

Roles of External and Domestic Debt in Economy: Analysis of a Macroeconometric Model for Indonesia

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This paper addresses some issues that arise in connection with the effects of government borrowing on an economy, particularly that of a developing country. We empirically investigated the case of Indonesia to address this problem. The analysis is intended to illuminate ongoing discussion related to the roles of domestic and external debt. The problem implies that the government is confronted with a choice between external and domestic debt. Government borrowing has apparently been a part of reasonable strategies; particularly, foreign debt has played a central role in Indonesia's experience. In particular, the rising trend of domestic debt subsequent to the financial crisis 1997 has not attracted much attention. Therefore, we used a macroeconometric model and found a primary result that the rising trend of domestic debt discouraged private investment because of the so-called *crowding-out* effect.

KEYWORDS: fiscal deficit, external debt, domestic debt, investment and growth

1. Introduction

Persistence of budget deficits has become a major challenge to economic development for Indonesia's policy-makers. Originally, the deficit was covered by external debt, with subsequent management after the financial crisis 1997 using domestic debt as well. Forestalling a potential debt crisis has become an important recent target. Domestic debt is defined as the public domestic indebtedness of a nation that is related to the government or public debt held by residents. However, it is difficult to determine the holdings of securities held by the residents because of trading. External debt at any given time is the outstanding amount of those actual current liabilities that requires payments of interest and principal by the debtor at some point in the future; the debt service is owned by non-residents. Actually, the distinction between domestic and external debt is blurred in some cases. Based on a legal perspective, external debt is contracted with non-resident lenders, rather than debt denominated in foreign currency. However, from an economic perspective, debt instruments denominated in local currency and underwritten by non-resident investors within the same currency zone have features of domestic debt.

Our selected periods of observation show that trends of the total debt to GDP ratio tended to decrease. Now, the Indonesian government is targeting an external debt to GDP ratio of about 31.8% by 2009. External debt has come to play a central role in Indonesia's experience; it has been attractive because of smaller crowding-out effect. Among all developing countries, the top six debtors at the end of 1993 were Brazil (US\$ 133 billion), Mexico (US\$ 118 billion), India (US\$ 92 billion), Indonesia (US\$ 89.5 billion), China (US\$ 84 billion), and the Russian Federation (US\$ 83 billion). Furthermore, in 1994, Indonesia's external debt reached approximately US\$ 97 billion, which cast Indonesia as the fourth largest external indebtedness. A huge external indebtedness presents the risk of exploding financial and debt crises. This grim economic picture is illustrated by the case of Mexico in the 1980s in its post oil bonanza. However, Radelet (1995) and Marks (2004) ensured that Indonesia's fiscal situation met the sustainability criterion.

For developing countries, the 1970s were a time of growing external indebtedness, but the government debt enhanced strong real growth. On average from 1970–1996, Indonesia had enjoyed more than two decades of rapid growth, under controlled inflation, and with a stable exchange rate. However, Indonesia has confronted its worst financial and economic crises since the great Asian crisis in 1997. As a repercussion from the Asian crisis, Indonesia has faced balance of payment difficulties along with a crippling level of external indebtedness; it has been forced into recession as it struggles to meet interest payments on its debt. Since the economic crisis, the Indonesian government has issued a substantial amount of domestic debt. In the earlier stage, this policy was intended to prevent the collapse of the domestic payment system; then the government temporarily nationalized the domestic banking system by injecting large amounts of government bonds. In recent periods, the government has also planned to shift the financing sources from foreign source to domestic source. Table 1 shows the recent situation of outstanding debt in Indonesia.

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Table 1. External and domestic debt of central government, 2000–2005 (in US\$ million, unless indicated otherwise).

Total Debt	2000	2001	2002	2003	2004	Q2-2005
Total debt	130,084	121,970	137,432	145,738	139,751	134,744
External debt	60,796	58,814	63,789	68,939	69,471	66,066
Domestic debt	69,288	63,156	73,643	76,799	70,280	68,678
Total debt service	7,977	10,071	11,609	12,644	18,205	1,215
External debt service	4,624	4,475	4,080	4,534	7,714	1,215
Domestic debt service	3,353	5,596	7,529	8,110	10,491	—
Total principal payment	1,710	1,564	2,570	4,964	11,358	879
External principal payment	1,710	1,564	2,006	2,330	5,193	879
Domestic principal payment	—	—	564	2,634	6,165	—
Total interest payment (including fees)	6,267	8,507	9,039	7,680	6,848	336
External interest/commission payments	2,913	2,911	2,074	2,204	2,522	336
Domestic interest payments	3,353	5,596	6,964	5,476	4,326	—
Gross domestic product (GDP) (in trillion of Rp)	1,265	1,449	1,611	1,787	2,273	—
Exchange rate (Rp/US\$)	9,595	10,400	8,940	8,465	9,320	9,716
Total debt to GDP ratio (%)	98	88	76	69	57	—

Note: Exchange rate as of end of period

Source: Directorate General of Treasury, Ministry of Finance of Indonesia, 2005, and BPS (Indonesian Statistical Bureau), various years.

The purposes of this paper are to determine the roles of domestic and external debt in Indonesia's macroeconomic situation. The structure of the paper is laid out as follows: Section 2 presents a macroeconometric model for Indonesia, Section 3 gives an empirical analysis, Section 4 gives a final test to investigate performance of model, Section 5 undertakes a simulation analysis, and Section 6 presents concluding remarks.

2. The Model

Sachs *et al.* (1987), Bulow *et al.* (1988), Warner (1992), Cohen (1993), Deshpande (1997), and Sachs (2002) are examples of works related aspects of debt problems in developing countries. In the present paper, we investigate the debt problem to different aspects by focusing on Keynesian and macroeconometric analyses. Meanwhile, some previous works related to Indonesia's debt are Radelet (1995), McLeod (1996), Usui (1997), Woo and Nasution (1998), Marks (2004), PPEFE-UGM and MoF (2004), and Lewis (2007). However, most of those studies investigated the problem using qualitative analyses. This shared feature motivates us to build a macroeconometric model to perform empirical analysis.

We start using Eq. (1) to show the composition of total debt, which consists of domestic and external debt. Domestic debt is domestic-currency denominated. External debt means any debt which is or might become payable other than in the currency of debtor or guarantor. All currency values and interest rates are measured respectively in real values of rupiah (Rp) and real interest rates. Total gross stock of central government debt in terms of domestic currency at the end of period t is given by the following equation:

$$B_t = B_t^D + \tau_t B_t^F \quad (1)$$

where, B , B^D , τ and B^F are the total debt, total domestic debt, exchange rate defined as the number of rupiah per US\$, and total external debt in US\$, respectively. We consider an intertemporal budget constraint in one period gap, as proposed by Marks (2004), as

$$B_t = (1 + i_t)B_{t-1} - S_t, \quad (2)$$

where $(1 + i_t)$ is the discount factor applying between period $t - 1$ and t , and S is the primary surplus. The primary surplus is equal to the overall government surplus, but with interest payments excluded. Demand for debt in period t is equal to the total budget deficit expressed by total debt repayment in the previous time or initial indebtedness minus the primary surplus in period t . The stock of real debt will grow at a rate that equals the real interest rate if the government runs a primary surplus that equals to zero ($S = 0$).

$$\Delta B_t \equiv B_t - B_{t-1} = i_t B_{t-1} \quad (3)$$

$(\Delta B_t / B_{t-1}) > i_t$ holds if the government runs a primary deficit that is $S < 0$, and $(\Delta B_t / B_{t-1}) < i_t$ holds if the government runs a primary surplus that is $S > 0$. For empirical calculations, we modify Eq. (2) to accommodate a

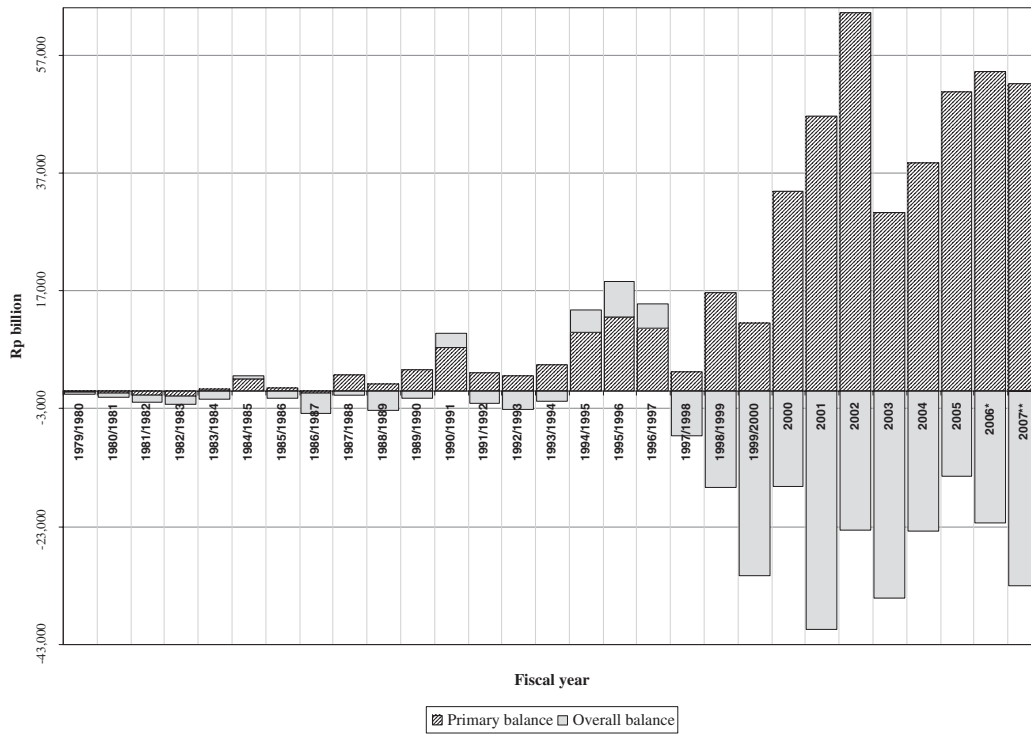


Fig. 1. Primary balance and overall balance, 1979–2007 (in Rp billion).

Note: * budget, ** proposed budget

Source: BPS (Indonesian Statistical Bureau), various years (illustrated by authors)

discrepancy between demand of debt in theoretical and factual terms. In the case of Indonesia, the discrepancy might occur for several reasons: such as the overhead cost that can not be accommodated by interest repayment only, or other technical budget policy. For these reasons, we adopt the stock of debt as the following equation:

$$B_t = [(1 + i_t)B_{t-1} - S_t] + \varepsilon_t, \quad (4)$$

where, ε_t is a discrepancy of demand of debt in period t . Considering the discrepancy, the statistical equation of total debt can be expressed as follows:

$$B_t = \alpha + \beta[(1 + i_t^D)B_{t-1}^D + (1 + i_t^F)B_{t-1}^F \tau_{t-1} - S_t] + \gamma GDP_{t-1} \quad (5)$$

Because of discrepancy is very large as shown by enormous of Indonesia's stock of debt, we expressed Eq. (4) to be Eq. (5). Our calculation shows that average discrepancy to stock of debt ratio, ε/B , between 1990–2005 is 103.89. Actual data shows that demand of debt does not match total deficit, but demand of debt is larger than total deficit. Total stock of debt has erupted as an effect of government policy to attain a significant economic growth. Moreover, enormous total stock of debt has exploded as an effect of financial crisis 1997, due to exchange rate depreciation, and issuing domestic debt for bailing-out the banking system.

Primary surplus S_t represents total government revenue G_t^R minus government expenditure G_t^E with interest payments excluded; it is equal to $[G_t^R - (G_t^E - i_t B_{t-1})]$. By definition, the interest payment is included in the current government expenditure. Here we distinguish the overall balance $G^R - G^E$ from the primary balance, as depicted in Fig. 1.

The value of the primary surplus, based on the fiscal balance 1979/1980–2007 was mostly positive. These data mean that interest payments contributed significantly to generate the overall fiscal deficit. Based on our calculation, as shown in Fig. 1, the share of the interest payment is around 12.63% of the total expenditure, or 13.45% of the total revenue. Moreover, by introducing government transfer payment, the primary surplus equation can be written as

$$S_t = G_t^R - [(G_t + Tr_t) - (i_t B_{t-1})], \quad (6)$$

where G is total net government consumption and Tr represents transfer payment. Total net government consumption is government expenditure G^E in the balance sheet minuses transfer payments. Government revenue comprises tax revenue Tx , non-tax revenue NTx , and foreign aid FA as determined in external currency.

$$G_t^R = Tx_t + NTx_t + FA_t \tau_t \quad (7)$$

However, in the case of Indonesia, total foreign aid in the meaning of grant aid is relatively small. Furthermore, gross domestic product Y_t , can be expressed as aggregate demand in the following way:

$$Y_t = C_t + I_t + G_t + EP_t - IM_t, \quad (8)$$

where C , I , EP , and IM are private consumption, private investment, and exports and imports of goods and services, respectively. We can divide government net expenditures into government consumption G_t^C and government investment G_t^I , which are determined by the central government.

$$G_t = G_t^E - Tr_t = G_t^I + G_t^C \quad (9)$$

Total export EP and import IM in period t are determined by the gross domestic product and the exchange rate level in the previous period.

$$EP_t = EP(GDP_{t-1}, \tau_{t-1}) \quad (10)$$

$$IM_t = IM(GDP_{t-1}, \tau_{t-1}) \quad (11)$$

The effect of an increase in GDP growth on export and import might be readily apparent: growth performance positively affects export and import. Exchange rate depreciation will encourage export and discourage import. Eq. (12) shows that income tax revenue is related to GDP and the lagged value of income tax, which is given as follows:

$$Tx_t = Tx(GDP_{t-1}, Tx_{t-1}) \quad (12)$$

The household consumption is determined as follows:

$$C_t = C(GDP_{t-1}, Tx_{t-1}), \quad (13)$$

which means that consumption is a function of disposable income. An increase in all disposable income might generate more consumption, although the total rise in consumption might not rise by as much as the rising income. It is conjectured that the marginal propensity to consume (MPC) is between zero and one ($0 < MPC < 1$). Meanwhile, it is readily apparent that raising the tax rate has a counterproductive effect on consumption. Eq. (14) shows that private investment is determined by GDP, increased domestic debt and capital stocks, as follows:

$$I_t = I\left(GDP_{t-1}, \frac{B_{t-1}^D}{B_{t-2}^D}, K_{t-1}\right) \quad (14)$$

As with the previous explanation, economic performance can be represented by GDP growth. The growth sustainability is a factor of rising investment. In addition, the lagged value of rising domestic debt has a negative effect on private investment because of reduction of funds available to industry (i.e. crowding-out effect). Furthermore, private capital stocks in the current year are defined as

$$K_t = (1 - \delta_t)(K_{t-1}) + I_t, \quad (15)$$

where δ denotes the depreciation rate for private capital stock. We assume no capital inflows such as foreign direct investment. Meanwhile, public capital stock G_t^K is

$$G_t^K = (1 - \hat{\delta}_t)G_{t-1}^K + G_t^I, \quad (16)$$

where $\hat{\delta}$ is the depreciation rate for public capital stock and G_t^I is public investment. The total national saving Sv is expressed as disposable income minus consumption:

$$Sv_t = (Y_t - Tx_t) - C_t \quad (17)$$

According to Eq. (8), Eq. (17) can also be rewritten as

$$Sv_t - I_t = (EP - IM)_t + (G^E - Tr)_t \quad (18)$$

Moreover, it is hypothesized that the exchange rate is influenced by the lagged values of net export, GDP, foreign debt, and the exchange rate, as follows:

$$\tau_t = \tau(NX_{t-1}, GDP_{t-1}, B_{t-1}^F, \tau_{t-1}) \quad (19)$$

Net export corresponds with external currency reserves, from which an increase in net export has an appreciation effect on the domestic currency. Meanwhile, depending on the GDP growth in other countries, GDP in the previous year may have a positive or negative effect on the value of the domestic exchange rate. We also recognize that increased external debt works to depreciate the domestic currency. Finally, the prior exchange rate is also indicated as a variable to determine an increase or decrease of current exchange rate.

Considering a prediction of demand for debt, we run the model in two steps. The first step is to estimate the total debt using Eq. (5) as \hat{B}_t^* . The estimates of domestic and external debt are, respectively, obtained as follows:

$$\hat{B}_t^D = \hat{B}^D(B_{t-1}^D, B_{t-2}^D, GDP_{t-1}, i_{t-1}^D) \quad (20)$$

$$\hat{B}_t^F = \hat{B}^F(B_{t-1}^F, \tau_{t-1}, (EP - IM)_{t-1}) \quad (21)$$

In the second step, the estimate of total debt \hat{B}_t^* is decomposed into \hat{B}_t^{D*} and \hat{B}_t^{F*} in two ways.

$$\hat{B}_t^* = \hat{B}_t^{D*} + \hat{\tau}_t \hat{B}_t^{F*} \quad (22)$$

$$\hat{B}_t^{D*} = \left(\frac{\hat{B}_t^D}{\hat{B}_t^D + \hat{\tau}_t \hat{B}_t^F} \right) B_t \quad (23)$$

$$\hat{\tau}_t \hat{B}_t^{F*} = \left(\frac{\hat{\tau}_t \hat{B}_t^F}{\hat{B}_t^D + \hat{\tau}_t \hat{B}_t^F} \right) B_t \quad (24)$$

To attain the composition of total maximum debt that can be issued by the government, we define total government debt to GDP ratio in period t , as

$$b_t = \frac{B_t}{Y_t} \quad (25)$$

This b_t is usually applied to detect potential risks. However, there is no certain analysis to define a debt limitation for all countries. For example, PPEFE-UGM (2004) defined the external debt to GDP ratio of 15% as a benchmark warning signal for the possibility of a debt crisis. The World Bank considered a debt-to-GNP ratio of more than 80% as a high risk signal. In terms of total debt service to export, the World Bank considered 18% as the warning threshold. In the basic model, we express that the total debt to GDP ratio should be less than or equal to a maximum ratio b_t^* as follows:

$$b_t \leq b_t^* \quad (26)$$

Now, we are considering the positive and negative effects of issuing external and domestic debt. In general theory, an increase in government expenditure that is funded by government debt might positively affect GDP. This can be expressed as

$$G^C \uparrow \rightarrow B \uparrow \rightarrow Y^E \uparrow \rightarrow GDP \uparrow .$$

However, considering the negative effects of an increase in government borrowing, it is divisible into two possibilities: 1). The effect of domestic debt can be expressed as

$$B^D \uparrow \rightarrow I \downarrow \rightarrow K \downarrow \rightarrow Y^P \downarrow \rightarrow GDP \downarrow .$$

Increased domestic debt discourages private investment and capital stock. It then reduces total production; finally, total GDP decreases. An increase in domestic debt reduces the total supply of funds, so that it crowds out investment. 2). Effects of external debt can be expressed as

$$B^F \uparrow \rightarrow \tau \uparrow \rightarrow IM \downarrow \rightarrow EP \uparrow .$$

An increase in external debt can depreciate the domestic currency, so that total debt redemption will increase. This effect further engenders a decrease in import and an increase in export. The system of analyses is illustrated in Fig. 2.

3. Empirical Evidence and Policy Implications

From the discussion in earlier sections, the appropriate measure for the relationship between government borrowing and economy is not so clear in the literature. This study is intended to investigate it empirically through ordinary least squares (OLS) estimation using the STATA regression package release-9. The data used in this study are the annual data for the period 1991–2006, and major sources of data are the Indonesian Statistical Bureau and the Directorate General of Treasury — the Ministry of Finance of Indonesia. In the initial stage, we would like to investigate a longer span of data; however, limited data availability, in terms both of the accuracy and the existence, encourages us to use the present approach. The descriptive statistics of data are shown in Table 2. Domestic debt and exchange rate are endogenous variables that have very large average rate of change; those are 370.91% and 29.19%, respectively. Financial crisis 1997 posed a mounting pressure on government budget in that domestic debt increased enormously. Moreover, Indonesia faced macroeconomic difficulties, specifically large exchange rate depreciation. However, demand of external debt tends to decrease as shown by average rate of change, about -3.08% .

Two dummy variables are introduced to eliminate the effects of the economic crisis in 1997, exchange rate dummy $Dm1$ and domestic debt dummy $Dm2$. For each equation, figures in the parenthesis are t -values, symbol d means Durbin-Watson statistic and symbol n is sample size of data. The system of model is “recursive” in that every endogenous variable is determined by lagged endogenous or exogenous variables. In this situation, it is known that the use of OLS will not cause serious simultaneous equation problems. We assume that the error term in the model obeys a normal distribution. In our paper, we judge the value of d sufficiently detect the “spurious regression.”

a. Consumption

Total average private consumption of GDP is around 62%. Therefore, consumption strongly affects the economic performance. Our analysis on consumption shows the estimated equation as follows:

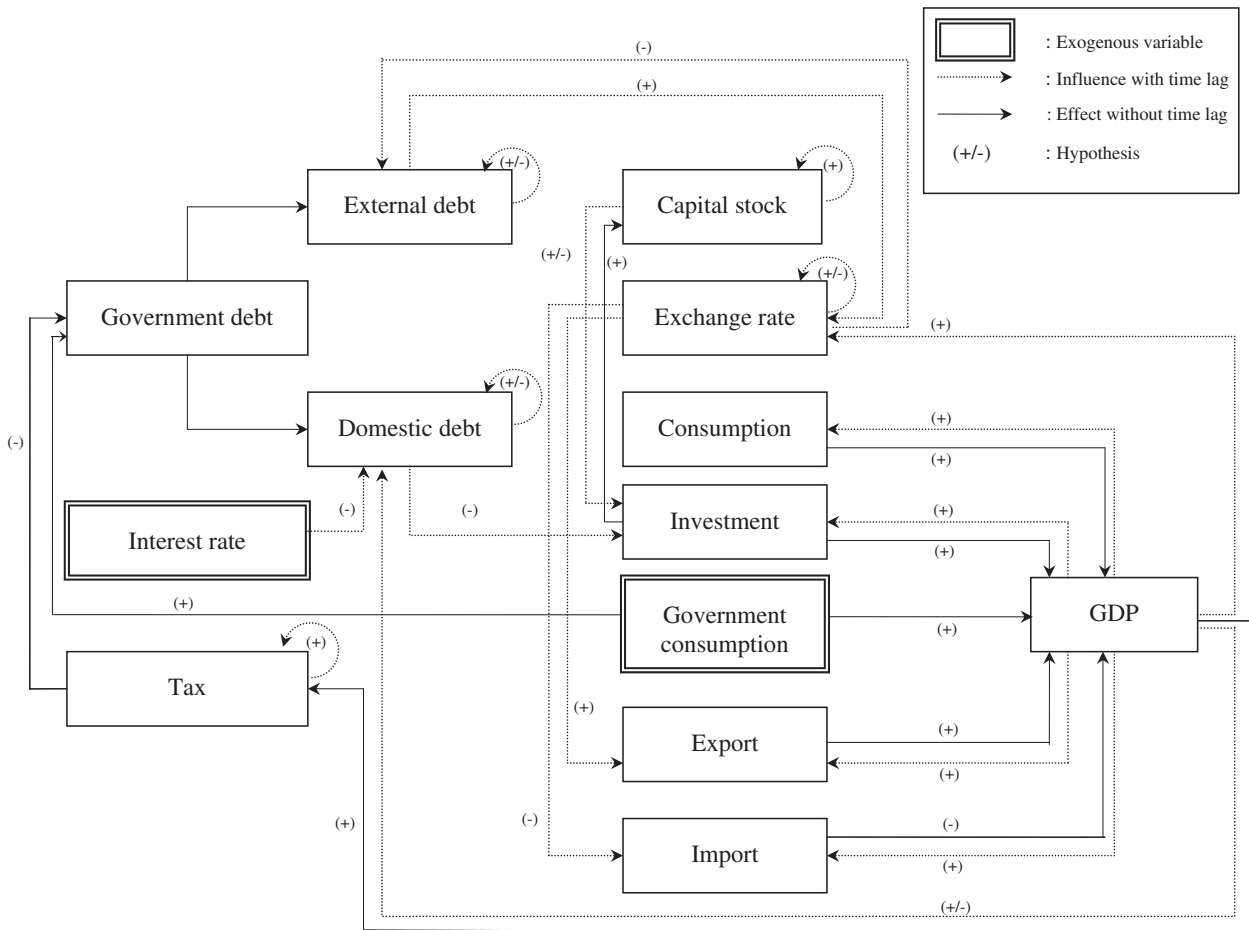


Fig. 2. Flowchart of a macroeconomic model for Indonesia.

Table 2. Descriptive statistics of data (in Rp million, unless indicated otherwise).

Variables	Mean	Standard Deviation	Min.	Max.	Average rate of change (%)
Consumption	8.46×10^{14}	2.19×10^{14}	4.59×10^{14}	1.16×10^{15}	6.61
Investment	3.14×10^{14}	7.38×10^{13}	1.47×10^{14}	4.33×10^{14}	5.02
Net government expenditure	9.91×10^{13}	2.17×10^{13}	6.74×10^{13}	1.41×10^{14}	5.2
Export	4.30×10^{14}	1.31×10^{14}	2.28×10^{14}	6.27×10^{14}	7.99
Import	3.72×10^{14}	9.34×10^{13}	2.25×10^{14}	5.13×10^{14}	6.66
Exchange rate (Rp/US\$)	6,212.52	4,079.69	1,992	14,166.65	29.19
Demand of debt	6.96×10^{14}	3.17×10^{14}	3.12×10^{14}	1.1×10^{15}	8.82
Domestic debt	2.56×10^{14}	2.62×10^{14}	2.45×10^{11}	5.85×10^{14}	370.91
External debt (US\$ million)	1.06×10^{11}	6.12×10^{10}	4.09×10^{10}	1.87×10^{11}	-3.08
Tax revenue	1.51×10^{14}	4.13×10^{13}	9.15×10^{13}	2.3×10^{14}	7.08
Non-tax revenue	7.73×10^{13}	1.57×10^{13}	6.02×10^{13}	1.14×10^{14}	4.62
Capital stocks	2.1×10^{15}	8.98×10^{14}	5.7×10^{14}	3.45×10^{15}	14.47
Real domestic interest rate (%)	3.74	3.6	-4.2	9.7	-31.93
GDP	1.32×10^{15}	2.78×10^{14}	8.35×10^{14}	1.77×10^{15}	5.32

$$C_t = -1.34 \times 10^{14} + \frac{0.88}{(16.38)^{***}} (GDP_{t-1} - Tx_{t-1})$$

$$\bar{R}^2 = 0.94, d = 2.0, n = 16 \tag{E-1}$$

** : significant at 5%, *** : significant at 1%

From the value of $\bar{R}^2 = 0.94$, we infer that about 94% of the variation in the annual consumption expenditure is explained by disposable income and that the coefficient of disposable income is significant at the 1% level. The MPC

value means that households spend 88% of each additional unit of disposable income on consumer goods and services.

b. Investment

Total average private investment of GDP is about 22.4%; it has a high contribution to the economic growth. We analyze a regression of private investment on lagged GDP, capital stock and domestic debt is shown as follows¹⁾:

$$I_t = -5.34 \times 10^{12} + 0.50 \text{ GDP}_{t-1} - 0.14 \text{ K}_{t-1} - 4.37 \times 10^{12} \left(\frac{B_{t-1}^D}{B_{t-2}^D} \right)$$

(-0.047) $(3.18)^{***}$ $(-3.15)^{***}$ $(-3.28)^{***}$

$$\bar{R}^2 = 0.68, d = 1.28, n = 16$$

***: significant at 1%

(E-2)

All coefficients have the theoretically expected signs and are significant at the 1% level. Domestic debt has a significant negative effect on investment because increased domestic debt implies a decrease in fund sources because of the so-called *crowding-out* effect. In this model, we assume that financial system in domestic market is determined by lagged domestic debt, B_{t-1}^D/B_{t-2}^D , and we judge that it is sufficiently good approximation for the purpose at hand. Data on capital stock and its depreciation, unfortunately, were not available for Indonesia. Therefore, we use the data of 1990 as the initial value of capital stock and assume that the depreciation rate is 5% over the period. Investment is proportional to the difference between optimal capital stock and the actual capital stock at the beginning of the period, where the desired capital stock is predicted on the assumption that the current level of sales will continue in the future. Lastly, GDP in the prior year has a positive effect on current private investment because of the expansion motive. About 68% of the variation in investment is explained by explanatory variables.

c. Export

A regression of total export on lagged values of GDP and the exchange rate is shown in the following equation.

$$EP_t = -1.04 \times 10^{14} + 0.36 \text{ GDP}_{t-1} + 30.05 \times 10^9 \tau_{t-1} - 20.23 \times 10^9 \tau_{t-1} Dm1_{t-1}$$

(-0.7) $(4.12)^{***}$ (0.58) (-0.50)

$$\bar{R}^2 = 0.80, d = 1.99, n = 16$$

***: significant at 1%

(E-3)

About 80% of the variation in export is explained by explanatory variables, indicating a high explanatory power. The relationship between the exchange rate and export is positive; however, it is not significant. As theoretically expected, if the value of domestic currency is depreciated or the nominal value of exchange rate τ increases, the quantity of export increases. The coefficient of the lagged value of GDP on export is positive and significant at the 1% level.

Many researches show that FTA has positive effect on economy. There are four regional and multilateral agreements that currently bind Indonesia, namely AFTA, APEC, WTO and ASEAN-China FTA. For example, AFTA (ASEAN Free Trade Area) was introduced in 1992 as ASEAN countries agreed to form an FTA among its members. Even though there were many significant improvements in AFTA implementation, some ASEAN members still have no motivation to fully open their markets (Hartono, *et al.*, 2007). McGuire (2004) offers the criticism that Indonesia had no specific trade policy. The government only adjusted tariff and non-tariff rates reactively in dealing with international trade problem. These reasons discourage us to introduce free trade area variable.

In this model, we don't consider oil sector as a variable. Rising crude oil price has a positive effect on government revenue; however, transfer payments for petroleum subsidy and social security programs also increase. The oil sector contributes about 20% of government domestic revenue. Beside this positive effect, rising oil price generates a negative multiplier effect on the economy: transportation costs, energy costs, and other costs of production increase. This is the reason that we prefer using export variable without classifying oil and non-oil sectors. Another reason is that total export of Indonesia has been determined by various non-oil manufacturing industries rather than oil sector, since 1990s. The recent situation is different from Indonesia's economy in 1970s and 1980s when oil sector contributed significant share of export. As an oil exporting country, Indonesia had been a member of OPEC (the Organization of Petroleum Exporting Countries) from 1961 to 2008. However, Indonesia is a small member of OPEC and the only Asian one, by the quota of oil production is 1.425 million barrels per day. Indonesia's membership of OPEC was voluntarily suspended recently as it had become a net oil importer. The government lowered its oil sales in 2008 to 927,000 barrel a day from previous 1.034 million barrels in 2007.

d. Import

A regression of import on the lagged values of exchange rate and GDP is estimated by the following equation.

$$IM_t = -5.35 \times 10^{12} - 5.44 \times 10^9 \tau_{t-1} + 0.32 \text{ GDP}_{t-1} + 2.04 \text{ Dm1}_{t-1}$$

(-0.072) (-0.59) $(5.02)^{***}$ (0.26)

$$\bar{R}^2 = 0.73, d = 1.53, n = 16$$

***: significant at 1%

(E-4)

As theoretically expected, depreciation of domestic currency over foreign currency discourages import. The coefficient has a correct sign, but it is not significant. Meanwhile, GDP in the previous year has a positive coefficient on import and is significant at the 1% level. It is reasonable that GDP growth has a positive correlation with purchasing power. About 73% of the variation in import is explained by explanatory variables, indicating a relatively high explanatory power.

e. Exchange Rate

The exchange rate model for Indonesia can be found in Fukuchi and Tokunaga (1999) which consider external transactions to estimate exchange rate related to the Asian currency crisis 1997. In the present estimation, we adopt lagged values of net export, GDP, external debt and exchange rate as independent variables. External transactions in this case are shown by lagged net-export and external debt. External debt is predicted to become a determinant of exchange rate due to foreign currency inflow. We assume no capital inflows such as foreign direct investment. Because of technical data source, we prefer to use the present approach. We also assume that the influences of shocks related to financial crisis 1997 are implicitly considered by manipulating the dummy coefficient. We obtain the estimated equation as follows:

$$\tau_t = \underset{(-0.26)}{-497.38} - \underset{(-2.71)**}{31.30} \times 10^3 \left(\frac{NX_{t-1}}{GDP_{t-1}} \right) + \underset{(1.92)*}{1.04} \times 10^{-11} (\tau_{t-1} B_{t-1}^F) - \underset{(-2.59)**}{0.33} \tau_{t-1} + \underset{(11.09)**}{9,830} Dm1_{t-1}$$

$$\bar{R}^2 = 0.97, d = 2.43, n = 15 \quad (E-5)$$

*: significant at 10%, **: significant at 5%, ***: significant at 1%

The value of $\bar{R}^2 = 0.97$ is high, therefore, those explanatory variables are useful to determine the domestic exchange rate value. Real income of a country is influenced by a cross border comparison of real income among countries, which is systematically exaggerated by GDP conversion at market exchange rates. This is the reason of using a two-step-estimation by introducing net export to GDP ratio. Increase in ratio of net export to GDP has positive effect on exchange rate appreciation. Rising net export determines domestic currency appreciation because of increased external currency reserve. Our calculation shows that net export to GDP ratio is significant at the 5% level. Meanwhile, an increase in external debt has a contribution to depreciate the domestic currency. It is significant at the 10% level. This result can be explained by the fact that external debt repayment will reduce total external currency reserve. Moreover, rupiah depreciation results in soaring debt repayments. Although we introduce the real external debt in rupiah, $\tau_{t-1} B_{t-1}^F$, together with exchange rate, τ_{t-1} in the equation, however, Pearson's correlation coefficient between real external debt and exchange rate is very low, 0.16. In this case, foreign currency inflow has no effect in the same way as the Dutch disease hypothesis. The phenomenon of Dutch disease in Indonesia as an effect of oil boom can be seen in Usui (1996). However, we neglect crude oil prices as a variable due to decrease in oil production.

Therefore, rising external debt can exacerbate exchange rate problems. Moreover, inadequate external debt control will generate a debt trap problem. Usually, a *Ponzi*-scheme-like strategy is used to overcome insufficient liquidity, in such way that all principal and interest repayments are forever "rolled over": financed by issuing new external debt. Finally, it is difficult to interpret the value of exchange rates based on a lagged value of exchange rates. If the previous exchange rate is depreciated greatly, as through economic turbulence, perhaps it will need a long time to recover, as depicted in Fig. 3.

f. Demand of Debt

We use Eq. (5) to estimate the demand of debt and overcome the existence of discrepancies. The estimated equation is shown in the following equation.

$$B_t = \underset{(-5.51)**}{-1.96} \times 10^{15} + \underset{(6.28)**}{6.40} [(1 + i_t^D) B_{t-1}^D + (1 + i_t^F) B_{t-1}^F - S_t] - \underset{(-3.05)**}{0.90} GDP_{t-1}$$

$$\bar{R}^2 = 0.84, d = 1.03, n = 15 \quad (E-6)$$

***: significant at 1%

We use the lagged value of GDP as a variable to eliminate discrepancies. As a result, the explanatory power is high and the coefficients of all explanatory variables are significant at the 1% level. This result implies that this equation is useful to mitigate the discrepancy problem.

g. Domestic Debt

Domestic debt is estimated by some explanatory variables, those are lagged domestic debt, GDP and domestic interest rate. We included government expenditure and government revenue as independent variables; however, we found that the coefficients are not significant. We adopt estimated equation as shown by the following equation.

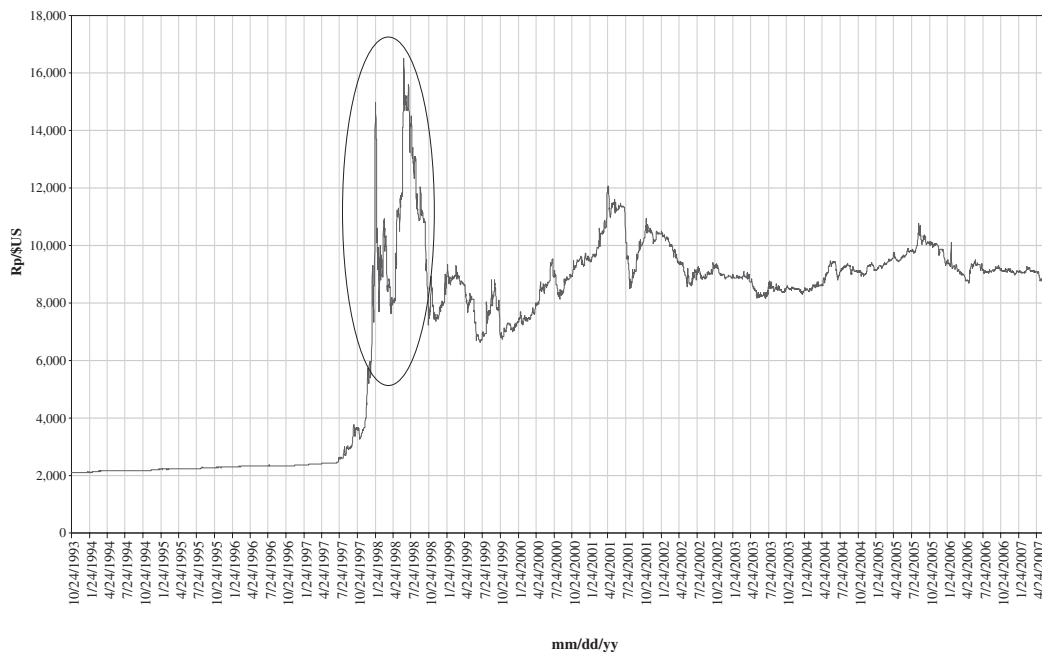


Fig. 3. Daily exchange rate, 1993–2007 (in Rp/US\$).
 Source: FX History, available from: www.oanda.com/convert/fxhistory (illustrated by authors)

$$\hat{B}_t^D = 2.97 \times 10^{13} + 3.21 \times 10^{14} \left(\frac{B_{t-1}^D - B_{t-2}^D}{GDP_{t-1}} \right) - 9.21 \times 10^{11} i_{t-1}^D + 4.78 \times 10^{14} Dm2_{t-1}$$

$\bar{R}^2 = 0.96, d = 1.32, n = 16$
(E-7)

*: significant at 10%, ***: significant at 1%

About 96% of the variation in demand for domestic debt is explained by explanatory variables. The domestic interest rate has a negative effect on the demand for domestic debt; theoretically the coefficient has a correct sign, but it is not significant. Indonesia’s interest rate is determined by the market mechanism. However, in practice, the central government intervenes level of interest rate significantly, and as a consequence it is difficult to determine interest rate endogenously. The same approach, that interest rate is introduced exogenously, can be seen in Fukuchi and Tokunaga (1999). We refer the Bank Indonesia certificates (SBI) to represent interest rate. Actually, SBI is used by the banking system to determine level of interest rate in the market. Furthermore, recently BI rate is used by Bank Indonesia as a benchmark for SBI auction. Based on the estimated equation, a rising stock of domestic debt in the prior year does not discourage the demand for domestic debt in the current year. Meanwhile, GDP growth in the prior year has a negative effect on the demand for domestic debt. The lagged domestic debt growth to GDP ratio is significant at the 10% level.

h. External Debt

The stock of external debt is estimated by some explanatory variables, those are the lagged values of exchange rate, external debt and net export. We also included government expenditure and government revenue as independent variables; however, we found that the coefficients are not significant. We adopt estimated equation as shown by the following equation.

$$\hat{B}_t^F = 3.82 \times 10^{11} - 9.30 \times 10^6 \tau_{t-1} - 1.28 B_{t-1}^F + 1.44 \times 10^{-3} (EP - IM)_{t-1} - 3.18 \times 10^{11} Dm1_{t-1}$$

$\bar{R}^2 = 0.72, d = 2.17, n = 15$
(E-8)

**: significant at 5%

Depreciation of domestic currency induces higher repayments, so that demand for foreign debt decreases. Moreover, an increase in external debt in the prior year discourages demand for external debt in the current year. Although the signs of all coefficients of explanation variables are as theoretically expected, the first two coefficients are not significant. While, the third one shows that an increase in net export stimulates confidence of the central government to issue more external debt, and it is significant at the 5% level. About 72% of the variation in demand for domestic debt is explained by explanatory variables.

Table 3. Composition of nominal non-tax revenues, 2000–2006 (in Rp billion).

Non-tax revenues	2000	2001	2002	2003	2004	2005	2006*
I. Natural resources	76,290	85,672	64,755	67,510	91,543	110,467	151,642
1.1. Oil	50,953	58,672	47,686	42,969	63,060	72,822	110,138
1.2. Gas	15,708	22,091	12,325	18,533	22,199	30,940	36,097
1.3. Other	9,629	4,909	4,744	6,008	6,284	6,705	5,407
II. Profit transfers from State Owned Enterprises (SOEs)	4,018	8,837	9,760	12,617	9,818	12,835	23,278
III. Other non-tax revenues	9,114	20,550	13,925	18,754	21,185	23,586	30,373
Total non-tax revenue	89,422	115,059	88,440	98,880	122,546	146,888	205,292
Total tax revenue	115,913	185,541	210,087	242,048	280,559	347,031	416,313

Note: * budget

Source: BPS (Indonesian Statistical Bureau), various years.

i. Tax Revenue

Tax revenue is the most important source of government financing. Our calculation obtains the following result.

$$Tx_t = -2.93 \times 10^{13} + 0.10GDP_t + 0.33Tx_{t-1}$$

(-1.92)*
(3.95)***
(1.74)*

$$\bar{R}^2 = 0.92, d = 1.86, n = 16 \quad (E-9)$$

*: significant at 10%, ***: significant at 1%

Increased GDP has a positive effect on tax revenue, and is significant at the 1% level. Tax revenue in the previous year has a positive effect on tax revenue in the current year; the coefficient is significant at the 10% level. The value of \bar{R}^2 is high, about 92% of the variation in tax revenue is explained by explanatory variables.

j. Non-Tax Revenue

Regression of non-tax revenue on the lagged value of non-tax revenue and the time variable yields the following result.

$$NTx_t = -4.36 \times 10^{15} + 0.29NTx_{t-1} + 2.21 \times 10^{12} t$$

(-3.37)***
(1.14)
(3.39)***

$$\bar{R}^2 = 0.65, d = 1.82, n = 16 \quad (E-10)$$

***: significant at 1%

Table 3 shows that oil and gas dominate the composition of non-tax revenue. The lagged value of non-tax revenue has a positive effect on non-tax revenue in the current year, but the coefficient is not significant. Effect of time on non-tax revenue is significant at the 1% level. We infer that about 65% of the variation in the annual non-tax revenue is explained by explanatory variables.

4. Final Test of the Model

We check and evaluate the performance of the econometric model proposed in the previous section using a final test. The mean absolute percentage error (MAPE) for endogenous variable Z is calculated as

$$\frac{1}{n} \sum_{t=1}^n \frac{|\hat{Z}_t - Z_t|}{Z_t},$$

where \hat{Z}_t is the predicted value of endogenous variable at time t and Z_t is the actual value of that variable at t . By giving actual values of exogenous variables for $t = 1991-2005$, and actual values of endogenous variables at the first period $t = 1991$, all endogenous variables are predicted for $t = 1992-2005$. The result is as presented in Table 4.

A large error is associated with estimation of domestic debt that is around 195%. After the financial crisis of 1997, domestic debt increased greatly as a result of government policies to recapitalize the banking system. A final test shows that the error of prediction of domestic debt was very high before the crisis, but small after the crisis. It is difficult to reconcile the data especially in transition term, before and after financial crisis 1997, for domestic debt. Domestic debt erupted very deeply after crisis in order to bail-out the financial system. As a result, this value induced bigger deviation for the whole system of model. We predict that even if structures are re-estimated, the performance of the model will not be improved to great extent. In particular, the average errors of the exchange rate, total debt, and external debt are small; they are, respectively, 13.4%, 15.2% and 16.2%. Although, it is not an extremely good result, it can be judged

Table 4. MAPE values of endogenous variables (%).

Endogenous variables	<i>C</i>	<i>I</i>	<i>EP</i>	<i>IM</i>	<i>Y</i>	<i>B^D</i>	<i>B^F</i>	<i>B</i>	τ	<i>K</i>	<i>NTx</i>	<i>Tx</i>
MAPE for all periods	35.8	52.9	41.8	35.2	34.5	195.0	16.2	15.2	13.4	48.8	27.5	45.9
MAPE before crisis	23.8	18.4	32.8	24.5	22.5	394.0	17.3	19.2	19.9	17.0	23.2	50.0
MAPE after crisis	46.2	83.1	49.8	44.5	43.4	20.9	15.3	11.6	7.8	36.7	65.8	48.2

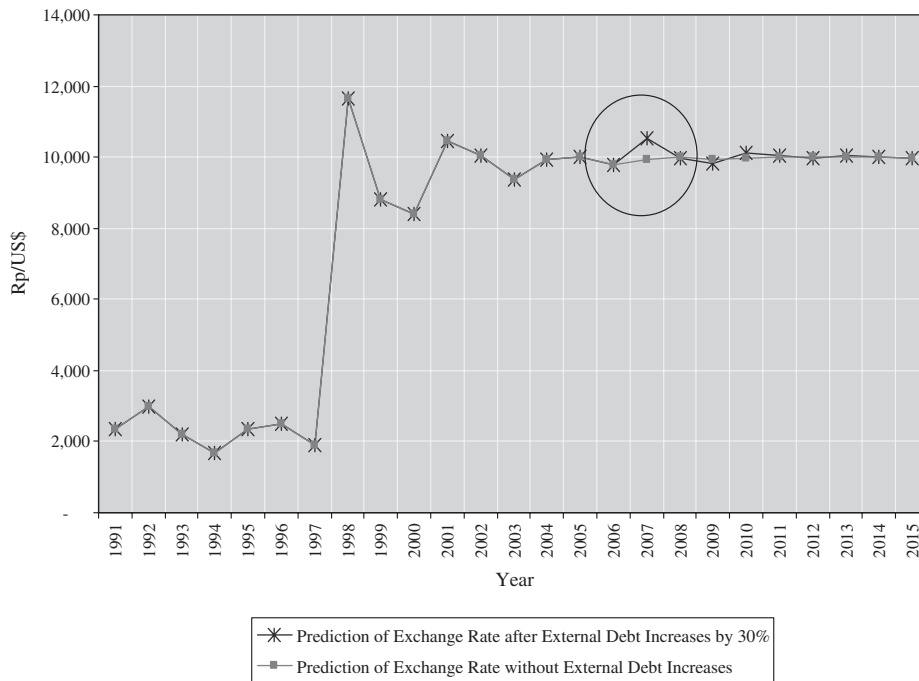


Fig. 4. Effect of external debt increases on exchange rates (in Rp/US\$).

that the adopted structures of the model are useful for evaluating the effects of external and domestic debt on Indonesia’s economy.

5. Simulation Analysis

In the simulation analysis, we address the effect of increased domestic and external debt on exchange rates, investment, and growth for the following scenarios:

- a. Predicting the situation of economy within 15 years when there is no independent debt increase.
- b. Investigating the effect of raising external debt by 30% during 2006.
- c. Investigating the effect of raising domestic debt by 30% during 2006.

The debt amount, whether domestic or external, is determined endogenously in the model. However, to simulate scenarios (b) and (c), we modify the equation for debt determination (5) as follows:

$$B_t = \alpha + \beta\{(1 + i_t)B_{t-1} - [G_t^R - (G_t^E - i_t B_{t-1})]\} + \gamma GDP_{t-1} + IB_t \tag{5-1}$$

In that equation, IB_t is determined “independently” by government policy. We assume that the government issues a new debt policy during 2006 by raising the demand of independent debt, which consists of both external and domestic debt. In this analysis, we predict results for a future time period $t = 2006-2015$: total net government consumption G_t , domestic interest rate i_t^D , external interest rate i_t^F and $[G_t^I + G_t^C + Tr_t - i_t B_{t-1}]$. The results are summarized as follows: 1) Increased external debt by 30% lowers the exchange rate, as shown in Fig. 4. A shock in the exchange rate occurs especially for short-term debt. Of course, as consequence, it has a negative effect on short-term debt repayment. As an effect of it, the government must make higher debt repayment in an external currency, which negatively affects the total external currency reserves.

2) Increased external debt by 30% positively affects investment, as shown in Fig. 5. This is because external debt has a positive effect on GDP, which will stimulate future investment. This scenario demonstrates that external debt plays an important role in investment, but the government must consider the effects of increased external debt on the exchange rate.

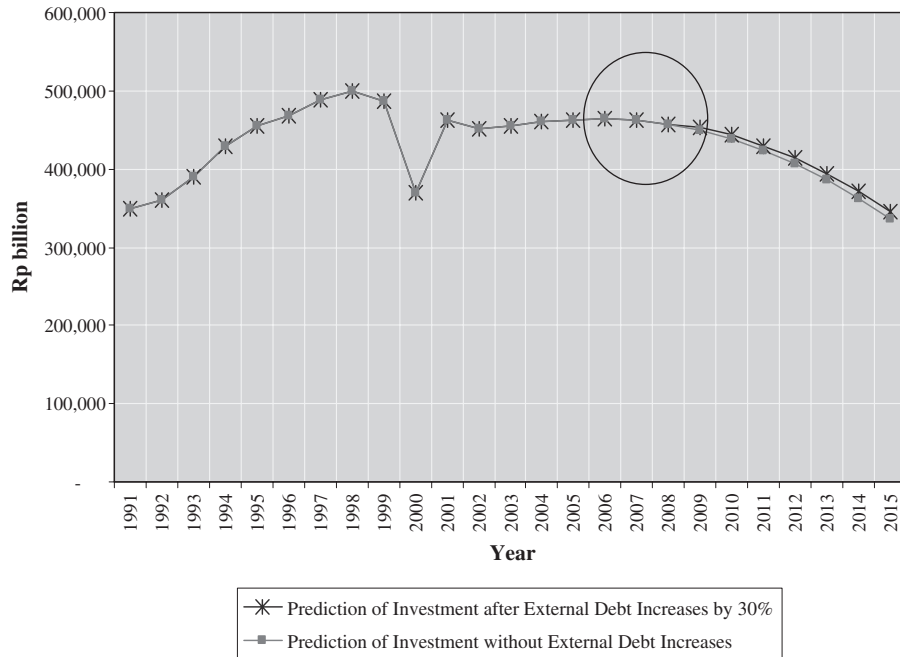


Fig. 5. Effect of external debt increases on real investment (in Rp billion).

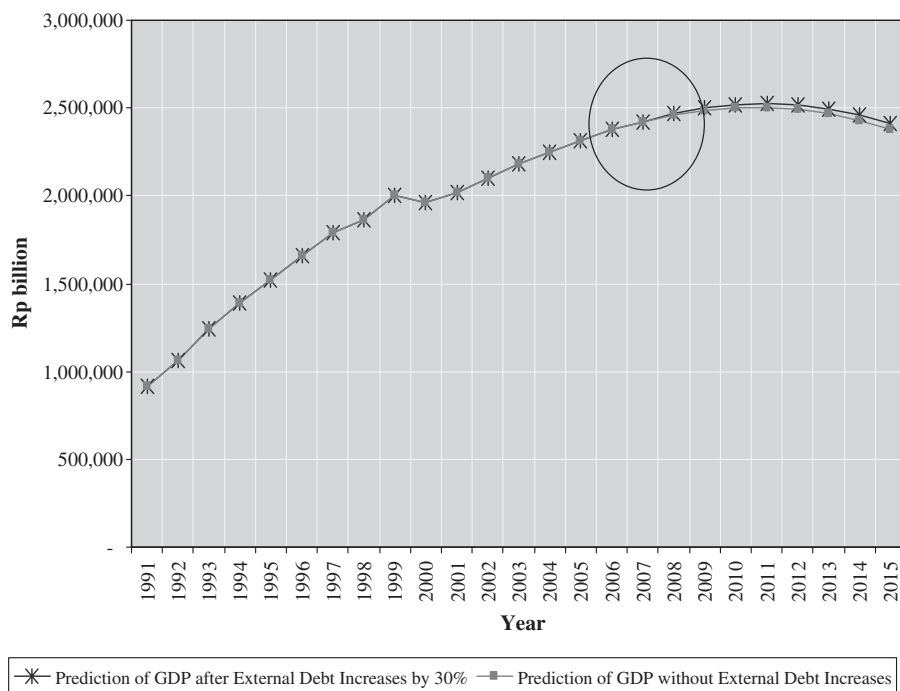


Fig. 6. Effect of external debt increases on real GDP (in Rp billion).

- 3) Increased external debt has a positive effect on growth, as shown by Fig. 6. It might be readily apparent that more financing has a positive effect on growth. Investigation of the model suggests several reasons for this positive relationship: a) export increases because of domestic currency depreciation; b) higher GDP in the prior year has positive effects on consumption, investment, export, and import.
- 4) Effect of increased domestic debt on investment is our main focus of this research. Increased domestic debt discourages private investment; the relationship is shown in Fig. 7. Increased domestic debt reduces the total supply of fund in domestic market. Therefore, the quantity of private investment falls. Result of this scenario demonstrates that rising trend of domestic debt generates a crowding-out effect.
- 5) Furthermore, increased domestic debt exerts a negative effect on growth, as shown in Fig. 8. As described earlier, rising domestic debt negatively affects private investment, and therefore negatively affects growth.

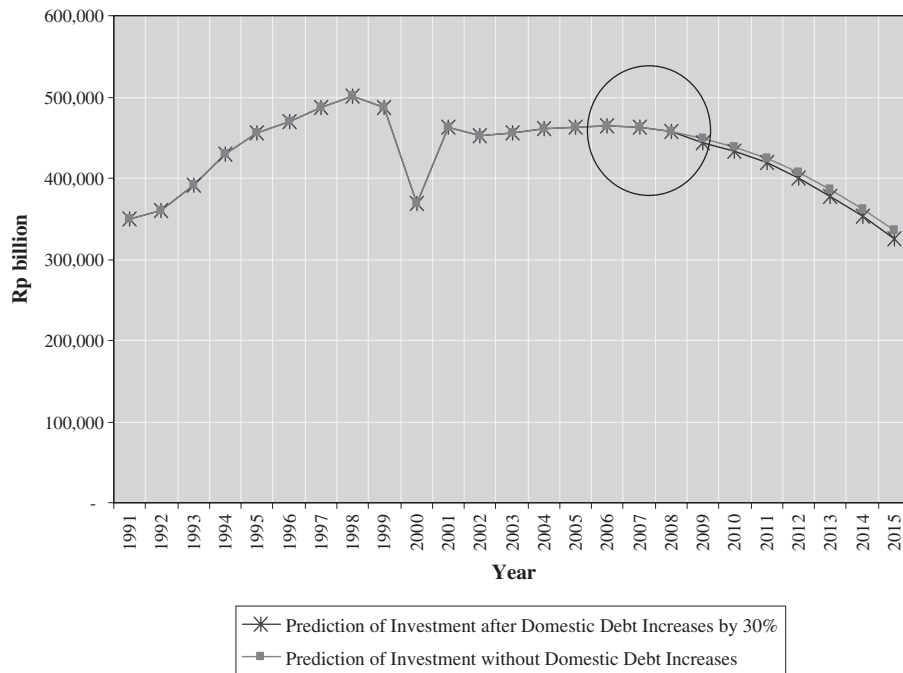


Fig. 7. Effect of domestic debt increases on real investment (in Rp billion).

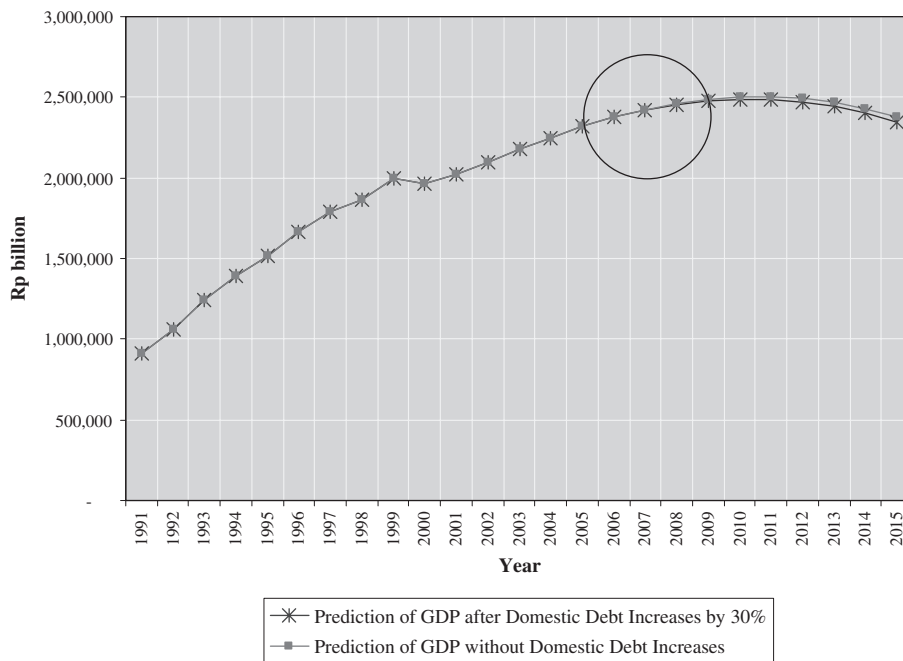


Fig. 8. Effect of domestic debt increases on real GDP (in Rp billion).

6. Concluding Remarks

We shall conclude the explanation of analyses related to the roles of external and domestic debt in Indonesia's economy as follows: the rising trend of external debt has become a central policy to overcome deficit. It has generated positive effects on both investment and economic growth. However, aside from these positive effects, the policy triggers domestic currency depreciation. It is related to negative effects of rising external debt repayment on external currency reserve. Together with external debt, since the financial crisis in 1997, the Indonesian government has issued an enormous amount of domestic debt. However, this policy has generated a side effect of discouraging private investment because, as funding resources decrease, the so-called *crowding-out effect* occurs. As a result of the investment decrease, economic growth decreases. In the future research policy simulation analysis for improving primary balance need to be pursued.

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Notes:

¹⁾ We tried to introduce domestic interest rate to explain private investment function; however, the result is not significant. Finally, we estimate investment as shown by equation (E-2).

Appendix

Definition of symbols:

- B_t : total government debt in period t
- B_t^D : total domestic debt in period t
- B_t^F : total external debt in period t
- \hat{B}_t^D : estimate of domestic debt in period t
- \hat{B}_t^F : estimate of external debt in period t
- b_t : total government debt to GDP ratio in period t
- b_t^* : benchmark for maximum total debt in period t
- τ_t : exchange rate (Rp/US\$) in period t
- i_t : interest rate in period t
- i_t^D : domestic interest rate in period t
- i_t^F : external interest rate in period t
- S_t : primary surplus in period t
- GDP_t : gross domestic product in period t
- Y_t : aggregate demand in period t
- Y^E : aggregate demand
- Y^P : aggregate supply
- C_t : consumption in period t
- I_t : investment in period t
- G_t^R : government revenue in period t
- G_t^E : government expenditure in period t
- G_t : net government consumption in period t
- G_t^C : government consumption in period t
- G_t^I : government investment in period t
- G_t^K : public capital stock in period t
- Tr_t : transfer payment in period t
- EP_t : export in period t
- IM_t : import in period t
- NX_t : net export in period t
- Tx_t : tax revenue in period t
- NTx_t : non-tax revenue in period t
- FA_t : total foreign aid in period t
- K_t : capital stock in period t
- δ_t : depreciation rate for private capital stock in period t
- $\hat{\delta}_t$: depreciation rate for public capital stock in period t
- Sv_t : national saving in period t
- $Dm1_t$: exchange rate dummy in period t
- $Dm2_t$: domestic debt dummy in period t
- ε_t : discrepancy of demand of debt in period t

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