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Debt Service – Income Nexus: A Cointegration Analysis of Indonesia

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Abstract

This paper analyzes long term and short term relationships between external debt service and income in Indonesia. These relationships use an extended production function model that measured GDP as a function of debt service ratio (DSR), capital stock, labor and human capital in which all data are represented by constant Rupiah.

Applying cointegration analysis of time series model from 1980–2005, we show that Indonesia faces a debt overhang problem in the long run since increasing the external debt service ratio slows economic growth. One percent increases in (1+DSR), elasticity of GDP will decrease by 0.1 percent. Labor and capital stock are the main variables supporting GDP in the long run. Moreover, elasticity of income to human capital is relatively small at 0.02 percent. The results of the short run equation show that change in capital stock is a significant variable in boosting economic growth. However, the variable of external debt repayment over total export shows insignificant values in relation to depressing GDP. A positive shock of one standard deviation of the change of debt service over total export makes the change of income stable in the short run.

Keywords: Indonesia, debt service ratio, debt overhang, cointegration

1. Introduction

Since the Old Order (Orde lama), Indonesia has used foreign borrowing to finance development. Indonesia utilized foreign debt, resulting from a lack of resources, during the first period of 1960s. Foreign borrowing reached USD 2,015 million in the mid 1960s, while export earning was only USD 679 million, but need to service its debt. The country became deeply indebted by 1966, and the government ran up a large budget deficit by printing money. As a consequence, annual inflation increased dramatically from about 51 percent in 1961 to 635 percent in 1966. This situation forced the government to begin discussion with creditors about a moratorium on Indonesian foreign debt. The discussion focused on rescheduling foreign borrowing under the Paris Club initiative[1]. In 1969/1970 fiscal year, nearly 80 percent of the development budget was financed through foreign aid (Hill, 1996).

During the oil boom years of the 1970s and 1980s, economic conditions improved and the

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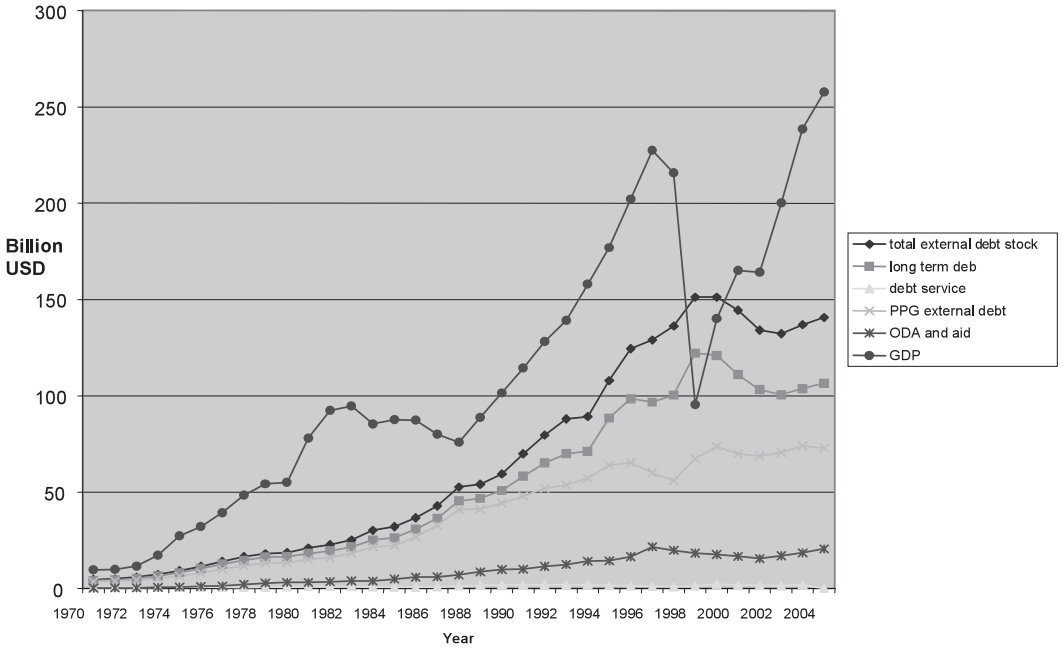
government gained revenue from oil earnings. However, stock of foreign borrowing jumped to more than USD 4 billion by the end of the 1970s and increased by almost five times to USD 20.9 billion in 1980. Declining oil prices in the first half of the 1980s resulted in the rapid accumulation of debt. Both total debt and its proportion of GDP, approximately doubled between 1980 and 1986. Percentage of total external debt on GDP increased from 26.8 percent in 1980 to 53.6 percent in 1986.

In the late 1980s and mid 1990s, during Indonesia's economic boom, foreign debt incurred by state-owned and private enterprises also increased. The investment climate was conducive to borrowing, and supported by political stability. The economy grew at an average of 7–8 percent annually, attracting foreign investors. However, higher domestic interest rates forced local investors to look for other alternative resources from abroad. Therefore, private debt increased significantly during this period. The debt service ratio in the 1980s, especially in 1988 and 1989 rose to an average 40 percent, but then declined as rapid export growth took hold. Accurate data on private debt in the 1990s, especially that with a short-term maturity, is limited (Hill, 1996).

When the Asian financial crisis surfaced in mid 1997, external debt increased significantly from more than USD 136 billion in 1997 to more than USD 151 billion in 1998, mainly due to the depreciation of Rupiah (Figure 1). In terms of repayment of debt, after paying more than USD 21.5 billion in 1996, from 1997 to 2002, the external debt service burden decreased modestly. Figure 1 shows that from 1970 to 1996, the total debt and debt services burden increased. However, from 1970 to 1996 GDP increased significantly, and then dropped dramatically in 1999 due to the massive impact

Figure 1 Total External Debt of Indonesia



Source: World Development indicator, World Bank.

of the Asian financial crisis. The ratio external debt over GDP during the Asian crisis (1998–1999) achieved the highest level, on average more than 130 percent per GDP.

The ratio of external debt over GDP and external debt over export decreased significantly from 2000 to 2003. However, debt service ratio during this period, 2000 to 2003 increased slightly from 24.6 percent to 28 percent. Share of private debt to total external debt after the year 2000 declined slightly. In 2004 and 2005, share of public external debt on total debt was bigger than share of private external debt (Table 1). Total external debt outstanding declines from 137 billion USD in 2004 to 125.3 billion USD in 2006.

Increase in external debt creates problems since whenever a country has debt accumulation, a high proportion of public expenditure and foreign exchange earnings are absorbed by the debt burden with heavy opportunity costs. Furthermore, increase of external debt may have negative effects on investment through debt overhang and credit-rationing (Eduardo, 1989). Similarly, external debt service (in contrast to the total debt stock) can also potentially affect growth by crowding out private investment or changing the composition of public spending (Clements, Bhattacharya, and Nguyen 2003). Referring to these facts and the channel in which debt repayment affects economic growth in Indonesia, the objective of this paper is to investigate the relationship between growth and debt service burden and to analyze whether or not the debt overhang phenomenon has occurred in Indonesia.

The paper is divided into seven sections. The first part is the introduction. Section two presents definitions and characteristics of the debt overhang in Indonesia. Section three provides a description of the theoretical and empirical study. Section four specifies the model and hypothesis. The following section explains about data and variables. Section six describes the results. Finally, section seven presents the conclusion and policy responses.

Table 1 External Debt Outstanding (million USD)

Period	Government	Share of Gov debt to Total(%)	Private				share of private debt to total(%)	Total
			financial institution		Non financlial lnstitution	Sub total		
			Bank	Non Bank				
2001	71,377	53.6	6,649	1,064	53,983	61,696	46.4	133,073
2002	74,661	56.8	4,870	2,772	49,040	56,682	43.2	131,343
2003	81,666	60.3	4,316	3,221	46,198	53,735	49.7	135,401
2004	82,725	60.4	3,909	4,306	46,084	54,299	39.6	137,024
2005	80,072	61.3	4,057	2,329	44,194	50,580	38.7	130,652
2006	74,126	59.2	3,918	1,755	45,458	51,132	40.8	125,258

Source: Central Bank of Indonesia and authors estimation.

2. Definitions and Characteristics of Debt Overhang in Indonesia

Many studies employ external debt stock (in contrast to external debt service) to analyze the impact of debt variable on economic growth. Some direct and indirect channels may describe the relationship between external debt and growth through debt overhang hypothesis, increases in domestic interest rate and downturn economy activities that cause decreasing profitability. This study defines debt overhang as a situation in which external debt service (in contrast to debt stock) may potentially affect growth by crowding out private investment or changing the composition of public spending. The mechanism is as follows: higher debt service can raise the government's interest bill and budget deficit, reducing public saving; this, in turn, may either raise interest rates or crowd out credit available for private investment, finally dampening economic growth (Clements et al. 2003). Higher debt service payments can also have adverse effects on the composition of public spending by squeezing the pool of resources available for infrastructure and human capital spending, with negative effects on growth (Sachs, 1989). The characteristics of debt overhang may be described as altering the composition of public spending (education expenditure) and increasing interest rates leading to crowd out private investment and finally reducing GDP.

From 1982 to 1989, external debt service increased from 22,052 billion Rp to 81,736 billion Rp. However, education expenditures declined in the same period from 11,255 billion Rp to 7,904 billion Rp. The domestic interest rate increased three times from 6 percent in 1982 to around 18 percent in 1989. Furthermore, the interest rate jumped dramatically from 17 percent in 1990 to 39 percent in 1998 due to the Asian financial crisis. After the crisis, the domestic interest rate stabilized at around 12 percent (Table 2).

Other characteristics of debt overhang in Indonesia are identified based upon the study of IMF and World Bank that has established a 'safe' level of external debt in which the ratio of external debt over GDP is between 35–42 percent (IMF, 2005)[2]. Above this threshold level, external debt leads to a lower growth rate. Furthermore, the ratio of debt service including principal payment and interest payment should be 20 percent of total export of goods and services. Beyond this debt service ratio (DSR) threshold, economic growth will be discouraged (WB & IMF, 2006)[3].

During the period of study (1980 to 2005), the debt service ratio, the ratio of debt service of initial and interest payment over total export was on average 28.9 percent. This means more than one quarter of total export went to service the debt. The ratio of total external debt over GDP shows an average 58.3 percent during the period of study (See Table 3). This value is more than the 'safe' level of debt suggested by IMF and the World Bank. In 1970 total external debt was 4.5 billion USD. It increased almost five times in the 1980s. Debt crises in the 1980s and declining oil prices in the first half of the 1980s resulted in the rapid accumulation of debt. Total debt and its proportion of GDP approximately doubled between 1980 and 1986 (Figure 1 and Table 3). During the period 1982 – 1986,

Table 2 Debt Service, Public Spending and Interest Rate Constant Price of Local Currency (Rp)

Year	GDP (Bill Rp)	External Debt Service (Bill Rp)	Education expenditure (Bill Rp)	Deposit Interest rate %
1979	455,626.2	25,331.7	4,724.4	6.0
1980	495,379.5	19,585.3	3,376.1	6.0
1981	535,740.0	20,231.2	7,214.6	6.0
1982	541,659.0	22,052.4	11,255.3	6.0
1983	587,428.7	25,743.5	10,059.8	6.0
1984	629,559.9	34,823.0	10,519.6	15.4
1985	651,453.2	43,431.0	10,147.2	18.0
1986	690,309.2	51,594.3	7,703.6	15.4
1987	726,895.6	67,026.3	5,948.8	16.8
1988	773,094.8	75,249.9	5,555.6	17.7
1989	843,328.2	81,735.9	7,904.2	18.6
1990	919,241.0	79,903.4	8,945.4	17.5
1991	1,001,309.0	89,605.8	10,026.2	23.3
1992	1,073,608.5	96,132.7	11,412.6	19.6
1993	1,151,488.9	102,672.8	12,446.7	14.6
1994	1,238,311.9	99,875.3	9,918.0	12.5
1995	1,342,285.0	109,013.0	9,920.5	16.7
1996	1,444,873.0	136,899.1	10,772.5	17.3
1997	1,512,780.2	138,389.8	11,271.6	20.0
1998	1,314,201.7	252,109.1	7,528.7	39.1
1999	1,324,598.8	167,131.5	10,095.0	25.7
2000	1,389,770.0	140,481.1	5,396.8	12.5
2001	1,442,985.3	136,543.8	7,870.6	15.5
2002	1,506,124.4	127,405.2	9,140.1	15.5
2003	1,579,558.9	122,205.1	11,626.0	10.6
2004	1,660,578.8	131,895.4	10,995.7	6.4
2005	1,749,547.0	101,189.1	16,387.4	11.0

Source: Authors calculation based upon World Develeopment Indicator (WB) and Ministry of Finance, Indonesia.

falling oil prices, rising external debt and decline in economic growth in 1982 signaled an end to a decade of oil-financed growth and abundance. During this period, ratio debt over GDP and ratio debt service payment over export showed 38.8 percent and 24.5 percent respectively. Indonesia began to face debt overhang (heavy debt burden) in this period. Perhaps the most difficult period of debt management was 1986–1987 when there was a large current account deficit and rapid appreciation of the yen, in which some 40 percent of Indonesia's debt was denominated (Hill, 2000). During the period 1982–1989, public spending, represented by education expenditure, decreased as the domestic interest rate increased. This shows that if utilization of debt focused on consumption activities rather than activities enhancing export, it might discourage economic growth[4]. Afxentiou and Serletis (1996)

Table 3 External Debt Indicator of Indonesia

Year	Total External Debt (billion Rp)	Percentage of External Debt/GDP	Percentage of External Debt/Export	Percentage of External Debt Service /Export (DSR)	Percentage of Interest payment/export
1979	11,603.7	33.8	110.5	18.2	0.3
1980	13,127.8	26.8	78.5	11.6	0.3
1981	14,379.5	24.6	84.8	13.0	0.5
1982	16,623.7	26.5	104.9	16.1	0.6
1983	27,486.5	35.4	134.4	16.6	0.8
1984	32,856.5	36.6	142.9	21.6	1.2
1985	40,775.2	42.0	189.4	30.0	1.3
1986	55,042.9	53.6	275.1	38.4	1.5
1987	86,359.9	69.2	289.1	38.5	1.8
1988	91,160.4	60.9	256.2	40.9	2.0
1989	105,144.5	58.6	241.1	39.9	2.3
1990	128,760.1	61.1	241.1	34.3	2.4
1991	155,143.5	62.1	240.6	34.7	2.5
1992	178,637.5	63.3	226.8	32.1	2.2
1993	186,111.0	56.4	210.9	33.3	2.4
1994	232,980,9	61.0	229.9	30.4	2.4
1995	279,722.9	61.5	233.9	30.8	2.7
1996	302,007.9	56.7	219.6	36.7	2.8
1997	396,143.5	63.1	226.5	32.8	3.3
1998	1,514,417.2	158.5	299.1	36.2	10.8
1999	1,187,860.5	108.0	304.1	35.5	10.4
2000	1,216,308.2	87.5	213.6	24.7	10.9
2001	1,375,594.2	81.7	214.1	24.8	10.6
2002	1,231,066.1	66.1	206.7	26.5	6.6
2003	1,161,352.5	56.8	185.2	27.9	5.9
2004	1,224,836.9	53.2	172.1	23.9	6.5
2005	1,267,943.8	45.5	152.5	19.4	4.5
2006	1,147,238.0	34.4	124.4	18.6	3.8

Source: Author calculation base upon World Development Indicator, World Bank and Key Indicator, Asian Development Bankort

argued that foreign loans may contribute to development when the borrower uses them exclusively to finance capital imports. They concluded that developing countries that faced difficulties of debt servicing in the 1970s used foreign loans primarily to finance balance of payment deficits and popular government welfare programs.

3. Literature and Empirical Review

3.1. Theoretical Analysis of External Debt and Economic Growth

The theoretical reviews that analyze the relationship between the stock of external debt and economic growth primarily focused on the effect of debt overhang. Krugman (1989) defines debt overhang as a situation in which the expected repayment on external debt falls short of contractual value of debt. If a country's debt level is expected to exceed the country's repayment ability with some probability in the future, expected debt service is likely to be an increasing function of the country's output level. Thus, some of the returns from investing in the domestic economy are effectively "taxed away" by existing foreign creditors. Investment by domestic and foreign investors is discouraged and economic growth is also slowed. In other words, Krugman's hypothesis states that debt overhang is partly due to the burden of foreign debt and that investment will be slow, resulting in poor growth performance.

Other theoretical literature indicate that external borrowing has a positive impact on investment and growth up to a certain critical value; beyond this threshold level, however, its impact is adverse (Cohen, 1993). The relationship between debt and investment is represented by a kind of "Laffer curve". The implication is that an increase in the face value of debt leads to increasing repayments, up to the critical level; along the other side of the debt laffer curve, on the other hand, increasing debt leads to decreasing expectation of repayment of the debt. Pattillo, Helene and Luka (2002) find strong support for a non linier laffer curve between external debt and economic growth. They use a large panel data of 93 developing countries over the period 1969–1998. They find that the average impact of external debt on per capita GDP growth turns negative for net present value of debt levels over 160–170 percent of export and 35–40 percent of GDP.

Cunningham (1993)[5] investigated the relationship between economic growth and external debt service in heavily indebted countries during the period 1971–1986 by classifying debt servicing as a primary factor of production. Cunningham (1993) used extended standard production function model to analyze the association between economic growth and external debt burden and argued that the debt service can be considered in the production function due to its effects on the productivity of labor and capital in a manner similar to the inclusion of exports in the production function. In cases where the nation has a significant debt burden, debt servicing will affect how labor and capital are employed in the production function. In other words, when any benefits arising from productivity accrue for foreign creditors rather than domestic investors, it adversely affects both capital and labor productivity and finally reduces economic growth.

3.2. Empirical Reviews

Various empirical reviews found mixed support in the literature for the "debt overhang"

hypothesis. Borensztein (1990), Geiger (1990), Cunningham (1993), Despande (1997), Chowdhury (2001) find evidence for supporting the debt overhang hypothesis. Afxentiou and Serletis (1996) investigated the impact of debt indicators among four groups of countries to per capita GNP. They found that per capita GNP had a significant, negative impact on debt. It meant that debt overhang happened for severely indebted low income countries and severely indebted middle income countries. Fosu (1999) also finds support for the debt overhang hypothesis by analyzing thirty five Sub-Saharan African countries. In contrast, Hansen (2001) finds that inclusion of three additional explanatory variables (the budget balance, inflation and openness) leads to rejection of any statistically significant negative effect of external debt on growth. The sample countries are 54 developing countries (including 14 HIPCs). Savvides (1992) finds that the ratio of debt to GNP has no statistically significant effect on growth. Djikstra and Hermes (2001) also find that debt overhang hypothesis is inconclusive.

Studies using the variable of external debt service (in contrast to the total debt stock) can also potentially affect growth by crowding out private investment or changing the composition of public spending. Higher debt service can raise the government's interest bill and budget deficit, reducing public saving; this, in turn, may either increase interest rates or crowd out credit available for private investment, and finally dampen economic growth. Higher debt service payments can also have adverse effects on the composition of public spending by squeezing the pool of resources available for infrastructure and human capital spending, with negative effects on growth (Sachs, 1989). This effect arises because highly indebted poor countries tend to frequently switch resources, including foreign aid and other foreign exchange resources to keep off pressing debt service obligations particularly debt owed to multilateral institutions (Iyoha 1999). In contrast, Fosu (1999) finds no such relationship between debt service and growth for countries in Sub-Saharan countries. Pattillo et al. (2002) also find no statistically significant relationship between debt service and growth.

Relatively few empirical studies are concerned with external debt service (instead of total external debt stock) for single country analysis using time series data. Karagol (2002)[6] and Wijeweera et al. (2005)[7] investigated the relationship between external debt service and GNP by applying an extended production function model. Karagol (2002) found a long run relationship exists between GNP and debt burden and accepted the debt overhang hypothesis in Turkey. However, in the case of Sri Lanka, Wijeweera et al. (2005) found conversely that external debt affected GNP positively in the long run equation and negatively in the short run. Karagol's suggested that education expenditure may not be an appropriate proxy for human capital. In contrast, in the case of Sri Lanka, the results suggested that education expenditure may have been an appropriate proxy for human capital. Both studies[8] followed the model of Cunningham (1993). Study by Were (2001), Audu (2004) and Desta (2005) investigated the relationship between external debt service and growth for Kenya, Nigeria and Ethiopia respectively. Those studies find that external debt service has a negative effect on growth.

Table 4 Effect of Debt Burden on Economic Growth: Some Selected Studies

No	Empirical Study	Sample Coverage	Effect Debt Burden on Economic Growth	Debt Overhang Hypothesis
1	Geiger (1990), Cunningham (1993), Afxentiou (1996), Despande (1997), Foseu (1999), Chowdhury (2001)	Cross Country Analysis	Negative	Support
2	Hansen (2001), Savvides (1992)	Cross Country Analysis	No statistically significant	Do not support
3	Djiktra and Hermes (2001)	Cross Country Analysis	No conclusive	Do not support
4	Maureen Were (2001),	Case Study of Kenya	Negative	Support
5	Karagol (2002)	Case Study of Turkey	Negative	Support
6	Isa Audu (2005)	Case Study of Nigeria	Negative	Support
7	Melesa Gizau Desta (2005)	Case Study of Ethiopia	Negative in significant	Do not Support
8	Wijeeweera Etal (2005)	Case Study of Sri Lanka	Negative in significant	Do not support

Therefore those studies conclude that the debt overhang phenomenon occurred in these countries. However, a study by Desta (2005) concluded that the debt overhang effect did not appear in the case of Ethiopia. Some selected studies that analyzed the effect of external debt on growth are shown in Table 4.

4. Model Specification and Hypothesis

To investigate the association between GDP and external debt service in Indonesia, this study will employ the extended model of production function originally applied by Cunningham (1993) using cross country data. There are a few single country analyses that applying extended production function model using time series data.

Cunningham's study (1993) presumed that the production function only consists of physical capital, labor and debt service. The model assumes that there is no human capital. Romer (1996) investigated and found that physical capital is important for the production function but that human capital is vital. Human capital consists of skill, abilities, and knowledge of particular workers, therefore this study inserts the variable of human capital represented by education expenditure. The model of this study will be:

$$Y=F(K, L, HK, DSR) \quad (1)$$

Where Y, K, L, HK and DSR are real GDP, fixed capital stock, labor, human capital and debt service ratio (DSR) respectively. By applying natural logs (written as L), the model is:

$$LY = a + \alpha LK + \beta LL + \gamma LHK + \phi L\ (1 + DSR) + \varepsilon \quad (2)$$

Since DSR is ratio instead of nominal value, in order to apply log, this ratio is transformed into (1 + DSR) then that is changed into log form.

Before constructing the system model, it is important to check the univariate time series of variables by using a unit roots test. This check is important to estimate whether variables are stationary. Here we check unit roots of variables by adopting the Augmented Dickey Fuller (ADF) (1979) test as follows (equation 3)

$$\Delta Y_t = constant + \partial Y_{t-1} + T + \sum_{s=1}^{n} \partial 1 \Delta Y_{t-s} + \varepsilon_t \quad (3)$$

Where Yt is the relevant time series, ε_t is the residual term and T is time trend. The null hypothesis is that the variables under estimation will have unit root, against the alternative hypothesis in which it does not.

After checking univariate of all time series variables, now we can test cointegration among these four variables (GDP, capital stock, labor force, human capital and debt service ratio). The purpose of the cointegration test is to determine whether a group of non-stationary series are cointegrated or not.

Engle and Granger (1987) pointed out that a linear combination of two or more non-stationary series may be stationary. If such a stationary linear combination exists, the non-stationary time series are said to be *cointegrated*. The stationary linear combination is called the *cointegrating equation,* and may be interpreted as a long-run equilibrium relationship among the variables.

This paper will adopt the method of investigation of cointegration developed by Johansen (1988) and applied by Johansen and Juselius (1990). This method depends on direct investigation of cointegration in the vector autoregressive (VAR) representation and produces maximum likelihood estimators of the unconstrained cointegration vector, but it allows one to explicitly test for number of cointegration vectors. Johansen cointegration test assumes that cointegration equation has a linier trend (equation 4)

$$LY = \alpha LK + \beta LL + \gamma LHK + \phi L\ (1 + DSR) + Trend \quad (4)$$

If there is an equilibrium or cointegration relationship among non stationary variables, there has to be an error correction representation (Engle & Granger, 1987) which illustrates the dynamic convergence of the system to the long-run equilibrium. A precondition for the existence of cointegration is that all the variables are integrated in the same order. If this is fulfilled, then the residuals from the long run estimates can be used as the error correction term (ECT) to explain the short run dynamic. The error correction variable in a short run dynamic relationship indicates the proportion of the disequilibrium from one period that is adjusted in the next period. The detailed Error

Correction Model (ECM) for short-run adjustments is given below (equation 5)

$$\Delta LY_t = \alpha_0 + \sum \alpha_1 \Delta LY_{t-i} + \sum \alpha_2 \Delta LK_{t-i} + \sum \alpha_3 \Delta LL_{t-i} + \sum \alpha_4 \Delta LHK_{t-i} + \sum \alpha_5 \Delta L(1 + DSR_{t-i}) + \sum \alpha_6 ECT_{t-i} + \varepsilon_t \quad (5)$$

where LY, LK, LL, LHK and LDSR are defined as log Real GDP, log capital stock, log labor, log human capital and log debt service ratio respectively. ECT_{t-1} is the time-lag error correction term, Δ symbolizes the change in variables (the first difference of the variables), and the indices (t, t-i) denote the time period of the variables (Engle & Granger, 1987).

In order to assess the effect on income of a particular shock in debt service ratio, this study will apply impulse response analysis (IRA) within a vector autoregression (VAR) framework. This analysis describes the effect of the system of an exogenous shock to one of the variables in the model. Simulating, for example, a shock in DSR caused by a sudden exchange rate depreciation. The effect of any unexpected shock to the system can be traced through deviations of the shocked time paths from the expected time path given by the model. This technique is quite useful in certain types of policy and sensitivity analysis.

This paper differs from the existing debt-growth literature in several points. First, all monetary unit of variables is the local currency unit (Rupiah), that reflects real situation in Indonesia, mainly to capture and observe the risk of exchange rate and interest rate fluctuation. Second, other single country analyses use debt service balance (debt stock) instead of debt service ratio. This study uses debt service ratio (DSR) since this ratio is a country's capacity to repay the debt due to availability of foreign earnings received from export. Third, this study uses GDP instead of GNP since GDP better reflects the independent productive capacity of the country (Cordella et al. 2005). Forth, many empirical studies have used cross sectional analysis to investigate the relationship between economic growth and debt. However, there are few studies using time series data to investigate growth − debt relationship in an individual country. Since developing countries differ significantly in terms of economic and political environment, organizations and institutions, they may face different debt burden issues due to their different stages of development. Therefore impact of debt service payment may vary. Fifth, this study uses cointegration and error correction model analysis. The advantages of applying cointegration analysis are that it shows long term effects of equation and short run dynamic effects. Moreover, using error correction terms (ECT), the model may be more valuable since ECT is an adjustment speed from long term effect in one year deviation. This is useful for policy makers when external shocks occur in the model.

This empirical study intends to deal with the following four hypotheses with certain expected (a priori) signs on the key estimated coefficients:

i. Capital stock is the existing supply of physical goods that are useful in the production function. Capital that involves buildings, machinery, equipment and inventory are used in the production

process. Therefore, we predict that capital stock has a positive relationship with GDP.

ii. This study defines labor as the number of employed people. It expects that labor force will have a positive coefficient with GDP.

iii. Human capital accumulation is believed to promote higher growth by improving labor through particular knowledge, skill, and ability. Therefore this study concludes that the effect of human capital, represented by education expenditure, will have a significantly positive influence on economic growth.

iv. The capacity to repay the debt depends upon how much foreign earning is attained. This capacity could be represented by the ratio between debt services over total export, known as debt service ratio (DSR). Increase in the ratio may discourage other activities that generate economic growth such as investment, infrastructure, and employment creation. During the period of study, Indonesia's DSR fluctuates. This study expects that debt service ratio has a negative effect on GDP in the long run and short run. A negative effect of debt service over total export to economic growth leads to the debt overhang problem.

5. Data and Variables Description

The empirical analysis of this study uses data for Indonesia that cover the period 1980 to 2005. Data sources are taken from the Ministry of Finance of Indonesia, World Development Indicators published by the World Bank and Key Indicators published by Asian Development Bank. Almost all monetary units of variables are local currency unit of Rupiah, labor is expressed by number of people, while debt service ratio (DSR) is expressed by percentage.

Gross Domestic Product (GDP) is a dependent variable, whereas, capital stock, labor force, human capital and debt service are determinant factors of GDP. The variable of income is represented by real GDP at 2000 constant prices since GDP better reflects the independent productive capacity of the country (Cordella, 2005). Previous studies conducted by Karagol (2002) and Wijeeweera (2005) used GNP instead of GDP. Capital stock is represented by real fixed capital stock. GDP and fix capital stock are taken from World Development Indicators (WDI) published by the World Bank. Labor force is defined as employed people. Total people engaged in jobs are extracted from various issues of key indicators published by Asian Development Bank (ADB). Since it may be difficult to find data of human capital such as level of education attainment or average year of schooling (Wobmann, 2003) in a long time series particularly for Indonesia, this study represented human capital as education expenditure per year. Human capital is important to boost the economy since this variable includes general skills and ability of labor to carry out a particular job. Figures for education expenditure are taken from various issues of financial notes of the state budget (APBN), from the Ministry of Finance. Debt service ratio is defined by ratio of debt service payment including interest rate and initial payment,

over total export of goods and services. This data is extracted from the World Development Indicator. All variables are deflated by GDP deflator 2000. Descriptive statistics for all variables are provided in Table 5.

In order to employ local currency unit (Rupiah), the monetary unit of USD is converted into Rupiah by average exchange rate per year. For instance, since the monetary unit of fixed capital stock is USD, it is converted into Rupiah. After converting into local currency, the variable is depleted by GDP deflator. Variable of GDP is available in local currency unit and at constant price. Education expenditure is in local currency unit, directly deflated by GDP deflator.

The correlation matrix presented in Table 6. The highest correlation is between economic growth and labor force. Correlations between GDP and capital stock are almost the same as correlation between economic growth and labor. Correlations between growth and external debt service ratio are the lowest.

Table 5 Summary Statistics

Variable	Units	Observation	Mean	Standard Deviation	Minimum	Maximum
GDP	LCU (Bill Rp)	1980–2005	1,080,000	399,701	495,000	1,750,000
Debt Service Ratio (DSR)	Percentage	1980–2005	28.9	8.5	11.6	40.9
Capital Stock	LCU (Bill Rp)	1980–2005	240,000	100,000	99,900	431,000
Human capital	LCU (Bill Rp)	1980–2005	9,363	2,661	3,376	16,387
Labor	Person (million)	1980–2005	77,257	13,034	51,553	94,948

Source: Author's calculation

Table 6 Correlation Matrix

	GDP	External Debt Service	Capital Stock	Labor	Human Capital
GDP	1				
Debt Service Ratio (DSR)	0.179	1			
Capital Stock	0.944	0.223	1		
Labor	0.967	0.341	0.877	1	
Human Capital	0.462	0.058	0.497	0.367	1

Source: Author's calculation

6. Empirical Result

6.1. Unit Root Test

Standard procedures in the time series literature suggest researchers to check for unit roots in each series before estimating any equations[9]. If unit root exists in any variable, then that particular series is considered to be non-stationary. Estimations based on non-stationary variables may lead to spurious results with high R^2 and t statistics, but without any coherent economic meaning and inconsistent parameter estimator (Granger & Newbold, 1974 and Pyndick, 1998).

The Augmented Dicky Fuller (ADF) test for estimating unit roots was applied in this study. The ADF test showed that all variables are stationary in first difference (delta). Since the ADF unit root testing technique is well established in the literature, the details are not discussed further. The result of ADF testing can be seen in Table 7.

Table 7 Result of ADF Test for Non stationary

Variables	ADF test in Level		ADF test in first difference (delta)	
	Calculated	Lags	Calculated	Lags
LY	−1.41	1	−2.86*)	1
LK	−2.17	1	−3.85***)	1
LL	−0.71	1	−3.33**)	1
LHK	−2.56	1	−4.09***)	1
LDSR	−1.96	1	−3.08**)	0

Source: Author calculation.
Critical Value:
ADF Statistic for levels at 1% (***), 5%(**) and 10% (*)significance are −4.39, − 3.61, −3.24 (with trend) respectively.
ADF statistic for first difference at 1%(***), 5% (**) and 10% (*) significance are −3.75, −2.99, and −2.64 (without trend) respectively.

6.2. Cointegration analysis and long run equation

Equation 4 is a long run relationship equation, since the order of integration in every variable (GDP, capital stock, labor, human capital and debt service ratio) is equal and that of residual is stationary in level[10] (Mukherjee, 1998 and Engle & Granger, 1987). Then this study applies the Johansen and Juliesus (1990) maximum likelihood method to investigate whether there is more than one single cointegration relationship. Looking at the trace statistics and maximum eigenvalue statistic shows that there is one cointegration relationship. The result of trace statistic and maximum eigenvalue statistic can be seen in Table 8.

Some interesting results were obtained by applying the Johansen co-integration test. Among the variables, GDP, external debt service ratio, capital stock, labor and human capital have a long run relationship. All determinant variables are significant and consistent with what we expected in the

Table 8 Testing of Cointegration

Hypothesized No. of Cointegration equations	Eigenvalue	Trace Statistic	Max-Eigen Statistic	1 Percent Critical Value
None **	0.884091	116.6644	51.71870	96.58
At most 1	0.739463	64.94575	32.28024	70.05
At most 2	0.462824	32.66550	14.91432	48.45
At most 3	0.391005	17.75118	11.90269	30.45
At most 4	0.216267	5.848492	5.848492	16.26

**) denotes rejection of the hypothesis at the 1% level
Trace test indicates 1 cointegrating equation(s) at the 1% level

Source: Author calculation

Table 9 Long Run Equilibrium Equation Dependent Variable: Log GDP

Independent Variables	Coefficient	t-statistic
Log (Capital stock) ***)	0.399	24.036
Log (Labor) ***)	1.090	5.892
Log (Human Capital) *)	0.024	1.893
Log (Debt Service Ratio (1 + DSR)) ***)	−0.104	−5.205
Trend ***)	−0.008	−2.667

Notes: 1) The asterisks (*), (**) and (***) indicates statistical significance at the 10%, 5% and 1% significance level, respectively. 2) The critical value at 1% significance level is 2.576, 5% level is 1.960 and 10% is 1.645 (two-tail).

Source: Author's calculation

hypotheses. Debt service ratio has a significant negative effect on economic growth implying that debt overhang occurs in the long run. Capital stock has a positive significant effect on GDP. Labor and human capitals show a positive significant on GDP. The calculation of long run equation results can be seen in Table 9.

Our results show that elasticity of income to the ratio between external public debt service payments over total export is 0.1[11]. This means that when there is one percent increase in (1+DSR), GDP will reduce by 0.1 percent[12]. This result is labeled as the debt overhang hypothesis. The negative impact of debt repayment over total export on GDP in the long run could be explained as follows: The utilization of foreign borrowing may generate output in the long run. However, the effect of utilization of foreign debt is attached by the improvement of physical and non-physical capital, that is capital stock and human capital. Therefore in the long run, coefficient of capital stock and human capital will

be bigger than in the short run. However, due to the repayment of foreign debt in the long run, lead to a negative impact on GDP.

Karagol's (2002) study of Turkey's economy showed that overhang occurs because the variable of debt service has significantly negative effect with very little elasticity. A study by Mere (2001) and Audu (2004) proved that debt overhang hypothesis exists for Kenya and Nigeria respectively. However, in the case of Ethiopia, Desta (2005) showed that this country did not accept debt overhang hypothesis. In Wijeweera's (2005) study analyzing Sri Lanka's debt payment, the result shows that debt service has a negative relationship with GNP, but the coefficient is not significant. Therefore Sri Lanka does not face the debt overhang phenomenon.

Debt overhang hypothesis argues that when foreign debt becomes excessive, actual payment to creditors becomes linked to the economic performance of the debtor country. Therefore, potential increases in debt payment depress the return to productive investment and discourage capital formation. Moreover, a greater percentage of reserves (foreign currency) go to pay the debt, making it difficult for the country to continue construction of large infrastructure, new projects and old investments. Krugman (1989) argues that a very high debt burden is a future tax on the return to capital. The heavy debt burden means that the government will have to increase taxes in the future to finance the high debt service payments. That increase in taxes means a lower after-tax return on capital and reduced incentive to invest. Lower investment leads to slower growth.

Among the variables considered, labor and capital stock contributed most to boosting the economy during the period of study. Labor contributed higher elasticity, 1.1 percent, than other determinant variables. In our model increasing one percent of capital stock, GDP improves by almost 0.4 percent. However, human capital contributes a little to supporting the economy. One percent increase in this variable raises GDP by less then 0.03 percent. This too is plausible since Indonesia's labor force is mostly unskilled, thus unlikely to greatly improve the level of output.

6.3. Short Run Dynamics equation

The results of the short run dynamic equation are presented in table 10. The change of 1+DSR is found, showing a positive relationship with the change of GDP. However, the sign is not significant. Capital stock and labor force have consistent signs as expected. However, only capital stock is statistically significant. Human capital is also consistent with the hypothesis. It contributes the lowest effect compared with other determinant variables. The positive sign of the ratio of debt service repayment over export is plausible since during the short run period, 1 to 5 years, the impact of utilization of foreign debt is shown by a positive sign of physical and non-physical capital (capital stocks and human capital) that may boost the economy. Similarly, the utilization of external debt may also have a positive influence on output in the short run.

More specifically, capital stock is statistically significant at one percent significance level. By

Table 10 Estimation of Short Run Dynamic
Dependent Variable: ΔLY

Independent Variables	Coefficient	t-statistic
Constant	0.296	0.891
ΔLY**)	0.323	6.3
ΔLL	0.248	0.884
ΔLHK	0.009	0.386
$\Delta L(1+DSR)$	0.013	0.328
ECT_{T-1}	−0.219	−0.799

Notes: 1) The asterisks (*) and (**) indicate statistical significance at the 5% and 1% significance level, respectively. 2) The critical value at 1% significance level is 2.576 and 5% level is 1.960 (two-tail).
Source: Author's calculation

increasing the change of capital stock by one percent, the change of GDP will increase by 0.32 percent. In the short run, physical capital is the most important item to generate national output. The impact of physical capital stock is permanent, since in the short run and long run capital stock has a positive significant on GDP.

The label of debt overhang hypothesis happened only in the long run. In the short run, the impact of debt service is insignificant. Therefore there is room for Indonesia to minimize the total external debt and avoid a heavy debt burden through effective usage of external debt that may create more investment.

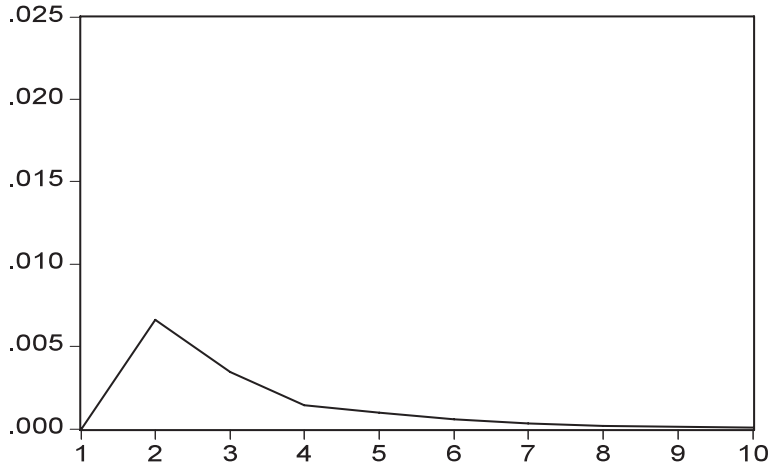
In order to evaluate whether the statistical results were robust, this study applied a variety of diagnostic checks. These included the White Heteroscedasticity Test, the Serial Correlation Lagrange Multiplier (LM) Test, and the Normality Test[13]. Satisfactory performance in these tests shows that the results are reliable[14].

6.4. Sensitivity analysis of debt repayment on economic growth

In order to investigate one standard deviation shock on debt service, this study will apply an impulse response analysis (IRA). The result is displayed in Figure 2. One shock is exercise; one standard deviation shock of debt service ratio on economic growth. The response is measured in terms of deviations from the expected time paths. A positive value indicates that the variable in question will increase due to a given shock.

Figure 2 shows that a positive shock of one standard deviation shock on the change of external debt repayment over total export will increase the change of economic growth in the first period to the second period. Then the change of economic growth will decrease and stabilize in the beginning of the

Figure 2 Effect of one standard deviation shock of the change ofdebt service ratio, dL (1+DSR), on the change of GDP



fourth period. Specifically, by assuming other variables are equal, one positive standard shock of debt service will stabilize the economic growth after the fourth period in the short run. This picture is consistent with the fact that when the Asian crisis occurred, economic growth plunged to −13 percent in 1998, compared to 7.8 percent in 1996. In 1999, economic growth was 0.8 percent, and stabilized for an average 5 percent during the period 2002 to 2006.

7. Conclusions and Policy Responses

The objective of this study was to analyze the long run and short run relationship between external debt service and income in Indonesia from 1980 to 2005. The results show that gross domestic product, debt service ratio, capital stock, labor force and human capital inputs have a long run equilibrium relationship. The ratio between external debt service over total export showed a significant negative relationship with GDP in the long run. This is labeled as an acceptance of debt overhang hypothesis.

Elasticity of income to the ratio between external public debt service payments over total export is 0.1. It means that when there is one percent increase in (1+DSR), GDP will reduce by 0.1 percent. Among determinant variables, labor is the highest contribution to economic growth. Meanwhile, increasing one percent of capital stock, GDP will increase by almost 0.4 percent. However, human capital has a minimal effect on GDP. Increasing human capital one percent will improve GDP 0.02 percent.

In the short run tests, the results showed that the external debt service ratio has a positive insignificant effect on income. Capital stock, labor and human capital variables showed consistent

signs, as was expected. However, only capital stock was statistically significant. Increasing the change of capital stock one percent appears to have resulted in an increase of GDP by 0.3 percent. The short run test confirms the importance of capital investment to generate national output.

The positive sign of debt service ratio in the short run and a negative sign of DSR in the long run is plausible since the utilization of foreign debt may generate GDP through improvement of physical capital and non-physical capital (capital stock and human capital). In the short run, capital stock and human capital will increase. Similarly, the utilization of external debt in the short run may influence output positively. In the long run, the utilization of foreign borrowing may generate output by improving of capital and human capital. However, the country has to repay the principal and interest payments that lead to reduced GDP.

By applying sensitivity analysis of one standard deviation shock of debt service on GDP, the result shows that the change of income will stabilize in the short run.

The findings above have two economic policy implications: (i) The government of Indonesia should adopt more prudent policies in borrowing money from external sources. The choice of lowest cost of borrowing (low interest rate and long repayment period and grace period) should be considered when the government proposes to take on borrowing from creditors in order to minimize the repayment of debt in the long run, and (ii) The government may reduce debt service ratio by strengthening total export in the long and short run, finally leading to foreign reserves improvement.

Although the following two policies suggestion do not directly relate to the results, they could be important for future policy agendas: (i) Coordination between government institutions that are responsible for managing the external debt such as Ministry of Finance, Ministry of Planning (Bappenas), and the Central Bank should be strengthened to scrutinize the utilization of foreign borrowing from planning stages through the implementation of development projects, (ii) Managing external debt should be comprehensively integrated with domestic debt management.

Finally, future single country research analyses may be improved by considering new independent variables that have similar effects to the export and debt service variables investigated in this study.

Notes

1 The principal of the debt was rescheduled for repayment in 30 equal installments over 30 years at an interest rate of zero.

2 This range was derived by assessing the public debt level from three angles:

• Vulnerability to financial crisis: Looking at a sample of fourteen emerging market countries for the past twenty years and using the early warning signals approach, the analysis indicates that Indonesia's debt/GDP threshold for being "safe" from a currency crisis is about 42 percent of GDP

• Debt overhang: A panel regression of growth on the debt to GDP ratio after controlling for other factors affecting growth suggest that an increase in the debt ratio to above 38 percent of GDP would lead to a lower

growth rate.

• Stochastic debt sustainability: This approach assumes that public debt is sustainable if the debt-to-GDP ratio would remain constant or decline in the medium term. The results indicate that Indonesia's debt would have to be 35 percent of GDP or less in the medium term.

3 The World Bank set up an indicative debt burden threshold that depends on country's policies and institutions measured by Country Policy and Institutional Assessment (CPIA). Since Indonesia is categorized at the level of 'Medium Policy', the debt burden threshold (debt services in percent of exports) under DSF (Debt Sustainability Framework) was 20 (The Joint World Bank and IMF, Debt Sustainability Framework, 2006). The debt-service-to exports ratio is a possible indicator of debt sustainability since it indicates how much of a country's export revenue will be used up in servicing its debt and thus, also, how vulnerable the payment of debt service obligations is to an unexpected fall in export proceeds (External Debt Statistic, Guide for Compilers and User, IMF, 2003)

4 The real issue is whether funds from foreign borrowing are being used productively. There has been insufficient analysis apart from the focus on the "mega projects" which surfaced in the 1990–1992 period and some of the "high tech" investment projects of Minister Habibie (Hill, 2000).

5 Cunningham (1993) used the variable of economic growth as the percentage change in real gross domestic product. The variable of capital is defined by the ratio of real gross domestic investment to real GDP. Labor is defined by the percentage change of population. Debt burden is the rate of change in the ratio of long term debt service on public and publicly guaranteed debt to the exports of good and services, denoted in dollars.

6 Karagol (2002) deflated all financial data (GNP, capital stock, and human capital and debt service) to 1987 million Turkish Liras (The State Institute Statistics Turkey). External debt service includes interest payments and repayment of long and short terms.

7 Wijeweera, et al, (2005) used all monetary data of GNP, capital, human capital and debt service in million USD, whereas the variable of labor is expressed by thousands.

8 Studies by Karagol (2002) that covered data of Turkey, and Wijeweera, et al. (2005) that covered data of Sri Lanka employed another determinant variable i.e. education expenditure representing human capital in the model..

9 Checking each variable (LY, LK, LL, LHK and LDSR) through visual assessment confirmed that all variables are not stationary at all in levels but stationary in first differences. Therefore, we checked all variables by applying the ADF test. The results showed that hypothesis of unit roots in variables of LY, LK, LL, LHK and LDSR are not rejected at 1% or 5% significance levels. However the first difference of each variables (dLY, dLK, dLL, dLHK, and dLDSR) is significant

10 Residuals were checked to test the integration in level (IU=0), following Engle and Granger (1988). The results show that residual (e) is stationary. Augmented Dickey Fuller test statistic is −4.75. It is significant at the 1% significance level.

11 When this study estimated GDP on debt service ratio without inserting human capital, the result showed that elasticity of income to the ratio between external debt service over total export was 0.08. This value was smaller when this paper estimated with including human capital variable. It means that utilization of external debt may improve human capital even with higher debt burden.

12 In other word, when there is an increase 1 percentage point of debt ratio, lets say: from 29% to 30%, actually debt ratio (DSR) increases by 0.77% that leading to depressing GDP by 0.1%.

13 The Normality Test displays histogram and descriptive statistics to examine of the residuals. The residuals are normally distributed since the histogram is a bell-shaped. The Serial Correlation LM test examines the possibility that errors exhibit autocorrelation; the test shows that there is no serial correlation. The White Heteroscedasticity Test showed that there is no heteroscedasticity.

14 When this study applied the model substituting variable of real price of local currency unit (Rupiah), the significant statistical results were the same in almost every variable when current price of USD were used. The cointegration analysis and error correction model all indicate that the model results are acceptable. The result is not included here, but it may be available upon request to author.

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