EADN WORKING PAPER No. 20 (2003)

MEASURING SUSTAINABLE DEVELOPMENT IN INDONESIA: GENUINE SAVINGS AND CHANGES IN WEALTH PER CAPITA

Armida S. Alisjahbana,
Arief Anshory
Yusuf and Budiono

Department of Economics and Development Studies
Faculty of Economics, Padjadjaran University
Bandung, Indonesia

Final report of an EADN research grant project.

Abstract

The overall trend in sustainability indicator as measured by changes in wealth per capita had shown that the Indonesian economy during the last twenty years had not been on a sustainable path. Despite this, sustainability had been on an improving trend during the 1980s and 1990s just until the economic crisis. The improvement in long-run trend of sustainability is due to the restructuring of the economy away from oil and gas sector, towards more reliant on secondary and tertiary economic activities. However, recent development do suggest the need for appropriate approach in managing forest resources depletion, and pollution as they had rapidly becoming a growing problem. Measures of sustainability during the economic crisis and its adjustment period clearly show that the crisis had adversely affected the positive trend in sustainability through a combination of reduction in savings rate and increases in natural resources depletion. Relevant policies to help address both problems are discussed.

JEL Classification: E21, O40, Q01

Keywords: Genuine Savings, Changes in Wealth per Capita, Sustainable Development, Indonesia.

1. Introduction

Any strategy that is consistent with sustainable development concept has to take into account the extent of resources depletion, i.e. the available stock of natural assets. These natural resources together with produced assets and human resources are inputs to development process.

The need for correction of conventional aggregate indicator has become a raising issue especially after the UN Conference on Environment and Development in 1992. Agenda 21 stressed explicitly the need for assessing a progress on sustainable development after being aware of the weakness of commonly used indicators such as GNP or other aggregate indicators. It was mentioned that methods for assessing interactions between different sectoral environmental, demographic, social and developmental parameters are not sufficiently developed or applied. Indicators of sustainable development need to be developed to provide solid bases for decision-making at all levels and to contribute to a self-regulating sustainability of integrated environment and development systems (Agenda 21, 1992, section 40.4).

Several responses have followed the agenda. Three main important approaches that have been applied internationally are: (1) United Nations Commission on Sustainable Development (UN CSD) indicators developed in 1995, (2) Correction of System of National Account (SNA) developed by United Nations Statistical Division (UNSD) in 1993, and (3) The World Bank's measure of the wealth of nations in 1997.

The two last approaches offer alternative complementary -rather than substitute- aggregate indicators because they corrected for commonly accepted conventional aggregate measure of economic performance. The UNSD offers an indicator called "Green NNP" or Eco-Domestic Product to correct for conventional GDP while The World Bank develops "genuine saving" to correct for conventional saving measure of a nation. The two indicators then were commonly known as green national accounting.

The World Bank measure of genuine saving could not be separated from its effort to broaden the concept of wealth. The notion of wealth is extended from natural and produced wealth to human and social capital. The broader concept of wealth can be invested in, enhanced, and used to produce a steady stream of productivity, or it can be overused, eroded and allowed to depreciate. Besides offering the value of wealth of a nation which is a stock concept, it could also generate a flow indicator termed "genuine saving": the true rate of saving in a nation after due account is taken of the depletion of natural resources and the damages caused by pollution.

In the case of Indonesia, a study commissioned by the United Nations University/Institute for Advanced Studies, Tokyo had been carried out in estimating the Genuine Savings rates for 1980 – 1997. The coverage for resource depletion is still limited to selected sub-soils, namely: oil, gas, coal, bauxite, tin and copper. Environmental degradation due to pollution had been included in the genuine saving estimation, but limited to pollution from industrial sources.[1] In the case of changes in wealth per capita estimates, there is no specific study on Indonesia available over several years. The only one available was a "snapshot picture" by Hamilton as part of a wider cross-countries study.

Key findings of the UNU/IAS genuine saving study are that there was an improvement in genuine savings rates up to 1995, from a slight negative rate as a percentage of GNP in 1980, to a rate of about 20 percent in 1995. The declining resource rents, most notably that of oil, contributed to such an increase. However, from 1995 onwards, at least until 2000, genuine savings had dropped considerably and was exacerbated by the impact of the economic crisis. The combination of sharp drop in conventional savings rates and jumps in resources rent has reversed the pre-crisis genuine savings trend.

It is still unclear, however, how the trend in genuine saving rates in Indonesia will play on with the crisis of 1997 and its subsequent period of adjustment. Further complication to this picture will likely emerge as Indonesia is embarking on regional autonomy and fiscal decentralization starting on January 2001. For policy makers, at the national or regional level, the implication is clear. A picture on the effect of crisis and its adjustment period on genuine saving rates will help disentangle the factors that mostly shape the sharp reduction in its rates. The same set of questions are posed to the changes in wealth per capita, its trend during pre crisis period, its estimates during the crisis and adjustment period of 1998 – 2000 as well as its policy implication for sustainable development.

It is precisely for the above reasons that this research proposes to have the following set of objectives: (1) to estimate and analyze genuine saving rate and changes in wealth per capita during the pre crisis period (1980 – 1997); (2) to arrive at and analyze genuine saving rate and changes in wealth per capita during the adjustment period : 1998 – 2000, (3) To compare the estimates and assessment of both indicators before, and during the adjustment period post crisis to arrive at policy implications.

2. Conceptual Framework

The measurement of sustainable development requires drawing together indicators from the three dimensions of sustainable development, the economy, the environment and society. The two primary aims are to form a coherent picture of sustainable development trends and to provide information that is relevant to policy questions. In defining a set of indicators to cover sustainable development, a necessary task is the development of frameworks to place indicators in context and within which the relationships between different policy goals, the links between indicators and goals and the interaction between different indicators are apparent. Thus, the measurement of sustainable development requires advances in both the theory of measurement and the practical construction of sustainable development indicators. Neither can easily be separated. Importantly, construction of both frameworks and sets of indicators must lead to indicators whose quality is defensible on both conceptual and practical

[1] Further refinement to the genuine saving estimates for Indonesia is possible in including pollution costs from transportation sector, and costs from soil/land degradation.

grounds and whose information content, and thus potential use on policy grounds, justifies the development[2]

The following statement from the World Conservation Strategy (IUCN/WWF/UNEP, 1980) appears to be the first actual attempt to define sustainable development: [3]

> "For development to be sustainable, it must take account of social and ecological factors, as well as economic ones; of the living and non-living resource base; and of the long-term as well as the short-term advantages and disadvantages of alternative action"

The World Conservation Strategy was frequently criticized for being concerned mainly with ecological sustainability rather than sustainable development *per s*e. The most universally quoted definition is that produced in 1987 by the World Commission on Environment and Development (WCED), otherwise known as the Brundtland Commission (after its Chairperson, Gro Harlem Brundtland, former Prime Minister of Norway):

> "Economic and social development that meets the needs of the current generation without undermining the ability of future generations to meet their own needs".

Following the publication of the Brundtland report, there was a rapid escalation of alternative definitions of sustainable development and lists are given by several authors(e.g. Pezzey, 1989, Pearce et. al., 1989, and Rees, 1989). Mitlin (1992) notes that, in general, definition involves two components: the meaning of development (i.e. what are the main goals of development: economic growth, basic needs, rights, etc.); and the conditions necessary for sustainability.

Economics has its own interpretation of this definition and restates it in a more compact form i.e. sustainable development is defined as non-declining welfare per capita. As long as future generation is as well off as the current generation then, we could say that development is sustainable. Measurable and applicable sustainable development indicator, then, has to be able to tell this to us. The problem with this definition is that how to measure the welfare itself. Is it the un-measurable notion of utility? If yes, utility of whom: certain individual or a nation? Measurement of well being of a group of people then inevitably will call for an applicable social welfare function, which has practical difficulty in itself. Or could it be some of the common well-being indicator, such as income per capita?

To overcome the problem in measuring welfare directly, economics then suggest a concept of “capital basis for sustainable development”. Capital stock indicates the ability of an economy to produce output, to generate well being. It is the productive capacity of an economy, the capacity of an economy to improve the welfare of its people. If we can sustain productive capacity, then we can sustain our well-being.

---

[2] Obst,Carl (2000) *Report Of The September 1999 OECD Expert Workshop On The Measurement Of Sustainable Development*, An OECD Expert Workshop

[3] Barry Dalal-Clayton, *What Is Sustainable Development ?*.International Institute for Environment and Development (IIED), London, and World Conservation Union (IUCN), Gland, in association with Earthscan Publication, London.

The above conception is certainly not new. The difference is in the need to broaden the concept of capital stock if we intend to conform with the agreed definition of sustainable development. Conventionally, economic notion of capital stock to include only man-made or produced capital stock i.e. building, machinery, or infrastructures, but in order to arrive at meaningful notion of sustainable development this concept has to be extended. What constitute capital stock (K) is not only man-made capital (K_M) but also natural capital (K_N), human capital (K_H), or even social capital (K_S). The sustainable indicator would be better the more complete the inclusion of capital stock by its components.

This capital basis for sustainable development translates into what is called "constant capital rule"[4]. Non-declining welfare per capita could be guaranteed by non-declining capital stock. Non-declining (or constant) capital stock means non-declining (or constant) well-being per capita. Thus, in order to determine whether an economy is on sustainable development path, we only need to know the path of its capital stock over time.

Table 1. Weak and strong sustainability rules

Form of sustainability	Requirement
WEAK	$\Delta K/\Delta t > 0$ where $K = K_M + K_N + K_H + K_S$ WS requires that capital depreciation on any form of capital must be at least offset by capital appreciation on other forms of capital. There must be 'reinvestment of rents'. The proceeds of capital depreciation must not be consumed. Forms of capital are assumed to be substitutable at the margin.
STRONG: Environmental	$\Delta K/\Delta t > 0$ <u>and</u> $\Delta K_N/\Delta t > 0$
Social	$\Delta K/\Delta t > 0$ <u>and</u> $\Delta K_S/\Delta t > 0$ SS requires the same rule as WS but in addition requires that the stock of the 'targeted' capital stock should also not decline. Hence the elasticity of substitution between the critical capital stock and other forms of capital is assumed to be zero.

Source: Table 3.5 in Pearce (forthcoming)

This concept of capital basis for sustainable development raises two opposing argument: the concept of weak sustainability (WS), and strong sustainability (SS). Weak sustainability rule states that as long as total stock of capital (K) is non-declining i.e. it does not matter, for example, whether stock of natural capital (K_N) is declining as long as increasing man-made capital (K_M) can offset its decline, then sustainability is assured. On the other hand, strong sustainability rule insists that

[4] This concept has been well documented in the literature, for example Hamilton, et. al. (1996).

beside total capital stock (K) should be set non-declining, some other form of capital such as K_N should also be kept intact. Table 1 from Pearce (forthcoming) summarizes the difference between weak and strong sustainability rule.

As described in Table 1, our option of adapting either rule lies on how we believe in substitutability among forms of capital. This section is not intended to provide thorough discussion on the debate between strong and weak sustainability. Readers who are interested in this issue could refer to other literature (for example Pearce, forthcoming, Atkinson et al, 2000).

In this study, we have elected to adopt the definition of sustainability as (a) non-declining welfare per capita, (b) capital basis approach for sustainable development, (c) using the assumption of some degree of substitutability among forms of capital i.e. weak sustainability rule. The above three points constitute the important framework of our work to measure a meaningful, applicable, and policy-relevant indicator of sustainable development.

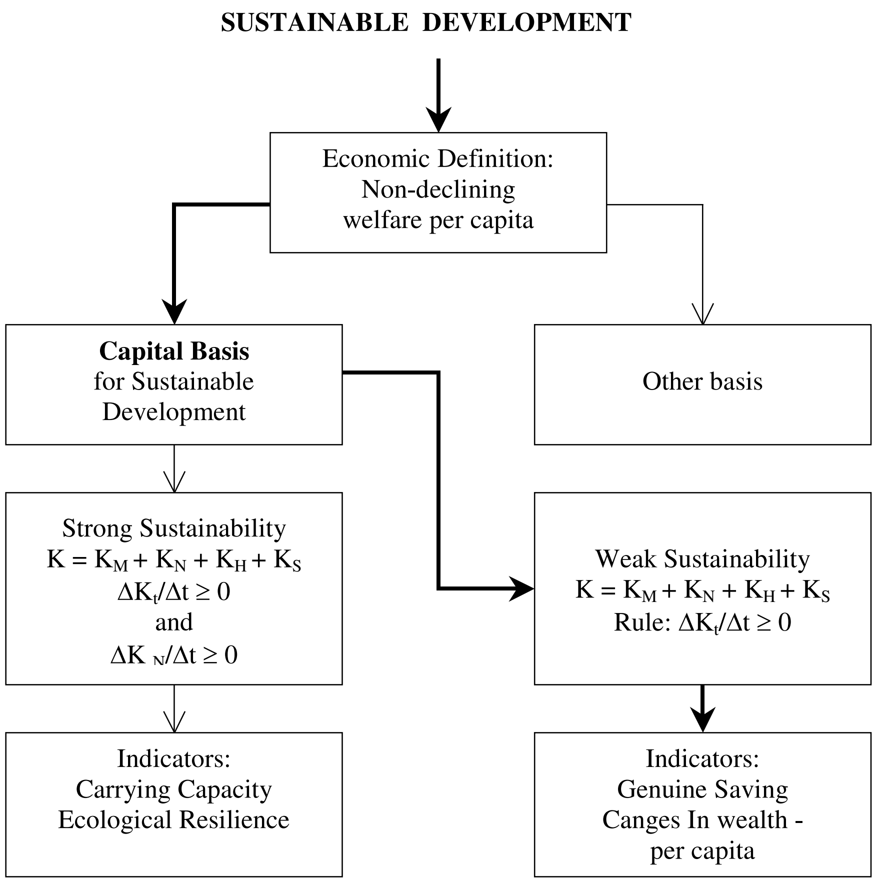


Figure 1. Sustainable development: from definition to indicators

Literature on indicator of weak sustainability suggests three common indicators i.e. Green NNP, genuine saving, and changes in wealth per capita. Our adopted framework has enabled us to measure two of the three measures of weak sustainability, i.e. genuine saving and changes in wealth per capita. How the framework is related to our objectives is illustrated in Figure 1. The bold arrowed line indicates the framework that we follow in this study. In relation to how sustainable development is measured, the concept of non-declining per capita well-being guides us on how indicators should be able to tell us. Good indicator of sustainable development has to be able to tell us whether or not a development path constitutes a rising or declining well-being per person.

Green NNP emphasizes the flow of income rather than stock of capital (income based, rather than capital based) and measured by deducting depreciation of all capital (broadly defined) from Gross National Product. The notion of Green NNP is elaborately discussed by Hartwick (1990), who derived the true NNP from inter-temporal maximization problem meaning that Green NNP is the true measure of income if an economy is on the optimum path.

Can Green NNP tell us whether or not an economy is sustainable by our definition? For broader context of sustainable development, Green NNP of course is meaningful. Divergence of green NNP from traditional GNP shows us a worrying situation, but from practical point of view it only tells us a few things. For example, Green NNP that is 10% lower than conventional GNP does not in itself tells us anything about sustainability. The same is true for growth in Green NNP? Green NNP could not tell us precisely and practically (especially for policy maker) whether or not a country is on a sustainable path (Hamilton, 1994).

Genuine saving, on the other hand is defined as the level of saving in the economy over and above the sum of all the capital depreciations (depreciation of K_M, K_N, K_H, and K_S) in the economy.[5] Intuitively, genuine saving is therefore investment in produced assets and human capital, less the value of depletion of natural resources and the value of accumulated pollutant.

If a nation's genuine saving is positive, then there is an addition to its capital base, and likewise if it is negative there is reduction in its capital stock. Persistent negative genuine saving means development is not on a sustainable path, i.e. well-being could be declining. However, since our concern is "per capita" well-being, genuine saving could only tell us whether or not total well-being, and not per capita well-being is declining. Hamilton (2000) proposed a new measure, i.e. change in wealth per capita to overcome the problem:

$$\dot{k} = \frac{d}{dt}\left(\frac{K}{N}\right) = \frac{K}{N}\left(\frac{\dot{K}}{K} - \frac{\dot{N}}{N}\right) = \frac{K}{N}\left(\frac{\dot{K}}{K} - n\right) \qquad [2.1]$$

Where $\dot{k}$ is the growth of capital per capita, K is broadly-defined capital, N is population, n is the rate of population growth, and $\dot{K}$ is genuine savings, i.e. the net addition to total wealth (K).

[5] The concept of genuine saving was first introduced by Pearce, et.al., 1993, and extended by Hamilton, 1997.

From this indicator, it is clear for example that if growth of genuine saving ($\dot{K}/K$) is less than growth of population (n), then changes in wealth per capita ($\dot{k}$) will be negative which means that the economy is not on a sustainable path.

3. Literature Review of Green Accounting Application for Indonesia[6]

The empirical exercise of green national accounts dated back to the classical work of Repetto, et. al. (1989) published by the World Resource Institute 13 years ago. Their work – which have been always cited in almost every literature of green accounting – is not only the first application of green accounting for Indonesia, but also a pioneering work in the literature of this area in general. For the period of 1970 to 1984, Repetto, et. al. (1989) estimated "net domestic product" that was defined as GDP minus estimates of net natural resources depreciation. The resources depreciation covers three sectors, i.e. timber, petroleum, and soil.

To arrive at adjusted GDP, first of all, this study constructed a natural resources account for each of natural resource sector. Natural resources account is a balance sheet reporting the stock at the beginning of the accounting period, addition, reduction, revaluation, and closing stock of the resources at end of the period. Information from this account then linked and inputed into the calculation of adjusted GDP. The result of this calculation suggested, among others, that while GDP over the period of 1970 to 1984 had increased by 7.4 percent per year, "net" domestic product had increased by only 4.0 percent per year. In 1984 for example, the whole resources depletion from the three natural resource sectors comprised of about 17.9 percent of GDP.

Pearce and Atkinson (1993) in their study also include Indonesia in their analysis. The objective of this study was to devise another indicator other than "Green National Product" that could tell us whether an economy is on a sustainable path. By assuming the possibility of substitution between man-made and natural capital – weak sustainability – Pearce and Atkinson (1993) tried to devise and estimate an index which was later known as "genuine saving ". They estimated environmental damage and resource depreciation for 18 countries including Indonesia. Data on depreciation of natural capital for Indonesia was based on Repetto, et. al. (1989). In their study, Indonesia's sustainability index was minus 2, and categorized as an unsustainable economy, together with countries such as Ethiopia and Papua New Guinea.

Vincent and Castaneda (1997) tried to predict the impact of natural resources depletion on a country's long-run consumption possibilities by either (i) checking whether comprehensive measure of net savings – genuine saving – is positive or negative; or (ii) checking whether the trend in a comprehensive measure of net product ("green" NNP) is upward or downward. The context of this paper is developing countries in Asia that includes Indonesia. Its period of coverage is 1970 to 1992 and includes resources sectors: minerals (coal and petroleum), metals (copper, iron ore, lead, manganese, and tin), forest (industrial roundwood and fuelwood), and agricultural soils. Results of the study showed that the ratio of total resource rent to

[6] For further detail on this literature review, interested readers could ask for report version of this paper. This paper version is constrained with space.

GDP in 1970, 1981, 1992, was 0.08, 0.18, and 0.10 respectively, while ratio of total resource rent to gross domestic saving was 0.55, 0.53, 0.31 respectively.

The work by Hamilton (1999) has gained widespread recognition considering the estimation of genuine saving now always been included in annual world bank's World Development Indicators. The measurement of genuine saving was started with the formal treatment of green accounting. Formal model of genuine saving was derived from maximization of aggregate utility over infinite time horizon with respect to several constraint which broadly expand the concept of capital stock to include natural resources and the environment. Natural resource sector or commodity was broadly covered in this work.[7] The genuine saving of more than 100 countries was estimated and the results for Indonesia suggest that genuine saving rate ranges from – 6.4 % in 1979 to 15.51% in 1994. There had been no evidence of persistent negative genuine saving from the results and hence no sign of (weak) unsustainability throughout the period.[8]

Indonesian Central bureau of Statistics (1996) had also started to step forward by conducting case study constructing natural resources account and estimating the Indonesian Eco-Domestic Product. Resources covered were timber, oil, gas, and coal, and by using the net-price method to calculate depletion of resources. The results suggested that in 1993 total depletion of Rp 36,782 billion had to be subtracted from NDP to arrive at adjusted NDP of Rp 278, 038 billion.

Alisjahbana and Yusuf (2000a) constructed the 1990 and 1995 System of Integrated Environmental and Economic Accounting (SEEA) for Indonesia, and derived the imputed environmental costs due to resources depletion, environmental degradation and destruction to the ecosystem. The method applied is based on the UN/UNSTAT SEEA. The study's coverage included non-financial assets of produced assets: man-made assets and cultivated forests, and non-produced natural assets: land use oil, gas, coal, bauxite and tin. Subtracting imputed environmental costs from Net Domestic Product yielded Eco-Domestic Product (EDP) of Rp 411,763,049 million in 1995 and Rp 189,263,648 million in 1990. Imputed environmental costs of Rp 23,561,351 million constituted about 5.41% of 1995 NDP, i.e. slightly lower than the 5.88% figure for 1990.

In addition to constructing Indonesian SEEA and estimating Green GDP, Alisjahbana and Yusuf (2000b) estimated Indonesia's genuine saving rates by extending the previous World Bank study by Hamilton and Clemens with regard to: (i) wider coverage, i.e. to include degradation costs due to air and water pollution, (ii) more recent period of coverage that extends from 1980 to 1998, and (iii) identification of relevant policy implications for sustainable development. Despite its slight short run fluctuation, all measure of genuine savings rates reflects the same increasing trend from 1980 to 1995. Extended genuine savings rate (with current education

[7] Minerals covered in this study are crude oils, natural gas, coal, bauxite, copper, iron ore, lead, nickel, phosphate, tin, zinc, gold, and silver. For forest resources, only timber value of forest i.e. value of roundwood production was covered while for pollution damage, only emission from carbon dioxide was estimated of which data for each country was readily available.

[8] It turns out that the genuine saving improved in 1980 as Indonesia experienced rapid industrialization which had changed its economic structure to less reliance on natural resources

expenditure) started very low at -4 percent in 1980, and ended up at 17 percent in 1995 before started to decline afterwards.

Table 2 summarizes previous studies on green accounting application for Indonesia as they relate to the adjustment of GDP:

Table 2. Results on adjustment to Indonesia's GDP from various studies

Study by	Adjustment to GDP (%)	Coverage
Repetto (1989), Pearce & Atkinson (1993)	17.9 (1984)	oil, forest (including deforestation), and soil degradation.
Vincent & Castaneda (1997)	2.5 (1992)	coal, oil, broad coverage of minerals, forest, soil. Use of "hotelling rent".
Hamilton (1999)	14.7 (1994)	oil, gas, broad coverage of minerals, forest, and damage from CO_2 emission.
BPS (1996)	11.7 (1993)	oil, gas, coal, forest.
Alisjahbana and Yusuf (2000a)	5.2 (1995)	Oil, gas, some important minerals, forest, broad coverage of pollution damage
Alisjahbana and Yusuf (2000b)	10.5 (1997)	Oil, gas, some important minerals, forest, broad coverage of pollution damage

Table 2 shows high variation among the different estimates. The highest figure (17.9%) produced by Repetto's study. One important difference that could generate this higher figure is how deforestation enter the natural resources account. Other studies did not calculate deforestation but mostly estimate net annual increment. In 1984 net annual increment excluding deforestation is positive implying zero depreciation of forest resource. Adjusting this from the calculation, the figure will become around 13.6%. The lowest (2.5%) figure produced by Vincent and Castaneda's study. This was mainly because the use of "hotelling rent" rent rather than total rent. If total rent were used instead the figure will become around 10%.

Alisjahbana and Yusuf (2000a) also reported somewhat low value of adjustment to GDP eventhough some broad coverage of pollution damage was imputed. The main reason is the use of user cost method rather than net price to calculate depreciation from mineral resources. If net price method was used instead, the figure will change to such as reported in Alisjahbana and Yusuf (2000b) for measuring Genuine Saving i.e. 10.5%. What Table 2 has shown us is that some consensus estimates is possible if the results are to be compared based on a common, and standard methodology. In this case, for example some range of figures from 10% to 13% is likely to be a more reasonable estimate.

4. Methodology and Data
4.1. Measuring Genuine Saving

This section discuss step-by-step methodology including the description of the data sources used in estimating genuine saving over the period 1980 to 2000. We applied the similar approach as used in our previous study (Alisjahbana and Yusuf, 2000b). However, in addition to updating the genuine saving by adding data for 1999 and 2000, we also extended the coverage and performed recalculation. Some important updating and extension will be discussed specifically in this section that follows.

The methodology for estimating genuine saving could be outlined into the following eight equations:

$$GS = S - D^K - D^{NR} - D^R - ED \qquad [4.1]$$

$$S = Y - C \qquad [4.2]$$

$$C = C^P + C^G - [\, C^G{}_{ED} + C^G{}_H + C^G{}_{RD} \,] \qquad [4.3]$$

$$ED = ED^L + ED^G \qquad [4.4]$$

$$D^{NR} = \sum_i r_i q_i \qquad [4.5]$$

$$D^R = \sum_j s_j (h_j - g_j) \qquad [4.6]$$

$$ED^L = \sum_m \sum_n ac_{mn} \cdot p_{mn} \cdot Q_n \qquad [4.7]$$

$$ED^G = mc \cdot CO_2 \qquad [4.8]$$

Where:

GS = Genuine Saving
Y = Gross National Product (GNP)
S = Gross (conventional) saving
C = (Adjusted) consumption expenditure
C^P = Private/household consumption expenditure
C^G = Government consumption (current government spending)
$C^G{}_{ED}$ = Current government spending on education
$C^G{}_H$ = Current government spending on health
$C^G{}_{RD}$ = Current government spending on research and development
D^K = Depreciation of man-made (produced) capital stock
D^{NR} = Depreciation of non-renewable natural resources
D^R = Depreciation of renewable natural resources
ED = Environmental degradation
ED^L = Environmental degradation from local pollution
ED^G = Environmental degradation from global pollution
i = 1,2,3,… (type of non-renewable natural resource)
r_i = Unit rent of non-renewable resource i

q_i = Quantity of non-renewable resource i extracted
j = 1,2,3,… (type of renewable natural resource)
s_j = Unit rent of renewable resource j
h_j = Quantity of renewable resource j harvested
g_j = Natural growth of renewable resource j
m = 1,2,3, … (type of pollutant i.e. NO_2, SO_2, …. etc.)
n = 1,2,3, … (sub-sector of manufacturing sector)
ac_{mn} = Unit cost of abating emission of pollutant m in manufacturing sector n (abatement cost)
p_{mn} = Volume of pollutant m emitted per unit of output produced by manufacturing sector n (pollution intensity)
Q_n = Output of manufacturing sector n
mc = marginal social cost of CO_2 emission
CO_2 = Volume of CO_2 emitted

Gross Saving and Adjusted Consumption

Equation [4.1] states that genuine saving (GS) is the "true" rate of saving calculated by subtracting depreciation of produced or man-made stock of capital (D^K), depreciation of non-renewable natural resource (D^{NR}), depreciation of renewable natural resource (D^R) and environmental degradation (ED) from gross saving (S). Depreciation of non-renewable and renewable natural resources is sometimes called "resource depletion" or "resource rent".

Gross saving (S) is calculated by subtracting from Gross National Product (Y), adjusted consumption expenditure (C). Data for GNP and un-adjusted (conventional) consumption expenditure i.e. private/household consumption expenditure (C^P) and current total government spending (C^G) was obtained from Asian Development Bank (ADB) macroeconomic database.[9]

In order to measure the "true" saving, we have to re-identify what constitute the "true" consumption and the "true" investment. In conventional national account, in many cases, type of expenditure spent either by private or by public sector, which is better classified as investment is simply counted as current expenditure or consumption. Those type of expenditure among others are expenditure on education such as school or university tuition spent by household sectors, current government spending on education such as subsidy to schools, spending for improving health status, or simply current government spending to support research and development activities.

Assigning those kinds of expenditure as "consumption type" not as "investment type" will simply underestimate the true saving or investment, because those type of spending obviously increase future productive capacity of an economy and each of them has its future return. Type of consumption spending that we re-classify in this study are current expenditure on education (C^G_{ED}), health (C^G_H), and R&D (C^G_{RD})

[9] Available from ADB website: http://www.adb.org/ Documents/Books/Key_Indicators/2001/INO.pdf

spent by government sector.[10] Household consumption of those types was not re-classified because we do not have adequate time-series data on those type of expenditure spent by household/private sectors[11]. Equation [4.3] formally states how to re-classify standard consumption into better-classified (adjusted) consumption.

Depreciation of Non-renewable Natural Resources

Equation [4.5] shows how to calculate the value of depreciation or depletion of non-renewable natural resources. We include 10 categories of non-renewable natural resources, i.e. crude oil, natural gas, coal, bauxite, nickel ore, gold, silver, iron sand, copper, and tin[12]. The data of extracted quantity of each sub-soil resource (q_i) was obtained from "Oil and Gas Mining Statistics" and "Non Oil and Gas Mining Statistics" published annually by the Indonesian Central Board of Statistics (BPS).

We use "net price method" to measure the depletion of sub-soil resources, i.e. by multiplying the quantity of extraction (q_i), or the change in stock of sub-soil resources, with its unit rent (r_i). The application of net price method was based on the Hotelling rent assumption. Unit rent for each resource (r_i) is calculated by subtracting unit cost[13] of extraction from its price. Because resource extracted is sold to different market, i.e. domestic and international market with different prices, we have to calculate weighted average price for each of resource. The data from "BPS Mining Statistics" made this calculation possible. This is the advantage of single country estimation of genuine saving compared to the same estimation for across countries such as done by the World Bank. The World Bank estimation simply uses international price and ignores specific condition of a single country.

Annual data of unit cost is hardly found. Hence, for the year in which the unit cost could not be measured (or the data is unavailable), we applied the assumption of real constant cost of production by adjusting for change in price index (wholesale price index). Thus, the variation in the unit cost for the year where data is unavailable (prior to 1990) follows the variation in the price index. The actual data of unit cost of some of the resource are only available for the year 1990 to 2000 from BPS publication "Integrated Environmental and Economic Accounting, 1990-2000". The cost structure covers primary cost, intermediate cost, and exploration cost. Unit rent for each of the sub-soil resources was obtained by subtracting unit cost from each price. Multiplying this unit rent (r_i) with the volume of depletion of each of the sub-soil resources (q_i)

[10] In our previous estimation of genuine saving (see Alisjahbana and Yusuf, 2000b), only current government spending on education was re-classified. The data is also not clear in a sense that whether capital expenditure is also included. Simply re-classifying total government spending as investment will double count investment because government capital expenditure has been classified as investment at the first place. In this study, we searched original data from the ministry of finance to obtain disaggregated current government spending over time. This enable us to add more type of expenditure i.e. current expenditure on health and R&D with greater certainty.

[11] We collected these data from annual publication of Ministry of Finance i.e. Financial Notes and Draft State Budget (*Nota Keuangan dan Rancangan Anggaran Pendapatan Belanja Negara*) from 1980 to 2000. Data for the budget year 1989/1990 was not available. We then use the estimated trend value for this year.

[12] Our previous studies (Alisjahbana and Yusuf, 2000b) only included oil, gas, coal, bauxite, and tin.

[13] Ideally, we have to use marginal cost instead of unit cost. However, data of marginal cost of extraction hardly exists. The use of average cost or unit cost tend to over estimate the resource rent if we still have long time of exhaustion (for e.g. see Vincent and Castaneda, 1997).

produces the series of the depletion cost or rent of its respective resources (equation [4.5]).

We use different method to estimate the unit rent for iron sands and copper since the extraction cost of these type of resource are not covered in BPS publication. For these resource, the unit rent was calculated, following Hamilton (1998), by assigning a proportion of unit rent from our own calculated price (0.58 for iron sands, and 0.49 for copper).

Depreciation of Renewable Natural Resources

For renewable resource, we have to slightly change the method for calculating its depreciation. Equation [4.6] shows that instead of multiplying unit rent with quantity of resource harvested, we multiply it with its net depletion or quantity harvested (h_j) minus natural growth (g_j). Because we only include one type of resource i.e. forest resource, this net depletion is called “excess felling”. Excess felling is defined as the volume of round wood production in excess of its natural growth.

Several strong assumption and simplification had to be made in order to arrive at the estimation of natural or sustainable growth of round wood. We assume that natural growth is proportional to the stock of the standing timber. Data for stock of standing timber is available for the year 1990 to 2000 from BPS Publication[14]. The data for the year before 1990 was estimated using trend regression[15]. Data for natural growth is also available for the same year (1990 to 2000), with the average proportion from the standing stock of 0.0036. We use this proportion to estimate the natural growth for the year 1980 to 1989.

The annual data on volume of round wood production was available from BPS and Ministry of Forestry. However, it is widely believed that this official data underestimates the true rate of production due to several reasons, such as illegal logging and shifting cultivation practice. The round wood production data then, was taken from FAOSTAT database on industrial round wood production. It was found that the rate of round wood depletion from this data was greater than from the official source.

The average world export price (calculated from FAOSTAT database[16]) was used to estimate round wood unit rent. Based on study by ITFMP (ITFMP, 1999), round wood unit rent is estimated to be 72.41 percent of its price. Unit rent of round wood for each respective year was calculated as unit rent percentage of price times price of the respective year. Equation [4.6] could then be applied.

Environmental Degradation

Equation [4.7] shows how to calculate the value of environmental degradation due to emission of several “local-type” pollutants. Air and water pollution originates from fixed sources, i.e. industrial sources which are mainly factories, from household

[14] Integrated Environmental and Economic Accounting, 1990-1993; 1994-1996,1996-2000
[15] We estimated the trend equation: Stock = a + bYEAR, with R-squared of 0.97.
[16] FAOSTAT database could be accessed from http://apps.fao.org

sources as well as from mobile sources, i.e. transportation sector (such as motor vehicles, aircraft). In this study only pollution from industrial sources was estimated.

For specific type of pollutant, the volume of emission depends on the pollution intensity (volume of pollution load per unit of output), and sectoral composition of the whole industry. Therefore, in order to estimate volume of emission we need to have information on pollution intensity and the structure of the industry.

The pollutants produced by manufacturing sectors, as residuals to air included in this study (subscript m) are Nitrogen dioxide (NO_2), Sulfur dioxide (SO_2), Carbon monoxide (CO), Volatile Organic Compound (VOC), Particulate, Fine particulate (PM10), Toxic air. Pollutant emitted to water includes Biochemical Oxygen Demand (BOD), Total Suspended Solid (TSS), Toxic water. The above type of pollutant except toxic sometimes referred to as "conventional air pollutants" and "conventional water pollutants".

Pollution intensity for each type of pollutants used in this study was based on World Bank "Indonesia, Environment and Development" (World Bank, 1994). It is an estimate of pollution intensity by World Bank IPPS (Industrial Pollution Projection System) adjusted for Indonesian condition[17]. The adjustments made were in separating out manufacturing sector into processing and assembly type of activities (subscript n). Table A1 (in the appendix) shows the pollution intensity by type of pollutant (m) and production activities (n):

Output data was obtained from Input-Output table and annual survey of large and medium manufacturing sectors for the year 1980 - 2000. Using 2-digit industrial classification, we then separated manufacturing sector into assembly and processing categories, and multiplying their output with their pollution intensity to obtain volume of emission for each pollutant type. Assuming constant pollution intensity throughout the 1980 – 2000 period, annual pollution intensity was estimated by adjusting it with each respective year's wholesale price index.

To arrive at the value of environmental degradation (ED^L) we applied maintenance cost approach i.e. total cost needed to maintain certain emission of pollution. For each type of pollutant, maintenance cost approach was applied by multiplying pollution load from separated industrial sub-sector (2-digit ISIC) with its abatement cost coefficient (varied by pollutant types and industrial sub-sectors). Abatement cost coefficient was obtained from World Bank IPPS (Industrial Pollution Projection System). Assuming real constant abatement cost, annual abatement cost coefficient was adjusted using each year wholesale price index.

Finally equation [4.8] shows how to calculate the value of environmental degradation from emission of "global type" pollutant i.e. CO_2. Methodology used in World Bank estimate of genuine savings was adopted to measure the cost of global damage from CO_2 emission (Hamilton and Clemens, 1999). It is assumed that global damages are charged to emitting countries on the assumption that the property right to a clean environment lies with the pollutee. The annual data of Indonesian CO_2 emission was obtained from World Bank World Development Indicator (WDI). The marginal social

[17] IPPS documentation can be downloaded from http://www.worldbank.org/nipr/work_paper/

cost of a metric ton of CO_2 is assumed to be $20 US in 1990 (based on Fankhauser, 199x, which was also applied in World Bank genuine saving estimation). The annual marginal social cost was estimated using relevant exchange rate and annual wholesale price index for the year 1980 - 2000.

4.2. Measuring Changes in Wealth Per Capita

Previous discussion suggest that when constant population growth assumption does not hold, then genuine saving is no longer a proper measure of sustainability. Changes in wealth per capita could correct this weakness. We will attempt to estimate changes in wealth per capita every year over the period of 1980 to 2000. We rewrite equation [2.1] as,

$$\dot{k} = \frac{d}{dt}\left(\frac{K}{N}\right) = \frac{K_t}{N_t}\left(\frac{\Delta K_t}{K_t} - n_t\right) \qquad [4.9]$$

where

$\dot{k}$	=	Changes in wealth per capita at year t
K_t	=	Total wealth at year t
N_t	=	Number of population at year t
$\frac{K_t}{N_t}$	=	Wealth per capita at year t
ΔK_t	=	Changes in wealth at year t (later it will be simply genuine saving)
n_t	=	Population growth at year t

The most difficult part in applying equation [4.9], is how to obtain the total value of wealth. Currently, there are several methods and studies in estimating wealth such as individually estimating every components of a nation's wealth such as done by Kunte, et. al. (1997), or by estimating it indirectly by calculating the present value of per capita consumption such as in Hamilton (2000).

In this study we will use our own estimates of wealth based on our previous study of green accounting. In Alisjahbana and Yusuf (2000a), we constructed an SEEA for the year 1990 and 1995 that required us to calculate the value of non-financial assets (not only produced-assets but also natural assets). However, this wealth estimate is only limited to two years and only covers selected components of wealth. Table A1 (in the appendix) shows the basis of our own estimation of wealth (K_t).

In order to obtain the time series estimate of K_t we applied the adjusted Perpetual Inventory Method (PIM), i.e. perpetual inventory method adjusted to account for revaluation of the change in the stock price. We used K_t for 1995 as the base.

To measure K_t for the year 1996 onward, the following formula was used:

$$K_t = \frac{P_t}{P_{t-1}} K_{t-1} + \Delta K_t \text{, for } t > 1995 \qquad [4.10]$$

Equation [4.10] simply says that the value of wealth at the end of year t (K_t) is the volume (or the quantity) of wealth at previous year (t-1) (the end of year t-1) evaluated at current or year t's price plus its net change in the current period (ΔK_t). Note that ΔK_t is evaluated at current price. Thus this formula, not only incorporates the net change in the volume of the stock but also accommodates the change over a year in the stock price (or price revaluation). This method enables us to estimate the value of wealth over time without calculating having to calculate it for every single year[18].

The following formula was used to measure Kt for the year 1980 to 1994:

$$K_t = \frac{P_t}{P_{t+1}}\left[K_{t+1} - \Delta K_{t+1}\right], \text{ for } t < 1995 \qquad [4.11]$$

Bearing in mind that the value of K_t for 1995 was obtained from SEEA 1995 as constructed by Alisjahbana and Yusuf (2000a) i.e. from Table A.2. The component of assets included in SEEA 1995 are produced-assets, land, and sub-soil assets. It is easy to understand that ΔK_t is simply genuine saving at year t. However, because assets classification in genuine saving and SEEA 1995 is different, some readjustment or reclassification is necessary. We excluded land component from the SEEA calculation, because land is not included in genuine saving estimates. We then reclassify assets component in genuine saving, i.e. dropping some components which does not exist in SEEA in order to arrive at comparable classification. In the end, the component of wealth left are produced-assets and natural assets which include oil, gas, coal, bauxite, tin and timber.

After this readjustment the value of wealth (K_t) overtime is calculated using equation [4.10] and [4.11]. We also assume that the change in the price of assets follows the rate of inflation. After annual series of K_t is calculated, we then applied equation [4.9] to arrive at the value of change in wealth per capita. The data on the number of population, population growth, and wholesale price index were obtained from World Bank's WDI.

5. Genuine Saving and Changes in Wealth per Capita: Long-term Trend and Impact of the Crisis

Result of our calculated genuine saving rate is shown in the following Figure 5.1, while our calculated change in wealth per capita can be seen from Figure 5.2. Figures 5.3 and 5.4 show detail component of genuine saving rate, i.e. resources depletion and environmental degradation.

[18] Implicitly, we impose quite a strong assumption that for non-renewable assets (i.e. sub-soil assets) we ignore positive change in the reserves such as discoveries over time.

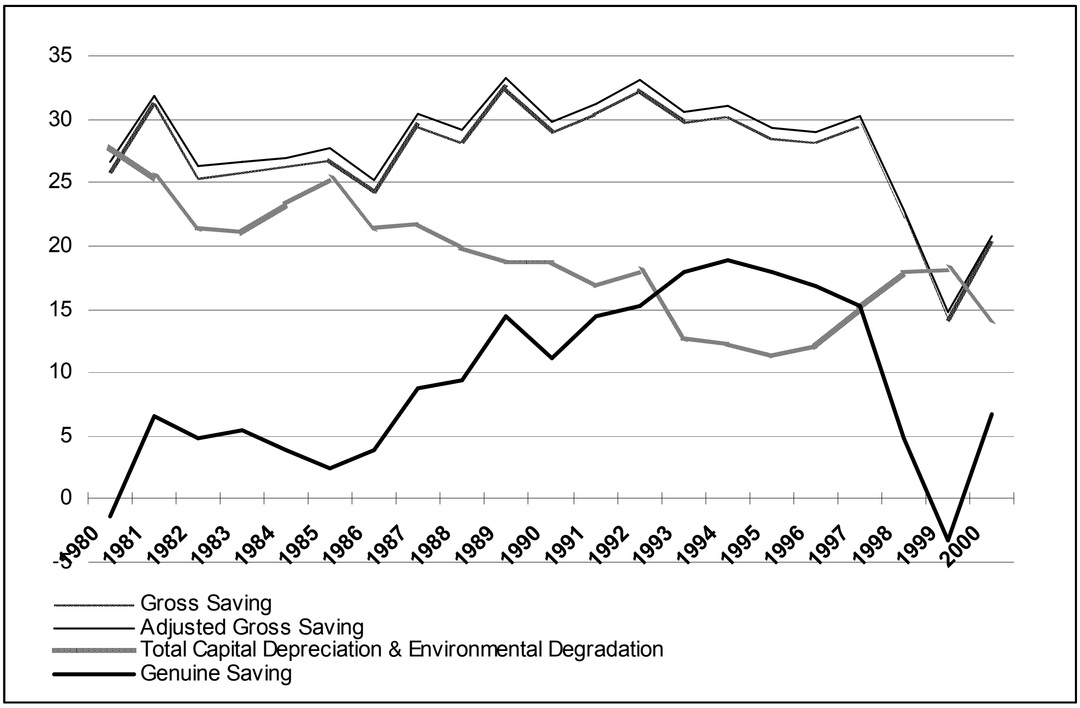


Figure 5.1. Gross Saving, Adjusted Gross Saving, Total Capital Depreciation, and Genuine Saving, 1980-2000 (percent of GNP)

5.1. Sustainability over the Long-run (1980 – 2000)

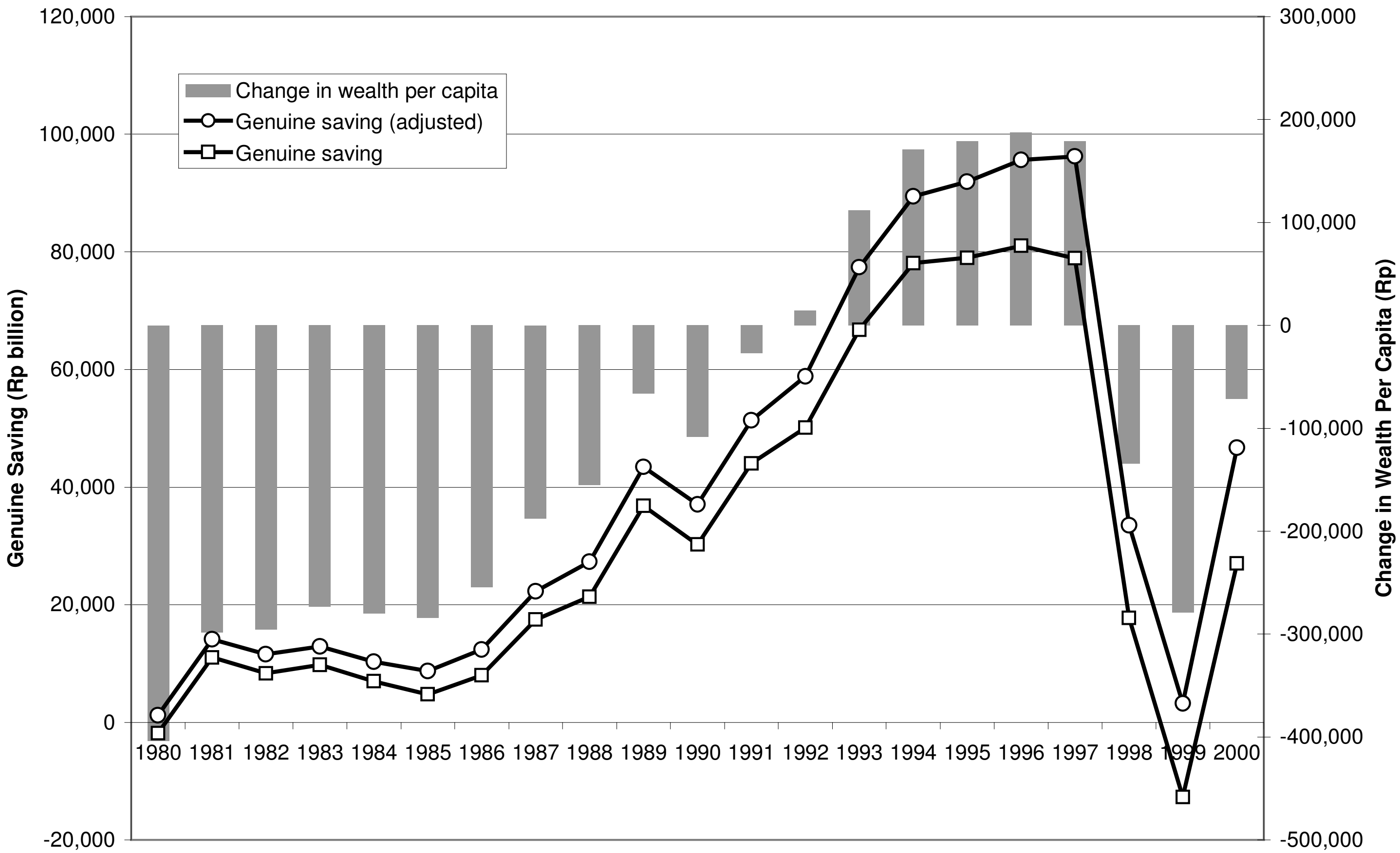
From the previous discussion, the advantage of genuine saving and changes in wealth per capita over the other indicators of sustainable development is how those indicators can answer straightforwardly the question of whether our economy is sustainable or in sustainable path? This is the fundamental question that need to be answered. The conceptual framework and the methodology discussed in the previous section suggests that positive genuine saving and/or changes in wealth per capita (for certain period of time) could inform us whether the economy is on a sustainable path.[19]

Results of this study are shown in Figures 5.1 and 5.2 on sustainability indicators i.e. genuine saving, change in wealth per capita, and adjusted genuine saving over the long-run. Adjusted genuine saving in this case is genuine saving that is comparable to changes in wealth per capita, because not every component of genuine saving could be incorporated when calculating changes in wealth per capita.[20]

[19] This issue has been formally discussed by Hamilton which stated that observed current negative genuine saving indicate declining welfare some time in the future (Hamilton, 1999).
[20] See previous section on methodology for further detail.

Figure 5.2

Genuine Saving & Change in Wealth Per Capita (Constant 1995 Price)



Interestingly, the general pattern of the two indicators (genuine saving rates and changes in wealth per capita) could suggest different conclusions. Over the period of 1980 to 2000, Indonesia only experienced two year of negative genuine saving rates: one in a "normal year" (1980), and the other during the crisis (1999)[21]. Based on genuine saving indicator, the Indonesian economy during the 1980-2000 period is sustainable. However, the over-time pattern of changes in wealth per capita suggests differently. As positive changes in wealth per capita only occurred in six years over the same period, the conclusion would be that the Indonesian economy in general (over the 1980-2000 period) is not sustainable.

Why the conclusions from the two indicators are different? Since genuine saving will be equal to change in wealth per capita only if population growth rate is zero, this means that population growth in one of the constraint's to Indonesia's sustainable deelopment Increasing aggregate total wealth of an economy does not guarantee sustainable development unless its rate of increase exceeds the growth of population. From our earlier conception, better indicator of sustainable development have to be in per capita terms since sustainable development is meant to be "non-declining welfare per capita". Using this definition of sustainability, one could argue that the Indonesian economy over the last twenty years had not been on a sustainable path.

How conclusive is our result depends on several aspects. First, we have not yet able to include some other important component of assets into our calculation. For example, non-timber benefit of forest which many people thinks has been depleted significantly or pollution from non-industrial sources such as from transportation and households, and many others component that could not be calculated because of data and methodological limitation. The inclusion of these omissions would certainly strengthened our conclusion on Indonesia's "unsustainable economic development". Second, our conceptual framework suggests that our result is "weak" because it is based on the belief of weak sustainability which was based mainly on strong neo-classical assumption of perfect substitutability between man-made and natural capital. Thus, if the Indonesian economy does not pass the weak sustainability test, it would certainly not pass the strong sustainability test either.

However, some cautions should also be in order. We do not, for example incorporate the value of human capital in calculating the changes in wealth per capita (due to methodological limitation) and we also did not include discovery of natural resources (because of data limitation) as positive changes in wealth. These could drive up our sustainable indicator results and will possibly weaken our conclusion of the unsustainability of the Indonesian economy.

5.2. Trend of Sustainable Development in the Pre-crisis Period (1980 – 1997)

The general trend of both indicators could also be interestingly noted. Both genuine saving rate and change in wealth per capita generally improves over time with the exception during the crisis period. If this trend continues, then it is a sign of optimism in the context of sustainable development. If we also divide the last two decades into

[21] If changes in wealth per capita have to be comparable with genuine saving, we have to compare it to adjusted genuine saving rate which had always been positive over time.

two period i.e. 80s and 90s, we could also says that based on the indicator of changes in wealth per capita, Indonesian development was not sustainable during 1980s but experienced sustainable development during the 1990s (especially when we counterfactually assume of no crisis at the end of the 90s).

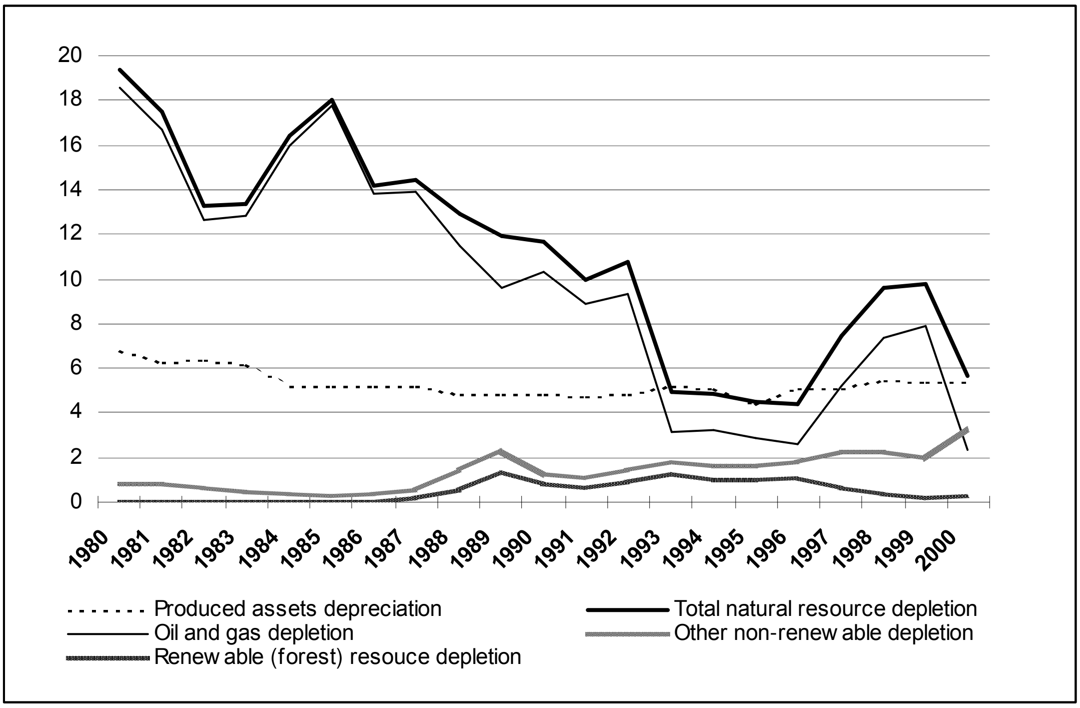


Figure 5.3. Depreciation of man-made and natural capital (Percent of GNP)

The general trend of improving sustainability indicators over time could be explained further by looking at the trend of genuine saving or changes in wealth per capita components (Figures 5.3 and 5.4). First conventional saving rate had been relatively stable. This "traditional measure" of economic sustainability, i.e. gross national savings had been relatively constant over the period of 1980-1997 ranging from 26.24 per cent of gross national product to the highest level of 33.12 per cent. Second, depreciation of man-made capital had been invariant over time at the rate of 5 percent of GNP. Third, total environmental degradation (local and global environmental degradation) slightly increased over time despite its insignificant magnitude (of around 1.5 to 3 percent of GNP). And finally, total resource depletion exhibit obvious decreasing trend over the period, i.e. from almost 20% of GNP in 1980 to only slightly less than 6% in 1997. Therefore, the only logical explanation of improving trend in the genuine saving rate from 1980 to the year just prior to the economic crisis is the significant decreasing trend in natural resources depletion rate.

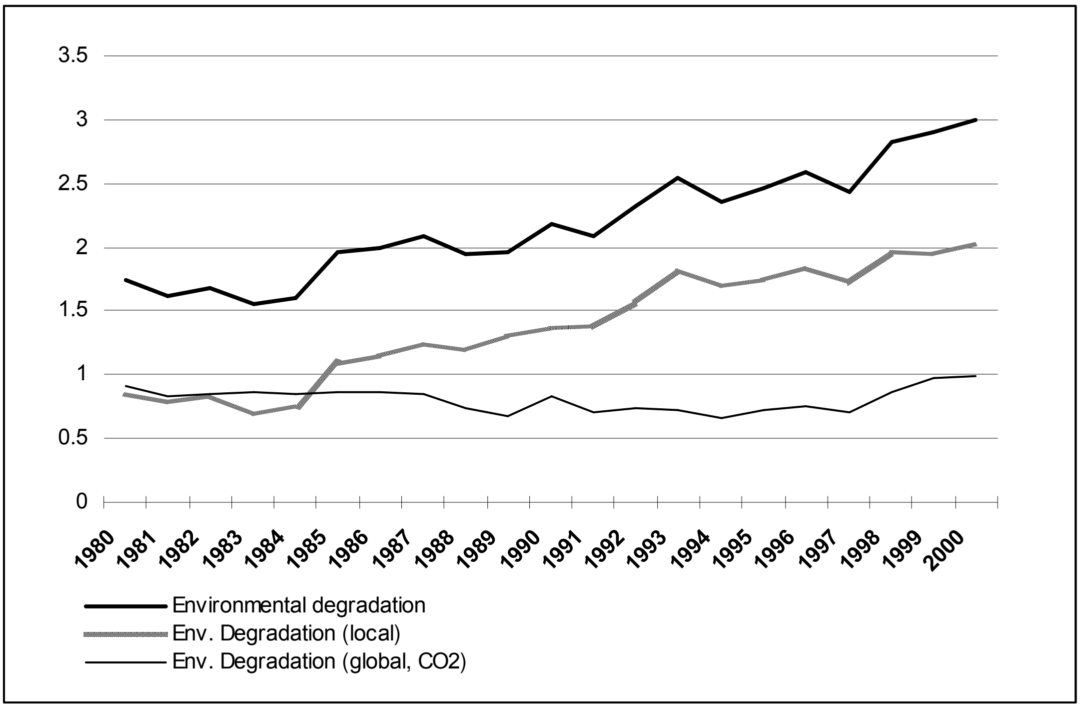


Figure 5.4. Environmental degradation (Percent of GNP)

Looking at the trend of natural resource depletion into more detail (see Figure 5.1), it is very obvious that constant decline of resource depletion had been due mostly to declining oil and gas depletion as a percentage of GNP. As we were restructuring our economy away from dependence on oil and gas, the economy moved towards more sustainable development. Figure 5.5 can help explain the significance of this structural change toward sustainable development. This figure clearly shows that up to the year 1997, declining share of the value added of primary sector (agriculture and mining) had been accompanied by increasing share of manufacturing sector's value added. Thus not only that economic policy during 1980s and 1990s to promote non-oil and gas sector/export help the economy to achieve higher growth, but at the same time also put the economy on a sustainable development path.

Structural shift, however, is not the only explanation. General tendency of the economy moving into more sustainable development as indicated by improving trend of sustainability indicator during the period of 1980-1997 might have been affected by various events and policies over the same period. First, a shift in Indonesia's industrialization policy from import-substitution in 1970s into export-oriented industrialization strategy since the second-half of 1980s. This shift might have important effect on the characteristic of its industry and the path of its economic growth. Second, different attitude towards foreign direct investment, from very restrictive in the late 1970s into one that is more open since 1986, and even more liberal during 1990s. Third, financial deregulation, particularly in October 1988, that had significantly increased savings.

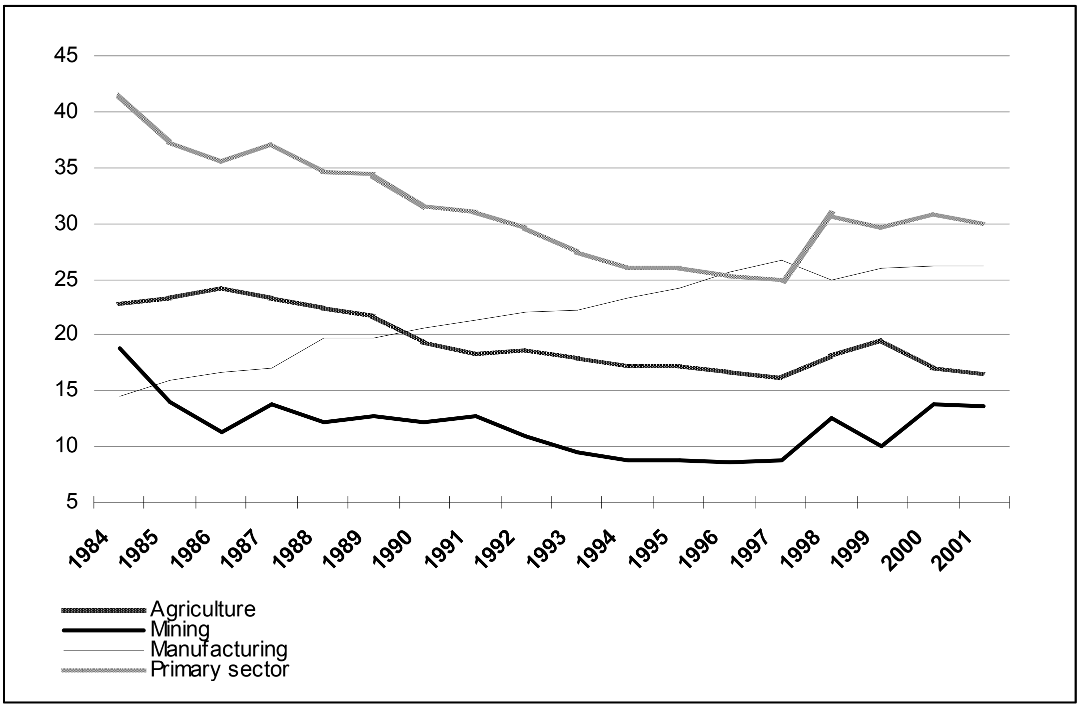


Figure 5.5. Share of Sectoral Value Added to GDP (Percent)

Lastly, it should be noted that minerals (non-oil and gas) depletion, forest resource depletion (as shown in Figure 5.3) and environmental degradation (as shown in Figure 5.4) have shown increasing long-run trend. If this continues, then we have to anticipate its future implication. As Indonesia is a country with abundant resources, once these resources are depleted, it will have adverse consequences on sustainable development. The same is true on the effect of more dominant industrial sector within the economy with its ensuing pollution problems.

5.3. Sustainable Development and Impact of the Crisis (1997 – 2000)

If we highlighted the period during the crisis and its ensuing adjustment, we could clearly observe that economic crisis do have significant impact on sustainability. Not only because from the year at the start of the crisis (1997) general trend (that had occurred for the preceding 16 years) of improving sustainability indicator seems to be halted, but more because both indicators had dropped considerably further. Although genuine saving rate was only negative once in 1999, changes in wealth per capita had been consistently negative during the crisis (1998, 1999 and 2000). The latter is an indication of unsustainability.

How has the economic crisis transmitted to unsustainable development? The answer would be found in disentangling the sustainable development indicators by its components. The fall in the sustainable development indicators is a result of two forces at work. First, sharp drop in the conventional saving rate, and secondly significant increase in natural resources depletion, mostly in the form of oil and gas depletion. Both factors had adversely affected sustainable development.[22]

The impact of savings variation on sustainability is substantial, in which case man-made capital is the largest share of total wealth, its up and down over-time would have big impact on sustainability. Compared to the condition during 1980s, in the late 1990s, accumulation of man-made capital (physical investment) had become much more important in the accumulation of total wealth. Saving, then, is very important in the context of sustainable development because this is the source of investment or addition to total man-made capital. When saving decreases, this will substantially reduce our capacity to maintain total wealth, and hence sustainability.

Sharp decline in saving rate was recorded when it dropped from around 30% of GNP in 1997 to only 15% in 1999. Figure A1 (in the appendix) reveal that this decline occurred in every components of savings: private saving (other domestic saving), government saving, and foreign saving (in the form of capital outflow). This clearly had destroyed the capacity to accumulate man-made capital, the important component of total wealth. Lowest points of saving rates in 1998, 1999, and 2000 are thought to be the causes of negative changes in wealth per capita over the same period.

There is common agreement in the literature that economic growth is an important determinant of saving rate (for example Gulati and Thimann, 1997). The scatter plot of saving rate and economic growth of Indonesia reveals that saving rate is strongly associated with economic growth (see Figure A2 in the appendix). When economic crisis caused sharp drop in the economic growth, sharp drop in saving rate became inevitable. How has this phenomena translated to sustainable development?

Economic growth is certainly not the only factor that affects savings rate. Other factors such as: fiscal policy, demographics, external factor, and financial market development are among the most important saving determinants (Gulati and Thimann, 1997). For example, Gross National Savings increased sharply after 1988, when the government of Indonesia started financial deregulation, known as Pakto 88 (1988 October Package). Through this package, the government deregulated the financial sector to mobilize domestic savings to finance economic development. Through this deregulation, the government intended to increase domestic savings by easing the establishment of banks and by lowering the reserve requirement. At the same time through increased competition among banks to attract money held by household, the interest rates increased. As a result, the banking sector was glutted by private savings and deposits. The deregulation had proved to be effective in raising domestic saving, until financial crisis hit Indonesia in 1997.

The second force that drove down the sustainability indicator during the crisis is the jump in resources depletion, mainly for oil and gas. Non-oil and gas resources rent also experienced substantial increases during the crisis although at a lesser degree (Figure 5.3). Because the depletion is in percentage of GNP, this raises an interesting question. How the economic crisis of the late 1990s had affected change in economic structure by affecting the behavior of certain sector, e.g. mining sector in the

[22] The former (saving) is our ability to accumulate man-made capital, and the latter is the rate of how we deplete our exhaustible natural resources.

economy? Figure 5.3 suggests that the crisis that started in 1997 had raised rent from oil and gas from 2.6% of GNP in 1996 to almost 8% in 1999 (an almost four times increase within 3 years). This, in turn, contribute significantly to the rise of total resources rent from around 4% of GNP in 1996 to almost 10% in 1999, very inconsistent with its long-run trend. Consequently, this sharp rise had been responsible for the negative genuine saving in 1999, and negative changes in wealth per capita in 1998, 1999, and 2000. In short, rapid increase in the resource rent per GNP due to economic crisis had reduced the sustainability of Indonesian economy.

This interesting phenomenon had raised a theoretical question of whether economic crisis changes the behavior of natural-resources or primary sector in the economy. Empirically, this was what actually happened with the Indonesian economy during the crisis as shown in Figure 5.5. As the figure suggests, share of the mining and agriculture sector value added rose during the crisis, and these together constituted quite an increase in total share of primary sector's value added from 25% in 1997 to almost 31% in 1998. On the other hand, share of manufacturing sector's value added dropped from 27% in 1997 to 25% in 1998. The economic crisis had clearly affected structure of the economy.

There are several links that could relate economic crisis to resource depletion or environmental degradation. The literature on the link between poverty and the environment argues that in the situation of open access resources, poor people tend to deplete resource more rapidly because poor people usually have lower personal discount rate. Unemployment and poverty that increased during the crisis had raised the number of poor people and accordingly, rate of natural resource depletion (for example forest depletion) will increase. Environmental degradation could also be driven by increasing poverty incidence, because in a period of economic hardship, assets (including natural assets) liquidation could be seen as an inevitable answer.

Other explanations that relate more specifically to the Indonesian case is on the relationship between natural resources depletion for export and currency depreciation (Dauvergne, 1999). Indonesian economic crisis was accompanied (and also triggered) by sharp depreciation of the Rupiah and this has increased the exploitation and export of natural resources sector because production costs were mainly in local currency but profit from exporting the commodities are in foreign currencies. Price of resource commodities relative to non-resource commodities had attracted more exploitation of natural resources, and this is what apparently happened during the crisis, as Dauvergne (1999) for example stated:

> … Mining exploitation has apparently increased during the crisis, including by small miners who are exceptionally difficult to supervise. The Indonesian government awarded 50 contracts in February 1998 to mine gold, coal, diamonds, and nickel, bringing the total number of mining contracts in Indonesia to 269 (Sunderlin, 1998:7). The government is now encouraging foreign investment in the mining sector to try and maximize its foreign currency earnings.…

Calculation of resource rents reveals that most of the increase in resources rent during the crisis is due to sharp increases in the value of unit rent. Rapid depreciation of the rupiahs is responsible for the rise. Thus, this strengthened our argument that economic crisis had substantially and negatively affected Indonesia's sustainable development which was mostly channeled through significant currency depreciation and its effects on resources rent.

As the economic crisis has reached its peak, we would expect that savings rate would improve and resources depletion would slow down, and hence contribute to an improvement in the overall economic sustainability. Lower saving rate was mainly due to lower economic growth that now seems on the recovery, and currency value had been stabilized. The positive recent macroeconomic development of the Indonesian economy would likely to imply the end of high resources depletion as had happened during the height of the crisis. On the optimistic side, we would expect that when the economy had returned to its normal situation, Indonesia' s sustainable development would again be on its improving long-run trend.

6. Concluding Remarks and Policy Implication

The overall trend in sustainability indicator as measured by both genuine savings and changes in wealth per capita had shown that the Indonesian economy during the last twenty years had not been on a sustainable path. Despite this, sustainability had been on an improving trend during the 1980s and 1990s until just prior to the economic crisis. The improvement in long-run trend of sustainability is due to the restructuring of the economy away from oil and gas sector, towards more reliant on secondary and tertiary economic activities. Economic policies in the 1980s and 1990s that had accelerated structural change in the end had the beneficial effect on sustainable development.

Although the share of oil and gas sector in the Indonesian economy had been on a decline with its positive effect on sustainability, the other development is on the increasing trend in the other minerals extraction, with concurrent unsustainable practice of forest depletion, and rapid share of environmental degradation from industrial pollution. Policies related to natural resources management specifically could be used to maintain optimal resource extraction path, to create proper regulation of property rights, royalties, concessions, command and control regulation and zoning of natural resources management.

In addition, the fact that resources rent was significantly influenced by unit rent in term of its magnitude and fluctuation requires this type of policy to create regulatory and institutional conditions, and the proper allocation of user charges, fees and rents. Certain policies in relation to control environmental degradation would be in the form of commitment and protection of critical environmental expenditures. The challenge is for the government to find an appropriate balance among these instruments and to enforce any environmental regulation in an effective manner.

It has been shown that economic growth per se has a profound positive effect on an economy's path to sustainable development.[23] Economic growth translates into higher savings, and consequently increases our capacity to add to our total wealth. An overall macroeconomic stability has to be achieved in order to attain higher growth rate in a

[23] As opposed to those proponent of limits to growth that only regards sustainability from the strong sustainability rule point of view.

more sustainable manner. Policies that would faciliate conventional savings rate are to be prioritized aside measures to improve the economic performance, or growth in itself. Policies such as: fiscal and monetary policies that encourage the better performance of the economy would fall into this category. Policies to maintain exchange rate stability would dampen the behaviour to extract more earnings from the extractive export oriented sector. On a broader policy context, certain aggregate savings-investment behaviour in the more micro context of private (household) savings would need to be encouraged.

References

Alisjahbana, Armida S. and Arief Anshory Yusuf, 2000a, "Trial Estimates of the 1990 and 1995 System of Integrated Environmental and Economic Accounting", Report submitted to the United Nations University/Institute for Advanced Studies, Tokyo.

____, 2000b, "Indonesia's Genuine Savings Rates: 1980 - 1997". Report submitted to the United Nations University/Institute for Advanced Studies, Tokyo.

____, 2000c, "Indonesia's Genuine Savings Rates and Sustainable Development". 7 th Convention Of The East Asian Economic Association 17-18 November 2000, Singapore.

Asian Development Bank, 2002, "Asian Economic Monitor 2002", http://aric.adb.org

Baharumshah, Ahmad Zubaidi, Marwan A. Thanoon, and Salim Rashid, 2002, "Saving Dynamics in the Asian Countries", *Journal of Asian Economics* 204 (2002) 1-19.

Baharumshah, Ahmad Zubaidi, Marwan A. Thanoon, n.d., "Foreign Capitals, Savings and Economic Growth: A Dynamic Panel Study on the East Asian Countries", Department of Economics, Universiti Putra Malaysia, mimeo.

Barry, Dalal-Clayton, (n.d.), *What Is Sustainable Development ?,* International Institute for Environment and Development (IIED), London, and World Conservation Union (IUCN), Gland, in association with Earthscan Publication, London.

Biro Pusat Statistik, 1996, "Trial Estimates of the Indonesian System of Integrated Environmental and Economic Accounting: 1990-93", a research report prepared by Biro Pusat Statistik, Jakarta, Indonesia.

Dasgupta, Partha, and K-G Maler, 2000, "Net National Product, Wealth and Social Well-Being," *Environment and Development Economics* 5:1&2, 69-93.

Dauvergne, Peter, 1999, "The Environment in Times of Crisis: Asia and Donors after the 1997 Financial Crisis" Canberra: Australian Agency for International Development of the Department of Foreign Affairs and Trade (AusAID).

Everett, Glyn, and A. Wilks, 1999, "The World Bank's Genuine Savings Indicator: A Useful Measure of Sustainability?". Bretton Woods Project.

Freeman, A.M., 1994, *The Measurement of Environmental and Resource Values: Theory and Methods*, Resources for the Future, Washington, D.C.

Gulati, Anuradha Dayal, and Christian Thimann, 1997, "Saving in Southeast Asia and Latin America Compared: Searching for Policy Lessons", *IMF Working Paper WP/97/110*, International Monetary Fund, Washington, D.C.

Hamilton, Kirk, 2000a, "Sustaining Economic Welfare: Estimating Changes in per Capita Wealth", *Policy Research Working Paper No. 2498*, November 2000, World Bank.

_____________, 2000b, "Genuine Saving as a Sustainability Indicator". pp 65-78 In *OECD Proceedings: Frameworks to Measure Sustainable Development*, An OECD Expert Workshop, September 2-3, 1999, Paris, France. Paris, France: OECD.

_____________, 2001, "Measuring Sustainable Development". Prepared for OECD Round Table on Sustainable Development. May 31, 2001.

Hamilton, Kirk, and Ernst Lutz, 1996, "Green National Accounts: Policy Uses and Empirical Experience." *Environment Department Paper Number 39. World Bank*, Environment Department, Vice Presidency for Environmentally Sustainable Development. Washington DC.

Hamilton, Kirk and Michael Ward, 1997, "Greening the National Accounts: Valuation Issues and Policy Uses", in Uno, K. and P. Bartelmus, *Environmental Accounting in Theory and Practice*, Kluwer: London.

Hamilton, Kirk, Giles Atkinson, and David W. Pearce, 1998, "Savings Rules and Sustainability: Selected Extensions," presented to the World Congress on Environment and Resource Economics, Venice, June 25-27.

Hamilton, Kirk and Michael Clemens, 1999, "Genuine Savings Rates in Developing Countries", *World Bank Economic Review*, 13, 333-356.

Hamilton, Kirk and John A. Dixon, 2000, "Measuring The Wealth Of Nations. Frameworks To Measure Sustainable Development". pp 39-50 In *OECD Proceedings: Frameworks to Measure Sustainable Development*, An OECD Expert Workshop, September 2-3, 1999, Paris, France. Paris, France: OECD.

Kunte, Arundhati, Kirk Hamilton, John Dixon, Michael Clemens, 1998, "Estimating National Wealth: Methodology and Results, Indicators and Environmental Valuation", *The World Bank*, January, mimeo.

Masson, Paul R., Tamim Bayoumi, and Hossein Samiei, 1998, "International Evidence on the Determinants of Private Saving", *The World Bank Economic Review*, vol 12, no 3, 483 – 501.

Obst,Carl, 2000, Report Of The September 1999 OECD Expert Workshop On "The Measurement Of Sustainable Development": pp.7-19 In *OECD Proceedings: Frameworks to Measure Sustainable Development*, An OECD Expert Workshop, September 2-3, 1999, Paris, France: OECD.

Pearce, D.W., 2000, "The Policy Relevance and Uses of Aggregate Indicators: Genuine Savings". pp. 79-82 *In OECD Proceedings: Frameworks to Measure*

Sustainable Development, An OECD Expert Workshop, September 2-3, 1999, Paris, France: OECD.

Pearce, D.W. and Giles D. Atkinson, 1993, "Capital Theory and the Measurement of Sustainable Development", *Ecological Economics*, 8, 103-108

Repetto et. al., 1989, *Wasting Assets: Natural Resources in the National Accounts*. Washington: World Resources Institute.

United Nations, 1993, Integrated Environmental and Economic Accounting (interim version), Studies in Methods: Handbook of National Accounting, Series F, no. 61, New York.

Vincent, J and B. Castaneda, 1997, "Economic Depreciation of Natural Resources in Asia and Implications for Net Savings and Long-Run Consumption", *Development Discussion Paper 614, Harvard Institute for International Development*, Harvard University.

World Bank, 2001, *World Development Indicators*.

Table A1
Pollution intensities: processing versus assembly
(in lbs. per Rp million of output value - 1989)

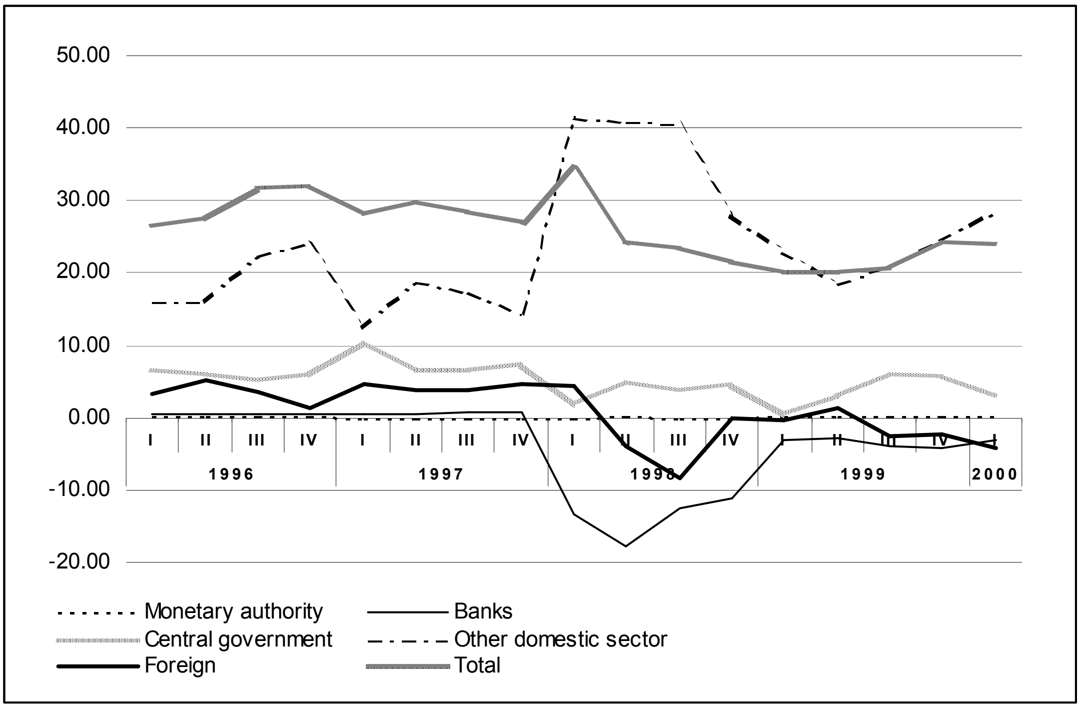
Pollutants	Assembly	Processing	Ratio Processing/Assembly
"New" Pollutants			
Volatile Organic Compounds (Air)	9.609	9.495	1.0
Lead (Air)	0.00048	0.00289	6.0
Toxic Release (All Media)	4.806	13.085	2.7
Bio-accumulative Metal (All Media)	0.254	0.987	3.9
"Traditional" Air Pollutants			
Fine Particulate (Air)	0.679	3.037	4.5
Sulfur Dioxide (Air)	7.394	24.03	3.3
Total Particulate (Air)	2.518	15.39	6.1
Nitrogen Dioxide (Air)	4.138	17.50	4.2
Carbon Monoxide (Air)	7.193	17.39	2.4
"Traditional" Water Pollutants			
Biochemical Oxygen Demand (Water)			
Suspended Solids (Water)	7.006	5.458	0.8
	2.632	36.27	13.8

Source: World Bank, "Indonesia: Environment and Development", 1994.

Table A2
The stocks and accumulation of man-made and non-produced natural assets 1995 (million rupiahs)

Type of assets	Opening stocks	Use of products	Consumption of fixed assets	Imputed environmental costs	Adjustments relating to accumulation	Other adjustments	Closing stocks
Produced assets	2,466,700,968	151,608,118	(43,484,328)	(6,623,532)	797,470	137,311,624	2,706,310,320
Man-made assets	1,008,920,000	151,608,118	(43,484,328)			123,587,824	1,240,631,614
Cultivated Forests	1,457,780,968			(6,623,532)	797,470	13,723,800	1,465,678,706
Teak	9,318,732			-	529,100	462,700	10,310,532
Deep-forest	1,448,462,236			(6,623,532)	268,369	13,261,100	1,455,368,174
Non-produced natural assets	1,618,688,849			(16,937,819)	36,980,577	202,474,056	1,841,205,663
Air				(6,825,420)	6,825,420		
Fixed				(6,189,076)	6,189,076		
Mobile				(636,343)	636,343		
Water				(1,596,906)	1,596,906		
Land use	921,459,949				7,617,392	103,663,156	1,032,740,497
Developed land	298,930,375				7,883,056	35,418,882	342,232,313
Agricultural land	366,554,787				2,953,297	39,065,861	408,573,945
Conservation	35,479,300				(3,028,041)	3,746,209	36,197,468
Forest and other land	220,495,488				(190,920)	25,432,203	245,736,771
Subsoil resources	697,228,900			(8,515,494)	20,940,859	98,810,900	808,465,166
Oil	198,524,000			(6,639,879)	274,439	33,833,300	225,991,860
Gas	430,133,300			(1,862,200)	21,021,166	50,125,600	499,417,866
Coal	63,330,900			(92)	(608,867)	10,761,200	73,483,141
Bauxite	671,300			(0)	(4,990)	(21,900)	644,410
Tin	4,569,400			(13,321)	259,111	4,112,700	8,927,889
TOTAL	4,085,389,818	151,608,118	(43,484,328)	(23,561,351)	37,778,046	339,785,680	4,547,515,983

Source: Alisjahbana and Yusuf (2000a)



Source: BPS

Figure A1. Development of Savings by Component during the Crisis

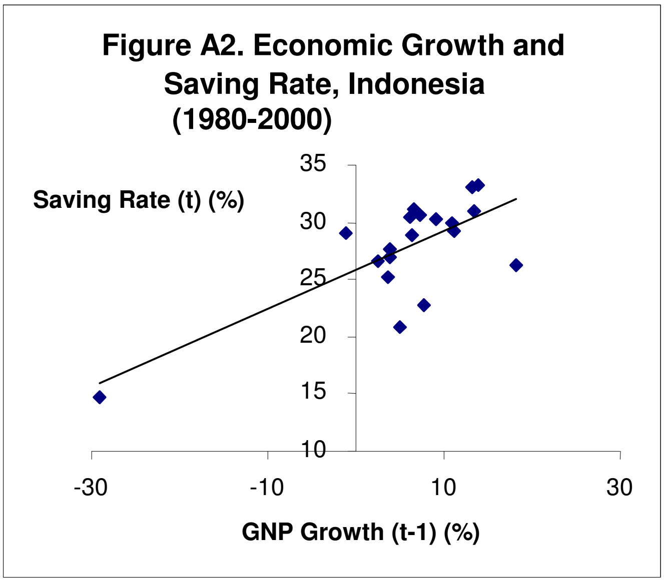


Figure A2. Economic Growth and
Saving Rate, Indonesia
(1980-2000)
Saving Rate (t) (%)
35
30
25
20
15
10
-30
-10
10
30
GNP Growth (t-1) (%)