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INDOMOD A Simulation Model of the Indonesian Economy

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Abstract

This paper presents a small macro simulation model of the Indonesian economy The model was constructed to assess the effects of alternative policies as well as changes in the external environment on the Indonesian economy over the medium term Accordingly, the focus is on the determinants of growth with relatively little attention devoted to explaining the effects of short-run demand fluctuations.

JEL Classification Numbers:
112, 121, 212

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Contents

Summary

This paper describes the construction and use of a small computer-simulation model of the Indonesian economy. It was developed as an aid in assessing the medium-term consequences of alternative policy packages, as well as changes in the external environment on output, prices, external debt, and the current account. Because the focus is on the medium term, primary emphasis has been placed on the determinants of supply; little effort has been made to explain short-run variations in output caused by transitory shifts in domestic demand. The model can be characterized as a neoclassical growth model of an economy that has access to international credit markets. The simulations reported in the paper show the results of a decrease in the efficiency of investment, an increase in the fiscal deficit from increased expenditure and from decreased revenue, and decreases in the prices of oil and in the price of non-oil exports.

I. Introduction

This paper describes INDOMOD, a macro-economic simulation model of the Indonesian economy developed as an aid in evaluating various policy options as well as in constructing alternative medium-term scenarios It is a relatively small model--32 equations in total, 8 of which are stochastic--and was designed to assess the likely quantitative medium-term effects of changes in either domestic policy or the external environment on output, prices, the current account, and the external debt position of the country Because the focus is on the medium term, primary emphasis has been placed on the determinants of supply; little attempt has been made to explain short-run variations in output caused by transitory shifts in demand The parameters of the model have been estimated with annual data taken from International Financial Statistics and the World Economic Outlook database

The next section of the paper describes the important behavioral and structural relationships in the model The second section discusses the results of several simulations done with the model An appendix lists the full model in detail

II The Model

Any model is, at best, an imperfect depiction of reality, its properties will, in large measure, be determined by the particular assumptions made about the structure of an economy. For example, investment and growth will be determined differently in countries that are debt constrained than in those that are not, and changes in aggregate demand will have different macro-economic effects in economies that are experiencing excess capacity than in those that are not In the case of INDOMOD, the model can be characterized as a neo-classical growth model where foreign lending is available on market terms Investment is determined by savings and the profitability of exporting. Attempts to model real investment as a function of real interest rates were unsuccessful, although additional data may allow this in future versions of the model

The capital stock, and subsequently output, increases with any rise in savings, domestic or foreign The paucity of data prevents the successful estimating of a production function to relate factor inputs to output As an alternative, the link from the capital stock to output is given by the incremental capital output ratio (ICOR), with a one period lag between a change in the capital stock and output The drawbacks with this approach are well known The ICOR is an endogenous variable, this technique treats it essentially as an exogenous parameter in the production process The particular measure of the ICOR used in the model is averaged over a five-year period in a attempt to remove out the largest of the variations in it that are not related to the production process

Output can also be increased if profitability rises in the production of export goods A positive terms of trade movement--defined as an increase in the price of non-oil exports relative to the consumer price index (a proxy for production costs)--causes the production of exported goods to increase.

Fiscal policy is important in the model because government consumption expenditure can crowd out capital formation with adverse, but delayed, effects on output Increased public sector expenditure on investment goods simply crowds out an equivalent amount of private investment with no output effects Money is neutral in the model, the central bank can set the inflation rate, but not affect real variables A change in the stock of base money feeds through, proportionately, to output prices, taking five years to fully work itself through Furthermore, a change in output prices is offset by a change in the nominal exchange rate. That is, the nominal exchange rate is established in the goods market by a relative purchasing power parity condition. Thus, a competitive nominal devaluation will not affect relative prices, even over the short run, and, consequently will have no effect on trade and output By contrast, structural policies which can increase both the stock and efficiency of capital, among other things, are potentially very effective in increasing output in the model.

Exports are determined by the relative profitability of production and economic activity in Indonesia's trading partners Profitability is given by the price of exports, adjusted for exchange rate changes, relative to the CPI, a measure of domestic costs, foreign activity is measured with an export-weighted measure of foreign activity. Equation (1) describes the determinants of non-oil commodity exports in volume terms. The use of the lagged dependant term indicates that commodity production responds to changes in relative prices over an extended period whereas equation (2), which models the exports of manufactures, shows that manufactured exports respond to relative prices changes over a shorter (one-year) period Long-run price elasticities in the two equations are similar, 0 42 and 0.56, respectively, but the long-run activity elasticity is substantially higher for manufactures The model treats exports of petroleum and petroleum products, as well as timber, exogenously. t-values are shown in parentheses

$$\begin{aligned} LOG(QXCOM) = {} & 1\ 794 + 0.190 * LOG(RELPCOMX) + 0.380 * LOG(PCGNP) \\ & (4\ 25)\quad (2\ 40)\qquad\qquad\qquad (1\ 76) \\ & + 0.594 * LOG(QXCOM(-1)) \\ & \quad (4\ 11) \end{aligned} \tag{1}$$

$\bar{R}^2 = 0\ 960$ SEE = 0 055 DW = 1 94

RANGE 1971 TO 1987

Where

QXCOM = Volume of commodity exports, exclusive of oil and timber

RELPCOMX = Relative price of commodities in rupiah to the domestic CPI

PCGNP = Index of partner country real GNP

$$\begin{aligned} LOG(QXMAN) = {} & -10.281 + 0\ 556 * LOG(RELPMANX) \\ & (-3\ 48)\quad (1\ 80) \\ & + 3.500 * LOG(PCGNP) \\ & (5.37) \end{aligned} \qquad (2)$$

$\bar{R}^2$ = 0 941 SEE = 0.203 DW = 1.67

RANGE. 1970 TO 1987 RHO = 0.553
(2 44)

Where

QXMAN = Volume of manufactured exports

RELPMANX = Relative price of manufactures, in rupiah, to the domestic CPI

Non-oil imports, in volume terms, are described in equation (3). In this case, relative prices are defined as the ratio of non-oil import prices, in local currency, to the price of domestically produced output As with exports, petroleum imports are treated exogenously.

$$\begin{aligned} LOG\ (QMNOIL) = {} & -3.157 - 0.839 * LOG\ (RELPM) + 1\ 155 * LOG\ (GDP) \\ & (-1.08)\ (-2.02) \qquad\qquad (4\ 16) \end{aligned} \qquad (3)$$

$\bar{R}^2$ = 0.942 SEE = 0 152 DW = 1.26

RANGE· 1967 TO 1985 RHO = 0 570
(2 71)

Where

QMNOIL = Volume of non-oil imports

RELPM = Price in non-oil imports, in rupiah, relative to the GDP deflator

GDP = Real gross domestic product

Equations (4) and (5) show the determinants of the export and import of non-capital services, respectively. They are simple statistical relationships that are intended only to provide plausible simulation properties.

$$\text{LOG (XNCS)} = \underset{(-1.24)}{-1.420} + \underset{(1.11)}{0.223} * \text{LOG(VXBOP)} + \underset{(5.69)}{0.229}\ T \qquad (4)$$

$\bar{R}^2$ = 0 934 SEE = 0.442 DW = 0.809

RANGE. 1967 TO 1987

Where

XNCS = Exports of non-capital services

VXBOP = Value of exports, balance of payments basis

T = Trend term

$$\text{LOG(MNCS)} = \underset{(-1.13)}{-0\ 427} + \underset{(11.97)}{0.802} * \text{LOG(VMBOP)} + \underset{(3.78)}{0.046} * T \qquad (5)$$

$\bar{R}^2$ = 0.989 SEE = 0.123 DW = 1.264

RANGE: 1967 TO 1987

Where

MNCS = Imports of non-capital services

VMBOP = Value of imports, balance of payments basis

The consumption function is given in equation (6), below.

$$\text{LOG (RC)} = \underset{(3.64)}{1.562} + \underset{(20.09)}{0.827}\ \text{LOG(RDY)} \qquad (6)$$

$\bar{R}^2$ = 0.973 SEE = 0.027 DW = 2.02

RANGE. 1974 TO 1985

Where

RC = Real private consumption

RDY = Real disposable income

Fiscal revenue, in contrast to fiscal expenditure, is endogenous in the model, it is described in equation (7).

$$\text{LOG(FISREV)} = -2.809 + 0.987 * \text{LOG (GDPNOM)} \quad (7)$$
$$(-8.66)(14.104)$$
$$+1.161 * \text{LOG(OILEXPLC)}$$
$$(3\ 05)$$

$\bar{R}^2 = 0.997$ SEE = 0.088 DW = 0.911

RANGE. 1969 TO 1987

Where

FISREV = Government revenue

GDPNOM = Nominal GDP

OILEXPLC = Oil exports, in rupiah

The demand for real balances, equation (8) below, is modelled in a conventional fashion. Given the extensive financial reform in Indonesia in recent years, it was decided to use a demand for base money equation in the model instead of a broader measure of the money stock.

$$\text{LOG (BASE/CPI)} = -0.2495 + 0\ 992\ \text{LOG(GDP)} - 0.005 * \text{CALLRATE} \quad (8)$$
$$(-4.53)\ (18.64) \qquad (-1.39)$$

$\bar{R}^2 = 0.972$ SEE = 0.037 DW = 2 23

RANGE· 1974 TO 1985

Where

BASE = Base money

CPI = Consumer price index

CALLRATE = The overnight inter-bank rate

There are several other equations which, while not estimated, are important to understanding the model's structure and behavior The first of these is the ICOR-based output relationship The ICOR is exogenous in the model, the measure used in the model is a five-year moving average of total gross investment to the change in GDP An increase in either public investment, which is exogenous, or private investment, which is proximately determined by the GDP identity, leads to the same increase in output in the following period

In contrast to many models which model net capital flows, INDOMOD has separate relationships for gross claims and liabilities Private demand for claims on foreigners is a function of the growth in nominal income, expressed in dollars. It can be shown that this is consistent with assuming that claims on foreigners are a constant proportion of private wealth holders' total portfolios Official claims on foreigners. are exogenous in the model Total external debt is given by the balance of payments identity, given the other components of the current account These three stocks--private claims, official claims, and total debt--allow the associated capital service flows to be modeled separately.

The other equations in the model are largely definitions, bridge equations, and balance sheet identities The full model is given in the final section of this annex.

III. Simulation Results

This section presents the results of a number of model simulations in which both domestic policy and external environment variables have been changed The results are expressed relative to a common baseline. While the reported simulations are necessarily arbitrary, it should be noted that the model is very nearly linear and additive. Thus a shock that is, for example, twice the size of the shock discussed will have very nearly twice the effect of the results presented. Similarly, the total effect of combining any two shocks is virtually the same as adding together the effects of the individual shocks.

Chart 1 summarizes the effects of three policy shocks: decrease in the efficiency of investment that could result from the failure of structural policy to be implemented, an increase in fiscal expenditure, and a decrease in taxes

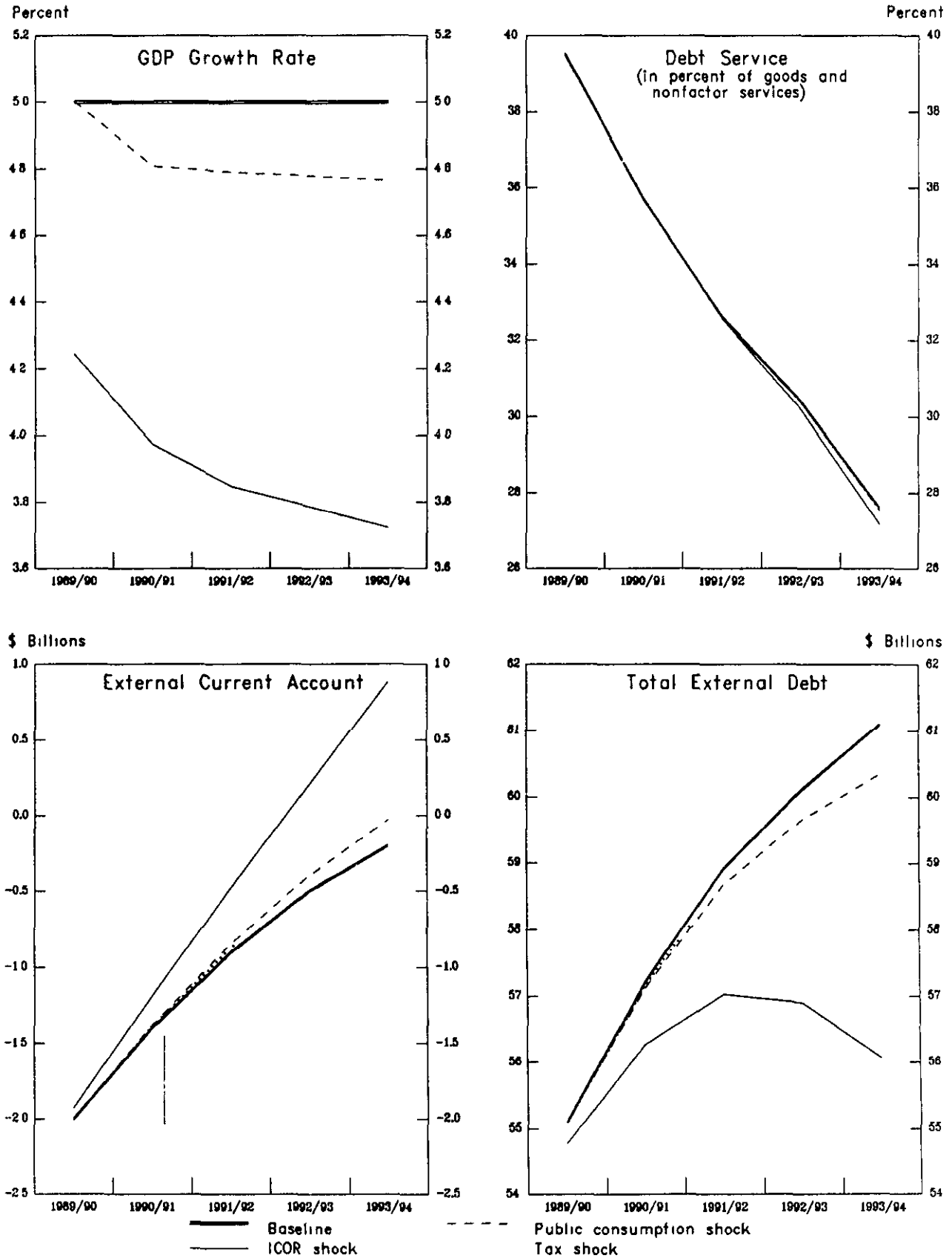
1 A decrease in the efficiency of investment

In this simulation the ICOR is increased from 5 5 in the baseline to 6 5 Thus efficiency, as measured by the ICOR, is less by an average 18 percent over the medium-term period 1989/90-1994/95. As Chart 1 below shows, the growth rate of real GDP is lower, on average, by slightly over 1 percent a year over the medium term with the effect becoming increasingly larger as the cumulated effects of a less efficient capital stock mount The decrease in the growth rate of employment could well be over half a percent a year Export production falls off as does the demand for imports On balance, the net effect is to cause the current account to go into surplus, decrease the debt to income ratio and worsen the fiscal position of the government

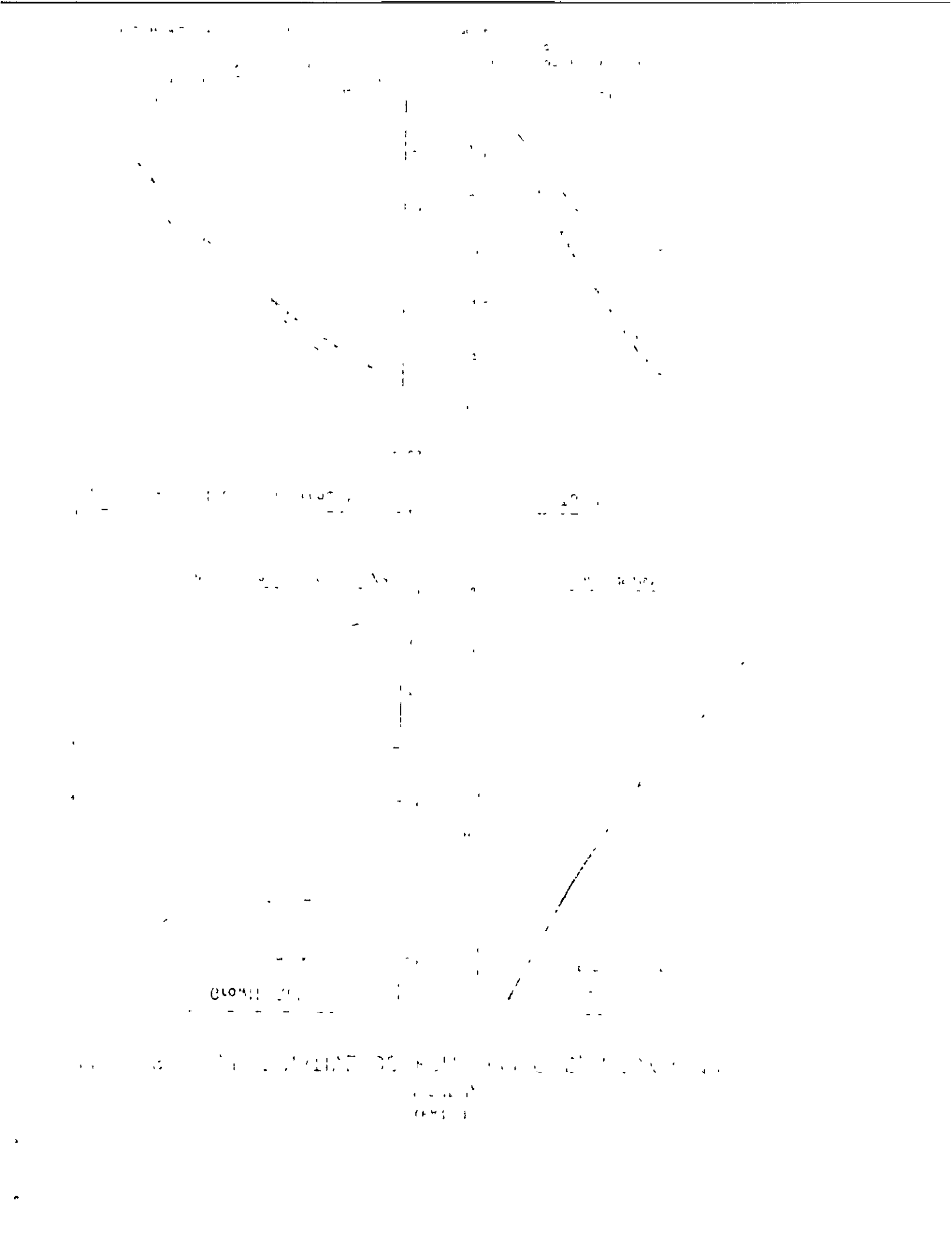
CHART 1

INDONESIA

EFFECTS OF ALTERNATIVE DOMESTIC POLICIES, 1989/90–1993/94



Sources: Data provided by the Indonesian authorities, and staff estimates and projections



2 An increase in government consumption

Chart 1 also shows how an increase in public consumption expenditure could worsen the medium-term outlook. Specifically, this simulation analyzes the effect of an increase in government consumption by an amount equal to 1 percent of GDP. In the initial period this takes place, 1989/90, increased consumption crowds out private investment that would otherwise take place and this, in turn, has the effect of reducing output in subsequent periods As Chart 1 indicates, the GDP growth rate decreased by about 0.2 percent a year. In this case the drop in the growth rate of employment would be slightly less. As in the first simulation, export production and import demand both fall with the current account showing a small surplus on balance, the debt to income ratio falls slightly and the fiscal position shows the effect of decreased production on taxes. Similar results would have been obtained if private consumption had increased instead of public consumption

3 A decrease in taxes

The final simulation shown in Chart 1 shows how a decrease in tax receipts could worsen the medium-term outlook. In particular, this simulation estimates the effect of an decrease in fiscal revenue by an amount equal to 1 percent of GDP In the first period of simulation this decrease in taxes leads to an increase in consumption (and a decrease in savings and investment), all relative to the baseline, and this has the effect of reducing output in subsequent periods. As Chart 1 indicates, the GDP growth rate has decreased by a little more than 0 1 percent a year. This is a smaller reduction in the growth rate than in the case discussed above where the same shift in government expenditure led to a larger drop in the growth rate. This happened because not all of the tax cut is spent, a portion of it was saved. In all other regards, the results are qualitatively similar to the case of increased government consumption discussed above.

The three simulations discussed above give an indication of how the baseline might be adjusted in the event that policy is less successful than assumed in the baseline case. The following simulations, shown in Chart 2, are intended to indicate how the baseline might be adjusted for adverse external developments

4. A decrease in the price of oil

The scenario simulated is an decrease in the price of oil of $1 per barrel. This has the effect of decreasing the value of exports a great deal initially The growth rate of GDP falls by slightly less than 0 5 percent a year, on average, over the medium term Ultimately, imports fall enough with the decrease in activity to cause the current account, which worsened initially, to improve. Throughout the simulation oil volumes are unchanged from their baseline values, only prices are changed Consequently, the employment effects would be relatively small.

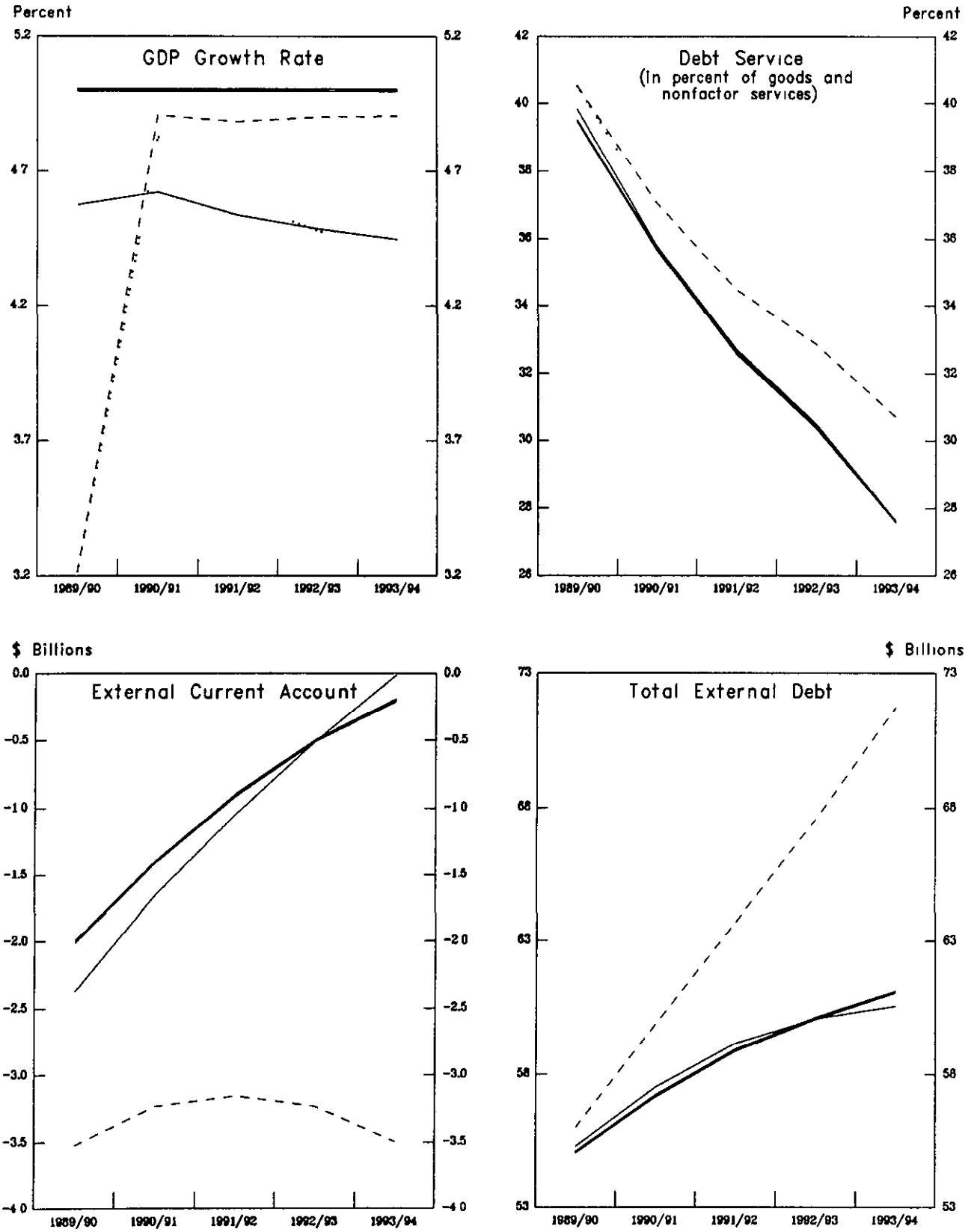
5 A decrease in the price of non-oil exports

This simulation differs from the preceding one in that it allows export production, in volume terms, to decrease as its profitability is diminished through a decrease of 10 percent in both the dollar price of manufactured and commodity exports The immediate effect is to cause exports and output to fall relative to the baseline; GDP falls 1.7 percent in the first year. Over the period as a whole, the decrease in the growth rate of GDP averages over 0 3 percent a year. If the fall in non-oil export prices was triggered by a drop in world activity, then exports would fall more, a decrease in the level of foreign activity of 1 percent a year would cause domestic output and employment growth to fall by nearly an additional 0 2 percent a year. The debt situation worsens substantially as the current account deficits accumulate; by 1993 the drop in export prices has lead to more than $10 billion in additional debt. This might not happen, if the country were to become debt constrained, then additional credit might not be forthcoming and more of the adjustment process would be felt through additional reduction in income The results of the same simulation, a 10 percent decrease in non-oil export prices, where international indebtedness is constrained to its baseline level is also shown in Chart 2. In this case imports are compressed and the growth rate in output must fall by over 2 percent initially with an average reduction of 1.3 percent over the medium term. The increase in the output gap suggests that the employment effect would be substantial with the growth rate in employment being close to one percent lower, at annual rates, than in the baseline scenario.

CHART 2

INDONESIA

EFFECTS OF ALTERNATIVE EXTERNAL PRICES, 1989/90–1993/94

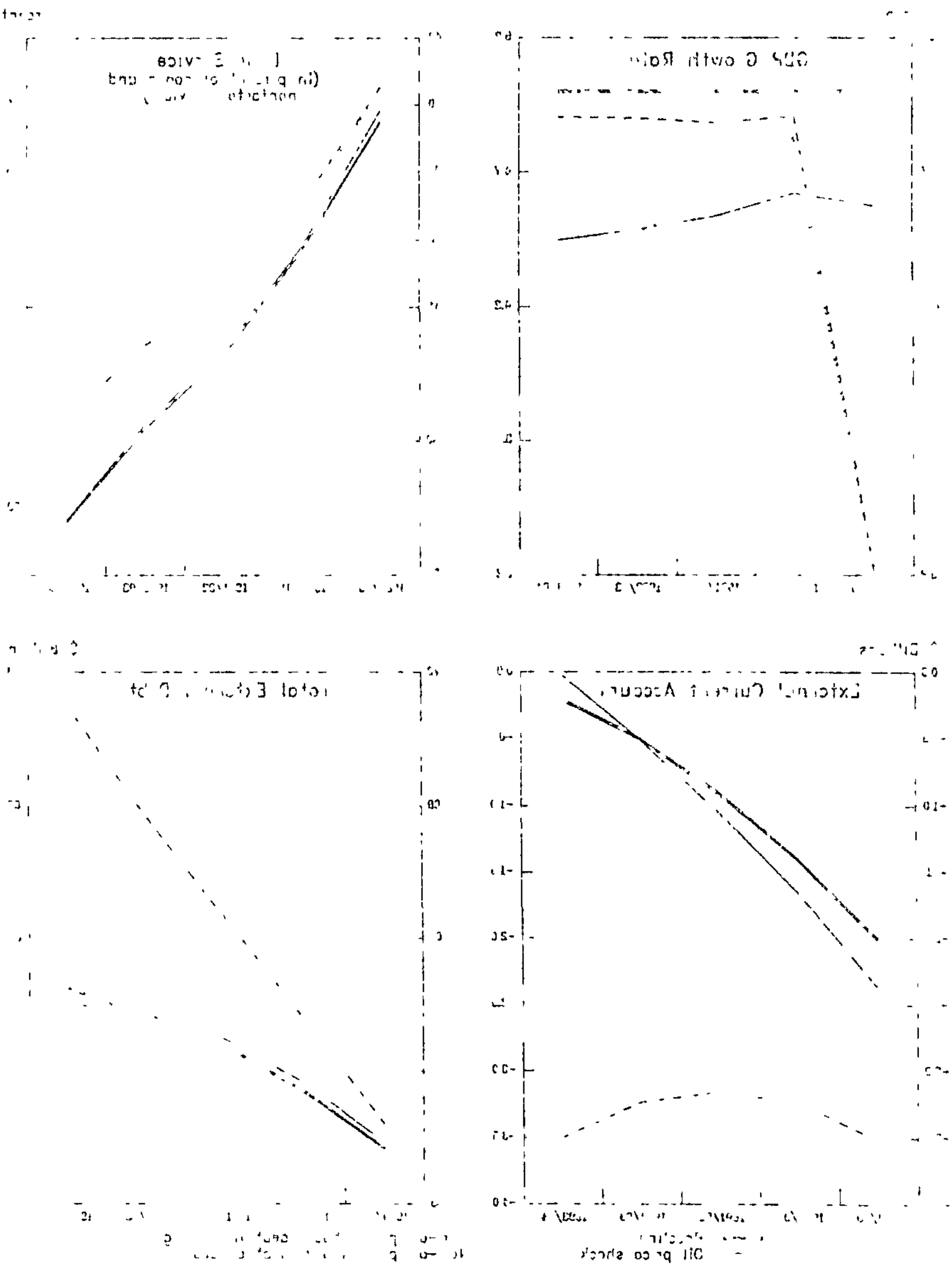


Sources: Data provided by the Indonesian authorities; and staff estimates and projections.

Chart 2

INDONESIA

EFFECTS OF ALTERNATIVE EXTERNAL PRICES



APPENDIX

The Complete Model

INDOMOD

Endogenous variables:

BASE	-	Base Money, in billions of rupiah
CAB	-	Current Account Balance, in millions of U S dollars
CALLRATE	-	Call Rate, in percent per annum
CPI1	-	Consumer Price Index, 1980 = 100
DYRATIO	-	Total External Debt to Nominal GDP Ratio
ERAVE	-	Average Exchange Rate, in rupiah per U.S dollar
FISREV	-	Total Government Revenue, in billions of rupiah
GDP	-	Real Gross Domestic Product, in billions of 1980 rupiah
GDPNOM	-	Nominal Gross Domestic Product, in billions of rupiah
MCS	-	Imports of Capital Services, in millions of U S dollars
MGS	-	Imports of Goods and Services, in millions of U S dollars
MNCS	-	Imports of Non-Capital Services, in millions of U S. dollars
MNIA	-	Imports of Goods and Services on a National Accounts Basis, in billions of rupiah
NFA	-	Net Foreign Assets of the Central Bank, in billions of rupiah
PCNIA	-	Private Consumption on a National Accounts Basis, in billions of rupiah
PGDP	-	Gross Domestic Output Deflator, 1980 = 100
PRINV	-	Private Investment, Including State Enterprises, on a National Accounts Basis, in billions of rupiah
QMNOIL	-	Volume of Non-Oil Imports, in millions of 1980 U.S. dollars
QXCOM	-	Volume of Commodity Exports, in millions of 1980 U.S. dollars

QXMAN - Volume of Manufactured Exports, in millions of 1980 U.S. dollars

RESTKD - Stock of Official Foreign Exchange Reserves, in millions of U S dollars

RYD - Real Disposable Income, in billions of 1980 rupiah

TOTCLM - Total Gross Private Claims on Foreigners, in millions of U.S dollars

TOTDBT - Total Gross Liabilities to Foreigners, in millions of U.S. dollars

VM - Value of Imports, Merchandise Trade Basis, in millions of U S dollars

VMBOP - Value of Imports, Balance of Payments Basis, in millions of U.S. dollars

VX - Value of Exports, Merchandise Trade Basis, in millions of U S dollars

VXBOP - Value of Exports, Balance of Payments Basis, in millions of U S. dollars

XCS - Exports of Capital Services, in millions of U S. dollars

XGS - Exports of Goods and Services, in millions of U.S. dollars

XNCS - Exports of Non-Capital Services, in millions of U S. dollars

XNIA - Exports of Goods and Services on a National Accounts Basis, in billions of rupiah

Exogenous variables

CAPEXOG - Direct Investment and Other Non-Debt Creating Capital Flows in millions of U S dollars

ERAVECON - Baseline Exchange Rate, in rupiah per U.S dollar

FXOD - Official Capital Flows (Intervention), in millions of U S dollars

GCNIA - Government Consumption Expenditure on a National Accounts Basis, in billions of rupiah

GDPCON - Baseline Value of Real Gross Domestic Product, in billions of 1980 rupiah

GINV	-	Government Capital Expenditure on a National Accounts Basis, in billions of rupiah
ICORBAR	-	Incremental Capital-Output Ratio
NDA	-	Net Domestic Assets of the Central Bank, in billion of rupiah
OFTRANS	-	Official Transfer Payments, in millions of U.S. dollars
OILFIN	-	Oil Financing, in millions of U.S. dollars
PCGNP	-	Index of Partner Country Real GNP
PGDPCON	-	Baseline GDP Deflator, 1980 = 100
PICPX	-	Industrial Country Export Price Index, measured in U.S. dollars
PMNOILD	-	Price Index of Non-Oil Imports, measured in U.S. dollars
PRTRANS	-	Private Transfer Payments, in millions of U.S. dollars
PXCOMD	-	Price Index of Commodity Exports, measured in U.S. dollars
PXMAND	-	Price Index of Manufactured Exports, measured in U.S. dollars
PXMANDCO	-	Baseline Level of Manufactured Export Prices, measured in U.S. dollars
QXMANCON	-	Baseline Level of Manufactured Export Volumes, measured in 1980 U.S. dollars
RCLAIM	-	Rate of Return on Claims on Foreigners, in percent
RLIAB	-	Rate Paid on Liabilities to Foreigners, in percent
T19	-	Trend Term
VMEXOG	-	Value of Exogenous Imports, Largely Petroleum, in millions of U.S. dollars
VXEXOG	-	Value of Exogenous Exports, Largely Petroleum and Timber, in millions of U.S. dollars
VXOIL	-	Value of Petroleum Exports, in millions of U.S. dollars
VXOILCON	-	Value of Petroleum Exports in the Baseline Solution, in millions of U S dollars

XCSCON - Value of Capital Service Exports in the Baseline Solution, in millions of U.S. dollars

XNIACON - Value of Exports in the Baseline Solution, National Accounts Basis, in millions of U S. dollars

Coefficients.

A0	1 7939	A1	0 189695	A2	0.380159	A3	0.593655
B0	-10.2818	B1	0 555982	B2	3.49581	C0	-3.15726
C1	1.15475	C2	-0.838905	D0	-1 42008	D1	0.223149
D2	0.228778	E0	-0.427402	E1	0.801657	E2	0 045922
F0	0	G0	1.56192	G1	0 826633	I0	-2 89094
I1	0 986834	I2	0.161017	J0	-2.4948	J1	0 992123
J2	-0.004764	K0	0.15				

Parameters:

ALPHA - Links export growth to output growth when set to one

BETA - Links output growth to export growth when set to one

GAMMA - Proportion of additional output that is exported

Equations

(1) Volume of Non-Oil Commodity Exports

```
LOG(QXCOM) = A0+A1*LOG(PXCOMD*(ERAVE/626 994)/CPI1)+A2*LOG(PCGNP)+
                    A3*LOG(QXCOM(-1))+RES1
```

(2) Volume of Manufactured Exports

```
LOG(QXMAN) = B0+B1*LOG(PXMAND*(ERAVE/626 994)/CPI1)+B2*LOG(PCGNP)+
BETA*(LOG(GAMMA*(GDP*1000/ERAVE/(PXMAND/100)-GDPCON*1000/ERAVECON/
                    (PXMANDCO/100))+QXMANCON)-LOG(QXMANCON))+RES2
```

(3) Volume of Non-Oil Imports

```
LOG(QMNOIL) = C0+C1*LOG(GDP)+C2*LOG(PMNOILD*(ERAVE/626.994)
                    /PGDP)+ RES3
```

(4) Value of Exports of Non-Capital Exports

LOG(XNCS) = D0+D1*LOG(VXBOP)+D2*T19+RES4

(5) Value of Imports of Non-Capital Exports

LOG(MNCS) = E0+E1*LOG(VMBOP)+E2*T19+RES5

(6) Value of Exports of Capital Exports

XCS = RCLAIM/100*(TOTCLM(-1)+RESTKD(-1))+RES6

(7) Value of Imports of Capital Exports

MCS = RLIAB/100*TOTDBT(-1)+K0*(VXOIL(-1)-VXOILCON(-1))+RES7

(8) Value of Merchandise Exports

VX = QXCOM*(PXCOMD/100)+QXMAN*(PXMAND/100)+VXEXOG+RES8

(9) Value of Merchandise Imports

VM = QMNOIL*(PMNOILD/100)+VMEXOG+RES9

(10) Bridge Equation, Value of Imports of Goods, Merchandise Trade Basis to Balance of Payments Basis

DEL(1 LOG(VMBOP)) = DEL(1 : LOG(VM))+RES10

(11) Bridge Equation, Value of Exports of Goods, Merchandise Trade Basis to Balance of Payments Basis

DEL(1 LOG(VXBOP)) = DEL(1 LOG(VX))+RES11

(12) Value of Exports, Goods and Services, Balance of Payments Basis

XGS = VXBOP+XNCS+XCS+OFTRANS+RES12

(13) Value of Imports, Goods and Services, Balance of Payments Basis

MGS = VMBOP+MNCS+MCS+PRTRANS+RES13

(14) Current Account Balance

CAB = XGS-MGS+RES14

(15) Balance of Payments Identity (solved for change in total debt)

DEL(1 TOTCLM) = CAB-FXOD+DEL(1 : TOTDBT)+CAPEXOG+OILFIN+RES15

APPENDIX

(16) Total Private Dollar Claims on Non-Residents

LOG(TOTCLM) = F0+LOG(GDPNOM)-LOG(ERAVE)+RES16

(17) Nominal GDP

GDPNOM = GDP*(PGDP/100)+RES17

(18) Stock of Official Foreign Exchange Reserves

RESTKD = FXOD+RESTKD(-1)+RES18

(19) External Debt to Income Ratio

DYRATIO = TOTDBT/(GDPNOM*1000/ERAVE)+RES19

(20) Consumption Function

LOG(PCNIA/(PGDP/100)) = G0+G1*LOG(RYD)+RES20

(21) Fiscal Revenue Function

LOG(FISREV) = I0+I1*LOG(GDPNOM)+I2*LOG(VXOIL(-1)
/1000*ERAVE(-1))+RES21

(22) Demand for Base Money

LOG(BASE/CPI1) = J0+J1*LOG(GDP)+J2*CALLRATE+RES22

(23) Real Disposable Income

RYD = GDP-FISREV/(PGDP/100)+RES23

(24) Inflation Equation

DEL(1 . LOG(PGDP)) = 0 2*(DEL(1 . LOG(BASE))+
DEL(1 LOG(BASE(-1)))+
DEL(1 LOG(BASE(-2)))+
DEL(1 . LOG(BASE(-3)))+
DEL(1 · LOG(BASE(-4))))+RES24TES

(25) Bridge Equation, Exports, BOP, to Exports, NIA

DEL(1 LOG(XNIA)) = DEL(1 · LOG(XGS))+DEL(1 LOG(ERAVE))+
RES25TES

APPENDIX

(26) Bridge Equation, Imports, BOP, to Imports, NIA

```
DEL(1   LOG(MNIA)) = DEL(1   LOG(MGS))+DEL(1   LOG(ERAVE))+
                     RES26TES
```

(27) Nominal GDP Identity

```
GDPNOM = PCNIA+PRINV+GINV+GCNIA+XNIA-MNIA+RES27
```

(28) Base Money Equation

```
BASE = NDA+NFA+RES28
```

(29) Real GDP

```
GDP = (PRINV(-1)/(PGDP(-1)/100)+GINV(-1)
                     /(PGDP(-1)/100))/ICORBAR+GDP(-1)+ALPHA*DEL
                     (1   XNIA/(PGDP/100)-XCS/1000*(ERAVE/626 994)
                     (GDP/100)-(XNIACON/(PGDPCON/100)-XCSCON
                     /1000*(ERAVECON/626 994)
                     /(PGDPCON/100)))+RES29TES
```

(30) Consumer Price Index Equation

```
DEL(1 · LOG(CPI1)) = 0.217*DEL(1 : LOG(PMNOILD*(ERAVE/626 994)))+
                     (1-0 217)*DEL(1 · LOG(PGDP))+RES30
```

(31) Exchange Rate Equation

```
DEL(1 · LOG(ERAVE)) = DEL(1 · LOG(PGDP))-DEL(1   LOG(PICPX))+RES31
```

(32) Net Foreign Assets of the Central Bank

```
NFA = FXOD/1000*ERAVE+NFA(-1)+RES32
```