saving mobilization.

The deposit interest rate, however, is not significant in the demand functions for currency in circulation, demand deposits, and dollar deposits. This may be in part due to the small variability in the deposit interest rate. In addition, inflation is very high. Inflation, therefore, dominates the opportunity costs of holding these assets. With regard to dollar deposit, inflation is implicitly included in the expected devaluation proxy.

After some experimentations, the best fit for representing expected inflation for currency in circulation is lagged inflation, whereas for demand deposits, and saving and time deposits it is current inflation. One possible explanation for this is the fact that demand deposits and saving and time deposits are held by the more modern segment of the population who have various means of transforming monetary assets to others assets. They also have access to current information and are able to analyze it. Hence, they would be more able to anticipate the current inflation rate and respond accordingly.

Foreign currency (dollar) deposits are responsive to both the foreign interest rate and expected devaluation. A similar result was also found by Boediono (1985). Foreign interest rate and expected devaluation, therefore, may serve as channels through which world economic disturbances affect the domestic economy.

The money supply function is represented by equation (5). The foreign interest rate is used as a proxy for the opportunity cost of holding excess reserves, but was not significant. Real gross domestic product was not significant either. Both foreign interest rate and real gross domestic product, then, were dropped from the equation.

Inflation has a negative coefficient and is significant at the 1 percent level. This may indicate strong government control during high inflation. As it has been shown in Chapter III, if there were no government credit control then the money supply might have been positively related to inflation. As expected, both the real monetary base and lagged dependent variable have positive coefficients and are significant at 1 percent level. The money supply function also has a very high R^2 (0.9927).

The banks loan function is given by equation (6). All of the coefficients have the expected sign. Loanable funds (bank deposits and borrowing from the central bank) and lagged dependent variable have positive coefficients and are significant at the 5 percent level. This indicates the importance of bank deposits for bank loans. Consistent with the money supply function, discussed previously, inflation has a negative coefficient and is significant at the 5 percent level. That is, as inflation increases, the government tightens credit controls, hence both bank loans and the money supply fall. The loan function has a very high R^2 (0.9896).

Non-oil merchandise exports are given by equation (7). All of the coefficients are significant at 5 percent level and have the correct sign. The coefficient of determination is high ($R^2 = 0.9103$).

The export of services is modeled by equation (8). All coefficients have the correct sign and are significant at the 5 percent level. The coefficient of determination is quite high ($R^2 = 0.9679$).

Imports of merchandise goods is represented by equation (9). The coefficient for the relative price of wholesale imports to the consumer price index is positive but not significant. A similar result was also found by Nasution (1982). Gross domestic product has a positive coefficient and is significant at the 1 percent level. More than 90 percent of the variation is explained.

Oil investment income transfers are shown in equation (10) in Table 9. All statistical properties of the equation are good. All coefficients have the expected sign and are significant at the 5 percent level.

Equation (11) represents transportation and insurance payments abroad. All coefficients are significant at the 5 percent level with the expected sign. The equation explains 99.9 percent of the data variation.

Other import of services is represented by equation (12). Both merchandise imports and lagged dependent variable are significant at the 10 percent level with the correct sign. The coefficient of determination, R^2, is reasonably high (0.8145).

Private capital inflows excluding foreign direct investment are given by equation (13). All of the coefficients have the expected sign and are significant at the 5 percent level. The autocorrelation coefficient is rather high, 0.4414. The coefficient of determination is low, only 0.6465. Clearly, private capital inflow is difficult to model, perhaps due to the difficulty of finding expected devaluation and investment risk proxies. As already mentioned, private capital flows are very volatile. They are highly affected by speculation about the value of the exchange rate and foreign interest rates.

Equation (14) is the policy reaction function to the balance of payments and domestic credits. The function represents the way that the government deposit at the central bank may be changed in response to balance of payments and other domestic credits changes. The function shows that the government sterilizes 80 percent of the balance of payments effect on the monetary base. This is similar to Djiwandono (1980) finding of 84 percent. The equation also shows that the government deposit at the central bank is partly intended to neutralize other domestic credit effects on the monetary base. The coefficients are different for different domestic credits. All the coefficients are significant at the 1 percent level, including autocorrelation. It should be also mentioned that inflation, the government budget

deficit, and a change in real gross domestic product were initially included in the model. All of them, however, were not significant, and hence were dropped. The coefficient of determination is reasonably high ($R^2 = 0.8499$).

Equations (15) and (16) are the price linkages for merchandise imports and non-oil exports, respectively, to world prices. All statistics are good. Coefficients are of expected sign and significant at the 1 percent level. The autocorrelation coefficient for nonoil merchandise export is also significant.

The investment function is given by equation (17). As can be seen, real investment is dependent on real banking loans and direct foreign investment. This indicates that financing is crucial for investment. This supports the hypothesis that bank loans are one of the most direct channels for monetary policy to affect the real sector of the economy. All coefficients of the investment function are significant at the 1 percent level. The coefficient of determination is also very high ($R^2 = 0.9677$).

The production function is represented by equation (18). All of the coefficient are significant at the 1 percent level and of expected sign. The function explained 94 percent of variation in real gross domestic product.

The domestic revenue function is given by equation (19). All of the coefficient are significant at the 1 percent level. The autocorrelation coefficient is also significant. The coefficient of determination is high ($R^2 = 0.9466$).

The rest of the equations in Table 9 are identities or definitions. The model is determinant.

In summary, the statistical properties of each of the equations in the model are generally good. Only one equation, the private capital inflows equation, has a rather low coefficient of determination.

Validation

Tracking performance validation is an examination of the predictability of the model. In this instance, a historical simulation of the model is compared to actual data by using some statistical criteria.

There are two types of simulations, static and dynamic. In static simulation the actual values are used for the lagged endogenous variables. In the dynamic simulation, on the other hand, the solution values of the model will feed the lagged endogenous variables. Naturally, the dynamic simulation will have larger errors than the static simulation. In addition to errors due to the inability of the model to predict economic events in any particular period, also true in static simulation, the dynamic simulation also has errors due to its inability to predict the lagged endogenous variables. Clearly, the errors may be accumulated over time.

Various statistics have been proposed as criteria for predictive performance of an econometric model (Klein, 1983; Theil, 1965; 1966). Among the common ones are root mean square errors (RMSE), root mean square percentage errors (RMSPE), and Theil inequality (U). These statistics are defined as follows:

$$\text{RMSE} = \sqrt{\frac{1}{T}\sum_{t=1}^{T}(P_t - A_t)^2} \tag{30}$$

$$\text{RMSPE} = 100\sqrt{\frac{1}{T}\sum_{t=1}^{T}((P_t - A_t)/A_t)^2} \tag{31}$$

$$U = \frac{\sqrt{\frac{1}{T}\sum_{t=1}^{T}(P_t - A_t)^2}}{\sqrt{\frac{1}{T}\sum_{t=1}^{T}P_t^2} + \sqrt{\frac{1}{T}\sum_{t=1}^{T}A_t^2}} \tag{32}$$

T = Total number of observations

P = predicted value

A = Actual value.

In all of the above criteria, the smaller the value the better is the model performance. The U value ranges between zero and one.

Another important measure for tracking performance is how weil the model simulates actual turning points. Most economic time series exhibit positive serial correlation. For a model to be superior to a simple time-trend model, it must predict turning points. The number of turning point errors (TPE), therefore, is also widely used as an indicator for tracking performance.

The Theil U statistic has a fundamental shortcoming. The statistic, which is intended to measure prediction error is dependent on the prediction itself. It can be seen from equation (32) that the predicted value is in the denominator. The U statistic, therefore, can not be used as a criterion of comparing and ranking alternative models. To solve this problem, Theil (1966) proposed a modification to his earlier U statistic as

$$U1 = \sqrt{\frac{\sum_{t=1}^{T} ((P_t - A_{t-1}) - (A_t - A_{t-1}))^2}{\sum_{t=1}^{T} (A_t - A_{t-1})^2}} \qquad (33)$$

U1 is bounded by zero, if there is a perfect forecast. Its upper limit, however, is infinity. U1 equals 1 if the prediction value is the naive previous observation.

For more detailed information about the sources of errors, the mean square error can be decomposed into three components (Pindyck and Rubinfield, 1981):

$$UM = T\,(PM - AM)^2 / \sum_{t=1}^{T} (P_t - A_t)^2 \quad (34)$$

$$US = T(SP - SA)^2 / \sum_{t=1}^{T} (P_t - A_t)^2 \quad (35)$$

$$UC = 2T(1 - r)SP\,SA / \sum_{t=1}^{T} (P_t - A_t)^2 \quad (36)$$

$$UM + US + UC = 1 \quad (37)$$

where: PM = Mean of prediction values

AM = Mean of actual values

SP = Standard deviation of predicted values

SA = Standard deviation of actual values

r = Coefficient correlation between the actual and predicted values.

UM is the biased proportion. It indicates systematic error of the model since it measures the deviation of the average prediction from the average actual value. A good model has a small value for UM. If prediction is perfect then UM = 0.

US is the variance proportion. It indicates the ability of the model to replicate the variability of the actual values. It is desirable to have a small value for US. Since there is no a priori reason to insist that the two variances should be equal, US is not very meaningful information (Maddala, 1977).

UC is the covariance proportion. It measures unsystematic error. This component of error is not worrisome. Ideally, all error is distributed to UC.

The mean square error can also be decomposed into another set of components (Theil, 1966):

$$UR = T(SP - rSA)^2 / \sum_{t=1}^{T} (P - A)^2 \quad (38)$$

$$UD = T(1 - r^2)SA^2 / \sum_{t=1}^{T} (P - A)^2 \quad (39)$$

$$UM + UR + UD = 1 \quad (40)$$

This latter decomposition, perhaps, is more useful than the previous one since US does not have a meaningful interpretation. All components of the latter decomposition have a unique interpretation. UM is the systematic bias component, as previously discussed. UR is the regression component which indicates the deviation of the slope of a regression of the actual values on the predicted values. Clearly, if the prediction is perfect, then the slope of the regression (rSA/SP) will take a value of one and there will be no intercept. In this instance, both UM and UR will vanish. Accordingly, a good model should have a small value for both UM and UR, and a high value for UD. UD is the residual component that captures unsystematic errors.

The model is dynamically simulated over the first quarter 1977 to the first quarter 1983 period. The model is quite stable, its average iteration is only 3.56. Validation statistics are given in Table 10, whereas mean square error compositions are given in Table 11.

As is shown in Table 9, some behavioral equations in the model are linear in the logarithms. Using their transformed equations directly for the simulation is biased. To demonstrate this, first consider the presumed true model.

$$LOG(Y) = b_o + b_1X + a$$

where: a = residual, normally distributed.

This equation can be transformed to get a multiplicative equation

$$Y = EXP(b_0 + b_1X)*U$$

$$U = EXP(a)$$

Table 10. Validation statistics of the Indonesian monetary sector model 1977QI-1983QI dynamic simulation[a]

Variables	RMSE	RMSPE	U1	U	TPE
CCR	0.703	8.066	0.077	0.039	4
DDBR	1.475	11.78	0.124	0.064	6
STR	0.704	8.92	0.093	0.047	6
FDBR	0.578	12.77	0.1541	0.080	4
M2	415.1	5.294	0.067	0.034	2
GDPR	6.175	15.57	0.123	0.062	7
INVR	1.063	12.27	0.099	0.049	6
CPI	12.51	6.524	0.062	0.031	6
TAX	420.5	20.74	0.174	0.088	7
IMPD	370.1	23.49	0.177	0.090	10
NOXPD	168.9	22.56	0.239	0.126	10
EXSVD	37.00	38.80	0.241	0.127	3
OITID	27.55	14.11	0.100	0.050	6
TIPD	46.39	21.10	0.166	0.084	7
OIMSVD	77.67	35.69	0.258	0.137	8
TPCD	165.3	1500	0.829	0.452	4
PWNO	89.17	13.44	0.139	0.071	4
PWIM	6.314	1.489	0.017	0.008	0
LOANR	2.090	8.367	0.075	0.038	4
GES	681.4	40.56	0.257	0.129	8
M2R	2.547	9.025	0.090	0.046	7

[a]Variable name definitions are given in Appendix I.

U is lognormally distributed.

The mean of Y is:

$$E(Y) = EXP(b_0 + b_1X)E(U)$$

$$= EXP(b_0 + b_1X + 1/2\sigma^2)$$

Clearly, a transformed equation like $Y = EXP(b_0 + b_1X)$, is biased. Accordingly, all loglinear equations used in the simulation are transformed following:

$$Y = e^{X\beta + 1/2\,MSE}$$

where: MSE = Mean square errors of the estimated function

Most variables have a low RMSPE. Out of 21 variables presented in Table 10, only 4 variables have an RMSPE higher than 25 percent—namely, TPCD, GES, EXSVD, and OIMSVD. These four variables also have the highest U1 and U values. These variables are very volatile. Clearly, they are very difficult to model. Most of the errors, however, are unsystematic (Table 11). Table 11 shows that all of the four variables have a UM of less than 0.1. Their UR and US are lower than 0.2.

None of the variables has a U1 higher than one. Only 5 variables have a U1 higher than 0.2, namely, TPCD, GES, EXSVD, OIMSVD, and NOXPD.

U is very low for most variables. It is less than 0.1, except for TPCD, GES, EXSVD, OIMSVD.

The turning points errors are reasonable in number. There are only four variables with more than 7 (28 percent) turning points error: IMPD, NOXPD, OIMSVD, and GES. IMPD and NOXPD, however, have very good performances judged by other criteria.

Error composition shows that almost none of the endogenous variables suffer from systematic error. All variables except M2 have a UM of less than 0.2. UR is also always less than 0.2 except for M2 and GDPR. GDPR, however, has a very low US, which is 0.058. Among all variables, only M2 and EXSVD have a US higher than 0.15. M2,

Table 11. Mean square errors decomposition proportions[a]

Variables	UM	UR	UD	US	UC
CCR	0.047	0.181	0.772	0.048	0.905
DDBR	0.169	0.028	0.803	0.110	0.721
STR	0.065	0.057	0.878	0.005	0.930
FDBR	0.060	0.050	0.890	0.137	0.803
M2	0.390	0.380	0.229	0.404	0.205
GDPR	0.012	0.239	0.749	0.058	0.930
INVR	0.002	0.062	0.936	0.001	0.997
CPI	0.002	0.003	0.995	0.007	0.991
TAX	0.011	0.000	0.989	0.039	0.950
IMPD	0.015	0.014	0.971	0.008	0.977
NOXPD	0.167	0.040	0.793	0.016	0.817
EXSVD	0.009	0.174	0.817	0.331	0.661
OITID	0.002	0.195	0.802	0.123	0.875
TIPD	0.020	0.015	0.965	0.007	0.973
OIMSVD	0.094	0.013	0.892	0.147	0.759
TPCD	0.004	0.084	0.913	0.037	0.959
PWNO	0.133	0.183	0.683	0.074	0.792
PWIM	0.009	0.002	0.988	0.000	0.990
LOANR	0.059	0.036	0.905	0.002	0.939
M2R	0.139	0.003	0.858	0.019	0.845
GES	0.005	0.067	0.928	0.000	0.995

[a]Variable name definitions are given in Appendix I.

however, has a very low RMSPE, U1, U, and TPE. EXSVD has a good performance based on TPE, U, and U1 criteria.

The stability of the model is tested by its ability to converge from various initial periods and its response to a one-period exogenous shock. If the model is stable, initial period changes would not significantly affect the convergeability of the model. If the fluctuation response to a one-period exogenous shock is decreasing as time passes, then the model is stable.

The model is simulated using the first quarter of 1979 and 1980 as initial points. The first simulation converges with 3.06 average iterations whereas the second one converges with 3.54 average iterations. As already mentioned, simulation using the whole data set (starting from the first quarter of 1977) converges with 3.56 average iterations. Clearly, the model is stable based on the different initial values convergeability criterion.

The exogenous variable shock test is conducted by the increasing exchange rate in the first quarter of 1980 by 20 percent. The percentage change in selected endogenous variables as the result of the exchange rate shock is given in Table 12. It can be seen that the impacts of the shock are damped over time. The model, therefore, is stable.

Overall, the model's performance is satisfactory. The relationships among all variables are consistent with prior economic expectation. The tracking performance is also good. More importantly, the model tracks the key variables, such as GDPR, CPI, INVR, NOXPD, IMPD, LOANR, FER, and M2, well. The model is also stable.

Table 12. Impacts of 20 percent increase in exchange rate in the first quarter of 1980 (percent change)[a]

Quarter	GDPR	IMPD	NOXPD	CPI	FER
1980 (1)	-0.0424	-1.3618	27.8846	2.5008	12.1230
(2)	1.2153	5.6196	5.0917	3.5810	3.8315
(3)	0.1982	2.7930	0.2747	2.2294	2.3363
(4)	-0.4877	-0.2741	1.0454	0.0788	4.2262
1981 (1)	0.0450	-1.4158	2.8198	-1.5131	5.4188
(2)	-0.5837	-1.8158	1.9275	-1.2438	6.3134
(3)	1.4718	2.1209	-0.3914	0.4102	3.6743
(4)	0.6607	2.6682	-2.6369	1.9108	1.2688
1982 (1)	0.1316	2.0336	-2.6837	1.8975	-1.0314
(2)	-0.1399	0.0255	-0.2754	0.1810	-0.9450
(3)	-2.2265	-2.9410	0.4043	-0.4377	1.1376
(4)	-0.0798	-0.5800	0.7244	-0.4997	1.4754
1983 (1)	0.0484	0.2752	-0.3178	0.2223	0.8677

[a]Variable name definitions are given in Appendix I.

CHAPTER V. POLICY SIMULATIONS

As mentioned earlier, one of the objectives in constructing an econometric model is to provide a tool for policy analysis. The magnitude and time path of the response of endogenous variables to changes in alternatives policy instruments can be predicted using the model.

The Indonesian monetary sector model, which was estimated in Chapter IV, will be used to analyze two alternative policies:

Case I. The central bank's unsterilized credit to commercial banks is increased by 20 percent. Unsterilized credit means that the increase is not accompanied by an increase in the government deposit at the central bank. This is an easy credit policy.

Case II. The exchange rate is increased by 20 percent from the historically observed values. This represents a once-for-all devaluation policy.

The impacts of Cases I and II on some key variables, namely GDPR, CPI, FER, INVR, NOXPD, IMPD, LOANR, and M2, will be evaluated in terms of elasticities. That is, the ratio of percentage change in the endogenous variable and the percentage change in the policy instruments will be examined.

The impact elasticities of central bank credit to commercial banks are presented in Table 13. Clearly, this policy has expansionary effects on the money supply and commercial bank loans. The average elasticities for commercial bank loans and the money supply are 0.2666 and 0.1817, respectively. As commercial bank loans increase, real investment, and hence real gross domestic product, will increase. The average elasticities for real investment and gross domestic product are 0.1105 and 0.0786, respectively. This finding confirms the importance of credit for capital formation and economic growth.

Table 13. Impact elasticities of 20 percent increase in CBC (Case I)[a]

Quarter	GDPR	CPI	INVR	LOAN	FER	NOXPD	IMPD	M2
1977 1	0.0168	0.1396	0.0161	0.0162	-0.4364	-0.1950	0.1571	0.0323
2	0.0007	0.2252	0.0075	0.0353	-0.7106	-0.3109	0.2226	0.0001
3	0.2541	0.2342	0.2157	0.0735	-1.5331	-0.2983	0.5335	0.0486
4	-0.0022	0.1847	0.0185	0.1041	-1.3867	-0.2578	0.1794	0.0667
1978 1	0.0586	0.1117	0.0708	0.1245	-2.5082	-0.1525	0.1781	0.1056
2	0.0349	0.0852	0.0861	0.1591	-1.7413	-0.1181	0.1242	0.1415
3	0.0432	0.0990	0.0688	0.1790	-13.1865	-0.1365	0.1476	0.1537
4	0.0764	0.1069	0.0938	0.1980	-1.6489	-0.1442	0.1940	0.1506
1979 1	0.0328	0.1095	0.0581	0.2139	-2.2216	-0.1521	0.1460	0.1444
2	0.2907	0.0599	0.2673	0.2460	-1.7850	-0.0567	0.3942	0.1801
3	0.0323	0.0632	0.0718	0.2613	-1.9107	-0.0874	0.0994	0.1915
4	0.0421	0.0964	0.0789	0.2700	-1.7546	-0.1330	0.1438	0.1813
1980 1	0.0801	0.1609	0.1183	0.2918	-1.6061	-0.2176	0.2524	0.1794
2	0.0637	0.2190	0.1061	0.3136	-1.4265	-0.2967	0.2912	0.1703
3	0.0843	0.2085	0.1264	0.3281	-1.3545	-0.2808	0.3051	0.1679
4	0.0383	0.1600	0.0880	0.3361	-1.7878	-0.2206	0.2025	0.1835
1981 1	0.0140	0.1318	0.0671	0.3363	-1.9448	-0.1847	0.1462	0.2033
2	0.0638	0.1445	0.1162	0.3397	-1.8657	-0.1970	0.2169	0.2184
3	0.1855	0.1581	0.2183	0.3611	-1.7788	-0.2035	0.3734	0.2370
4	0.0718	0.2243	0.1332	0.3944	-2.2171	-0.3029	0.3061	0.2384
1982 1	0.0502	0.3475	0.1221	0.4398	-2.9674	-0.4619	0.4032	0.2323
2	0.1717	0.5712	0.2450	0.5405	-4.8942	-0.7143	0.7797	0.2932
3	0.2920	0.2580	0.2861	0.4221	-3.9205	-0.3257	0.6039	0.2665
4	-0.0735	-0.0941	-0.0233	0.2952	-3.3182	0.1323	-0.1745	0.3237
1983 1	0.0425	0.0126	0.1062	0.3854	-2.9892	-0.138	0.0608	0.4318
Avg.	0.0786	0.1607	0.1105	0.2666	-2.5158	-0.2132	0.2515	0.1817

[a]See Appendix I for variable definitions.

This easy credit policy, however, also has negative effects. It increases inflation and creates balance of payments problems. As can be seen from Table 13, the average impact elasticity for price (CPI) is 0.1607. Perhaps the most serious impact is the effect on the balance of payments. The average impact elasticity for the central bank's foreign exchange reserve (FER) is very small (large in absolute value). It is -2.5158. Non-oil merchandise exports have a negative average elasticity, whereas merchandise imports have a positive average elasticity. All of these results are consistent with the monetary approach to the balance of payments predictions (Frenkel and Johnson, 1976).

The impacts of a 20 percent sustained devaluation (Case II) are given in Table 14. As expected, devaluation increases the central bank's foreign exchange reserves. This is mainly due to the increase in exports. The average impact elasticity for non-oil merchandise export is very high at 1.9702. Although merchandise imports are also increasing, their average elasticity is only 0.2310. Since the elasticity is less than one, the dollar value of the merchandise imports is actually decreasing.

The common problem with devaluation is its inflationary effects. As can be seen from Table 14 the impact elasticity of devaluation on the price level is quite high. The average impact elasticity is 0.3340. The inflation rate, however, is less than the devaluation rate.

Of interest is the effect of devaluation on real investment and gross domestic product. Table 14 shows that devaluation has contractionary effects on real investment and gross

Table 14. Impact elasticities of 20 percent increase in EXC (Case II)[a]

Quarter	GDPR	CPI	INVR	LOAN	FER	NOXPD	IMPD	M2
1977 1	-0.2386	0.0799	-0.1980	-0.0965	1.2381	1.4734	-0.1420	-0.0285
2	-0.6131	0.2716	-0.4923	-0.3177	1.7574	1.7179	-0.3800	-0.1251
3	-0.0576	0.3587	-0.0722	-0.4014	1.9591	1.8764	-0.3949	-0.1381
4	-0.1873	0.3760	-0.1812	-0.4171	1.9725	1.9079	-0.2620	-0.1168
1978 1	-0.0685	0.3511	-0.0833	-0.3860	3.1322	2.0020	-0.3911	-0.0539
2	0.0614	0.2158	-0.0327	-0.2864	2.4687	2.2990	0.4178	0.0252
3	0.0729	0.1642	-0.0912	-0.2186	17.9416	2.3884	0.2057	0.1059
4	-0.3845	0.2646	-0.3435	-0.3123	2.8202	2.1358	-0.0728	0.0840
1979 1	-0.0981	0.3690	-0.1219	-0.4013	3.4974	1.9791	0.3793	0.0656
2	-0.1639	0.4201	-0.1960	-0.4677	2.7214	1.8737	0.3475	0.0477
3	-0.0568	0.4197	-0.1118	-0.4478	2.8420	1.8890	0.4706	0.0745
4	-0.1132	0.4227	-0.1425	-0.4107	2.4830	1.8717	0.4140	0.1155
1980 1	-0.1091	0.4141	-0.0935	-0.3893	2.0130	1.8930	0.4109	0.1462
2	-0.1237	0.4194	-0.1532	-0.3787	1.6257	1.8811	0.3977	0.1723
3	-0.1058	0.3842	-0.1493	-0.3620	1.4429	1.9495	0.3856	0.1845
4	-0.0840	0.3330	-0.1363	-0.3084	1.8102	1.7893	0.3620	0.2079
1981 1	-0.0865	0.3315	-0.1308	-0.2902	1.8688	2.0527	0.3575	0.2300
2	-0.0879	0.4094	-0.1275	-0.3159	1.7029	1.9049	0.4329	0.2409
3	-0.0093	0.3804	-0.874	-0.2979	1.4512	1.9708	0.5024	0.2313
4	-0.0715	0.3027	-0.1329	-0.2426	1.6482	2.1108	0.3475	0.2440
1982 1	-0.0719	0.2556	-0.1291	-0.1978	1.8906	2.2040	0.3001	0.2653
2	-0.1019	0.3552	-0.1327	-0.2233	2.5957	2.0049	0.3618	0.2979
3	0.0229	0.4006	-0.0527	-0.2453	1.9732	1.9375	0.5634	0.2714
4	-0.0643	0.3758	-0.1091	-0.2326	1.8316	1.9714	0.4292	0.2560
1983 1	-0.0618	0.2754	-0.1195	-0.1750	1.6170	2.1661	0.3323	0.2654
Avg.	-0.1183	0.3340	-0.1448	-0.3037	2.7322	1.9702	0.2310	0.1228

[a]See Appendix I for variable definitions.

domestic product. This may be explained by the reduction in commercial bank loans. The average impact elasticity for real commercial bank loans is -0.3031. This is even less than the average impact elasticity of the price level. Hence, even nominal loans are decreasing. Commercial bank loans decrease because bank deposits decrease due to inflation. In addition, the government will also tighten credit controls during a high inflation.

This finding shows that devaluation could lead to stagflation (output stagnation and high inflation). A similar result was found by Boediono (1979). Nasution (1982), however, found that devaluation increases real gross domestic product. Nasution finding is obvious from his real income specification, which is a direct function of purchasing power parity. If the impact elasticity of the price level is less than one, then devaluation will increase real gross domestic product. There is no consideration on the role of commercial bank loans on investment.

The evidence of the stagflationary effect of devaluation is not uncommon for developing countries (Alejandro, 1963; Cooper, 1971). Theoretical analysis of this phenomenon can be found in Alejandro (1963), Krugman and Taylor (1978), and Buffie (1984). The stagflationary impacts of devaluation may partly explain the government's strong persistent in maintaining an overvalued exchange rate.

CHAPTER VI. SUMMARY, CONCLUSIONS, AND SUGGESTIONS FOR FURTHER RESEARCH

The main objective of this study has been to develop a monetary policy oriented model for Indonesia. As background, a brief survey on the development of economic modeling in developing countries in general and in Indonesia in particular was undertaken. A qualitative description of Indonesian financial institutions and policies was also provided. It was found that none of the previous models of the Indonesian economy considered the role of financing availability, particularly bank loans, on investment. It was argued here that the bank loan-investment nexus may be the most direct channel for monetary policies to affect the real sector. All previous models of the Indonesian economy also neglect the government's attempt to sterilize the balance of payments and other domestic credits effects on the money supply. In addition, private capital flows and trade in services are treated as exogenous in all previous models.

This study constructs a monetary policy oriented model which includes commercial bank loans determination, the role of financial availability for investment, the government's sterilization reaction function, private capital inflows, and trade in services. Monetary assets are decomposed into four components: currency in circulation, demand deposits at commercial banks, saving and time deposits, and foreign currency deposits. This disaggregation is crucial because each asset behaves differently and bank deposits are linked to commercial bank loans. A money-supply function which provides a linkage between the money stock and the balance of payments through the monetary base is also derived. The government's credit control is incorporated into the model through inflation. That is, credit restriction is assumed to be positively related to inflation.

The model's coefficients are estimated using data from 1976 quarter one to 1983 quarter one. The non-linear three stage least squares method is used for the estimation. Due to the limited number of observations, lagged dependent variables are not included in the instrument variables. The estimated behavioral equations have acceptable statistical properties. The estimated directional relationships are in accord with theoretical expectations. Validation of the model through historical simulation provided a satisfactory performance of the model. If tracks the data well. It is also stable. Some important conclusions drawn from the empirical results are discussed below.

First, saving and time deposit respond significantly to their interest payments. This confirms the importance of the interest rate for domestic saving mobilization. The deposit rate, however, is not significant in other monetary assets demand functions. This may be due to the relatively low and stable deposit rate compared to inflation. Inflation, therefore, dominates the opportunity costs of the assets. This study also shows that foreign currency deposits are significantly responsive to both the foreign interest rate and expected devaluation. This indicates that the Indonesian monetary sector is vulnerable to world financial disturbances.

Second, investment is, indeed, dependent on financial availability. This confirms the important role of commercial bank loans for economic growth. The bank loan-investment nexus, therefore, is one of the most important channels for monetary policies to affect real activities.

Third, there is strong evidence that the government sterilizes the balance of payment and other central bank domestic credits using the government deposit at the central bank. About 80 percent of the balance of payments is sterilized. The sterilized portions of the central bank credit to commercial banks and to the private sector are about 80 and 67 percent, respectively.

Fourth, non-direct private investment capital flows are significantly responsive to both expected devaluation and the foreign interest rate. Both have a negative sign. Again, this indicates a vulnerability of the Indonesian monetary sector to both domestic and foreign financial disturbances. A more flexible exchange rate after the financial liberalization policy could lead to a higher and more unstable capital flows.

One of the objectives of building the econometric model is for policy analysis. In this study, two alternatives policies are simulated using the model: (1) an unsterilized 20 percent increase in central bank credit to commercial banks; and (2) a 20 percent devaluation. Some important results of the simulation exercises are summarized below.

First, domestic credit expansion could increase real gross domestic product and investment. Inflation, however, could also increase as well. This may also indicate that the government's credit controls were successful in controlling inflation. Another important problem of the easy credit policy is that it causes a deterioration in the balance of payments as predicted by the monetarist approach.

Second, devaluation may reduce real economic activities. This is in contrary to the general view that devaluation increases real income (Nasution, 1983). The stagnation effect of devaluation, however, is not uncommon in developing countries (Alejandro, 1963; Cooper, 1971; Krugman and Taylor, 1978; Buffie, 1984). This finding, at least, serves as a warning for too high expectations from a devaluation. Devaluation is inflationary. The advantage of devaluation is that it might improve the balance of payments problem. Clearly, however, devaluation is a costly cure for this problem.

The model developed in this study can be used to evaluate some other policies such as deposit interest changes, and abandoning a sterilization effort. Certain extensions of the model could improve the performance of the model and allow additional policy analyses. Some of the interesting extensions are as follows:

(1) to consider the role of financial availability on working capital or capacity utilization. This is another important channel for monetary policies to affect real output.

(2) to disaggregate production according to sectoral origins. Of particular interest is the separation of the agricultural sector, since it is the largest sector in the economy.

(3) to link the model with another sectoral model. As an example, linking the model with another agricultural sectoral or crop model would provide a very interesting analysis on the transmission of monetary policies to the agricultural sector and vice-versa.

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APPENDIX I. VARIABLE NAMES AND DEFINITIONS

Variables with an asterisk (*) are exogenous. All values are in billions of rupiahs unless otherwise indicated.

AID* = Government foreign borrowing

BASE = Monetary base

BGD* = Government deposit at commercial banks

BOP = Balance of payments

CBC* = Central bank advances to commercial banks

CCR = Real currency in circulation (billion)

CDC* = Central bank direct credit

CPI = Consumer price index (1975=100)

CPIW* = Trade weighted foreign consumer price index (1975=100)

D = Dummy variable for managed peg regime starting from 4th quarter of 1978

DDBR = Real demand deposits with commercial banks (billion)

DGC = Change in the government deposit at the central bank

DRN* = Weighted average of annual deposit rate (%/year)

EDE = Expected devaluation (%)

EXC* = Exchange rate (Rp/$)

EXSVD = Export of services

FDBR = Real dollar deposits with commercial banks (billion)

FDID* = Foreign direct investment

FNP = Industrial production index of the OECD countries (1975=100)

GDP = Nominal gross domestic product

GDPR = Real gross domestic product (billion)

GES = Government expenditures

IFA = Inflation rate (%)

IFE = Expected inflation (%)

IMPD = Merchandise exports

INVR = Real investment (billion)

KPS = Real capital stock (billion)

LIB* = London eurodollar deposit rate (%/year)

LOAN = Commercial bank loan to private sector

LOANR = Real loans (billion)

LTSLR* = Real total stock of foreign liabilities of the private sector (accumulated RPCR in the previous period

MAR = Real monetary assets of the private sector (billion)

M2R = Real broad money (billion)

NOXPD = Non-oil merchandise exports

OCDC* = Other central bank domestic credit

OITID = Oil investment income transfers abroad

OIMSVD = Other imports of services

OXPD* = Oil exports

PWIM = Wholesale price index of imported goods (1971=100)

PWNO = Wholesale price index of exported goods (1971=100)

RESB* = Residual of the balance of payments identity

STR = Real saving and time deposits (billion)

S1*, S2*, S3* = Seasonal dummies for quarter one, two, and three, respectively

TAX = Government non-aid revenue

TIPD = Transportation and merchandise insurance payment

TPCR = Real private capital inflow (billion)

APPENDIX II. DATA SOURCES AND TRANSFORMATION

Sources and the correspondent data obtained from are as follows:

(1) Indonesian Financial Statistics, Bank Indonesia, Jakarta: Monetary variables, domestic interest rate, and oil investment income transfer.

(2) International Financial Statistics, International Monetary Fund, Washington, DC: Price indexes, London eurodollar deposit rate, government expenditure, government revenue, investment, gross domestic product, and exchange rate.

(3) Balance of Payment Statistics, International Monetary Fund, Washington, DC: Balance of payment components

(4) OECD Main Economic Indicators, OECD, Paris: OECD industrial production index.

(5) Indikator Ekonomi, Biro Pusat Statistik, Jakarta: wholesale price indexes of imported and exported goods, and capital imported goods.

Gross domestic product (GDP) and investment (INV) data are only available in annual series. The annual series is converted to quarterly series by some estimation technique, with a condition that their total value in a given year matches the corresponding value of the annual series. This technique has been widely used (Aghevli, 1977; Boediono, 1979; Djiwandono, 1980; Nasution, 1982).

The annual GDP is fit with annual data of some explanatory variables which values are also available in quarterly. The best fit is

$$\underset{\quad (3.975)}{GDP = 3108} + \underset{(3.132)}{1.6050GES} + \underset{(3.889)}{1.5107EXPT} + \underset{(1.753)}{0.9347\ IMPT} \qquad R^2 = 0.996$$

where: GDP = gross domestic product (billion Rp)

GES = Government expenditure (billion Rp)

EXPT = Total export (billion Rp)

IMPT = Total import (billion Rp)

This equation is used to get unadjusted estimate values of quarterly GDP by assigning the quarterly values to the explanatory variables. The estimates are, then, adjusted to make their total value for one year equal the actual value in that year.

The first estimate quarterly data are refitted again with the same independent variables as the annual equation. The estimated value is, then, readjusted. This process is repeated until the best fit, highest R^2, is found. In this study, the best fit is found after the second interaction. The equation used to estimate quarterly GDP is:

$$\begin{array}{llllll} GDP = 783.950 + 1.4933\ GES + 1.47664\ EXPT + 1.1550\ IMPT & & & & & \\ \quad\quad\quad (8.291) \quad (16.291) \quad\quad (13.277) \quad\quad (6.827) & & & & & R^2 = 0.995 \end{array}$$

The annual data for investment are converted to quarterly using the same procedure as GDP data are. The annual investment equation is:

$$\begin{array}{lll} INV = -277.027 + 0.1709\ GDP + 0.7407\ NIK & & \\ \quad\quad\quad (-1.942) \quad (9.531) \quad\quad (3.718) & & R^2 = 0.997 \end{array}$$

where: INV = Investment (billion Rp)

NIK = Capital imported good (billion Rp)

The best quarterly equation is found after the first interaction. The equation is:

$$\begin{array}{llll} INV = -57.3701 + 0.1740\ GDP + 0.6816\ NIK\ . & & & \\ \quad\quad\quad (-2.262) \quad\quad (44.027) \quad\quad (16.367) & & R^2 = 0.994 & \end{array}$$