

*RELATIONSHIP BETWEEN
ENVIRONMENTAL
ACCOUNTING
INDICATORS, MACRO
ECONOMIC INDICATORS
AND SUSTAINABLE
DEVELOPMENT
INDICATORS IN
DEVELOPING COUNTRIES:
CASE STUDY: RWANDA*

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Abstract

This paper report results of an explanatory survey of literature on the relationship between environmental accounting, macroeconomic indicators and sustainable development. A detailed survey of the literature on environmental accounting, national accounting and sustainable development was used by the researchers in order to establish correlation between those variables. The macroeconomic indicators were measured by focusing on the national accounts performance measures like the gross domestic product, gross national income and the net savings. The environmental accounting was measured by looking at the environmental cost in the national accounts and adjusting them to get environmentally adjusted domestic product and domestic income whilst the sustainable development was measured by the use of social capital and natural capital through the genuine progressive income, index of social economic welfare and the genuine saving. The researchers found out that there is a direct relationship between environmentally adjusted indicators and sustainable development indicators and an inverse relationship with conventional macroeconomic indicators and the sustainable development indicators. The researchers recommended that further studies need to be carried out on how developing countries incorporate the environmental costs and social cost in their economic decisions.

JEL classification numbers: PD 77

Keywords: Environmental Accounting, Sustainable Development And Gross Domestic Product.

1. Introduction

For many years economists have been measuring the economic performance of an economy using the convention techniques like the gross domestic product (GDP), gross national income (GNI), net saving (NS) and others, although they knew that these techniques have failed to measure the welfare (Tim Jackson 2006, pg 24). More to that these techniques measure the economy in terms of economic growth but the trend has changed after the Rio summit of 1992 where economies should be looked upon in terms of sustainable development, this necessitates to account for both the natural and social capital which are not considered by the convention technique measures. Currently we are talking of green economy which implies a green GDP, but the economic performance is still measured in terms of the traditional GDP should we talk of green GDP in the developing countries. Although economist and other policy makers have continued to use the GDP as the measure of economic health and wellbeing, its creation was never intended for this role. According to Kuznet Simon (1934) cited by Jackson et al (2006, pg 2) the GDP measures only tallies the product and services with no description on between transactions that enhance well being and those that diminishes it. It simply assumes that every monetary transaction adds to social well being. As many developing countries depend on the natural resources for their survival there is a need to look at these measures in terms of sustainable development. The target of millennium goal seven is to integrate the principle of sustainable

development into the country's policy and progress and reverse the loss of environmental resources (Rwanda environment management authority-REMA 2009, Pg 7).

Following the Rio summit, adjustments were made in the system of national accounts to reflect the effect of environment in the national accounts by considering the consumption on natural assets the same way as the consumption of produced assets is treated in the system of national accounts. With this the conventional techniques of measuring performance that is the GDP should reflect the effects of environment in the accounts, new methods have been developed and these include the environmentally adjusted domestic product (EDP) and environmentally adjusted domestic income (EDI) and inclusion of the natural assets in other accounts of the system were considered and a system of integrated environmental accounting was developed (UN 2000 pg 22). The need to account for the environment and the economy in an integrated way arises because of the crucial functions of the environment in economic performance and in general of human welfare (UN 2000 pg 23). These functions include the provision of natural resources to production and consumption activities such as waste absorption by the environmental media and environmental service of life support and other human activities.

The production of goods and services requires inputs from the environment and this affects the natural environment. In particular these effects are depletion of resources and production of waste which are returned to the environment. Pollution occurs when these wastes disrupt or change the natural resource system for human well being e.g air, and water.

If the natural environment is conceptualized as a stock of natural capital and if its uses for humans are regarded as the service that flow from this stock then in the principle use of natural environment for economic activity can be accounted for in the same way as the use of other kind of capital such as manufactured capital including machines buildings and infrastructure and the product to which they give rise.

Because any product that is included in the GDP has made use of natural capital as a resource or as waste depository and therefore any accounting system that does not account for the natural capital will be incomplete and may be misleading if it does not adjust for the environmental costs.

Environmental losses are costs that bring no benefit to the business. They include fines, penalties, and compensation, impairment or disposal losses relating to assets that have to be scrapped or abandoned because they damage the environment.

Depletion of natural resources

Those countries whose economies are heavily dependant on the contribution made by the natural resources such as timber, fish, agricultural products, minerals, and tourist attraction have a need for accounting for them carefully in their accounts.

To treat income from the natural resources without accounting for permanent loss for their income generating capacity and other amenities derived from them is to commit fundamental error of economic analysis. For a sound economic management the depletion of resources must be regarded as capital consumption rather than a value added. The depletion of resources should be treated as a production cost and move these costs into the production and income account.

Pollution and Environmental Degradation.

The cost of pollution and other environmental degradation costs are not easy to calculate as the costs of depletion as they intend to be non market. As with natural resource it is desirable for the costs associated with the pollution and environmental degradation to be allocated in the accounting structure to the economic sectors which are responsible for them according to the accounts inputs- output framework.

The compilation of flow accounts of natural resources use and depletion and the corresponding adjustment will be the greatest boom for the developing countries which rely on the exploitation of their minerals, soil, water, fisheries and forestry stocks for the generation of substantial proportion of their accounts. Great challenge facing most parts of the world and particularly the developing countries is the systematic destruction of the environment. Through continued crude method of farming, felling of trees and bush burning and non-sustaining fishing methods without replacement of the natural resources, local farmers have destroyed the biodiversity. Industrial emissions have contributed in greater dimension to the atmosphere and climate change and effluent pollution to land degradation processes.

Environmental protection expenditure has been regarded as part of the costs necessary to compensate for the negative impacts of economic growth, The treatment of the environmental degradation and depletion as consumption of natural resource capital for all the accounting aggregates. Reducing the GDP by the amount of natural resource consumption will affect all those ratios that use the GDP as a denominator or a numerator like the foreign debt, debt obligation service, Balance of payment (BOP), deficit, Savings and investment, public expenditure and the money supply.

Much as the system was developed to cater for sustainable development, the system only considered the natural capital and has ignored the social capital. The system considers only the costs associated with the environment such as environmental depletion, degradation, and pollution. It has failed to consider the social factors like income inequality crimes, consumption of durable goods, expenditure in education, and domestic labour (John and Noah, 2006 pg 5). In addition to that the system was designed basing on the system of the national accounts and therefore it uses the same production boundaries which boundary ignores the house work and yet domestic work increases the social value of the house hold. It is within this frame work economist like Daly and Cobb (1989 pg 120) developed the genuine progress indicators and index of social economic welfare to bridge the gaps that were left by the conventional techniques. Genuine progress indicator (GPI) and Index social economic welfare (ISEW) are measures which try to capture the overall impact of economic activities on human welfare. They attempt to capture the costs and benefits that were not traditionally measured in the monetary terms (Jackson et al 2004, pg 1)

$$\text{ISEW} = \text{PCE} - \text{LIE} + \text{VDL} + \text{NDE} - \text{DPE} + \text{CA} - \text{EC}$$

Whereby;

ISEW = Index social economic welfare

PCE=private consumption expenditure

LIE=Loss from income inequality

VDL=Value of domestic labour

NDE =Non defensive public expenditure

DPE =Defensive private expenditure

CA=Capital adjustment

EC=Cost of environmental degradation and depreciation of natural assets.

The GPI and ISEW uses the same personal consumption data as the GDP, they make deductions to account for income inequality and cost of crime, environmental degradation and loss of leisure, volunteering and house work and the consumption of durable goods (John et al 2006, pg 7).

Genuine investment/saving Index, (GSI)

In the national accounts, the net investment or saving is got by subtracting the final consumption from the adjusted disposable income. But this net saving does not consider the sustainability of the economy and therefore need to be adjusted to reflect the investment in environmental assets. GS is the sum of net investment in produced assets and the changes in various stocks of natural resources and pollutants valued at the shadow prices (Kirk et al 2008, pg 10)

$GS = NS - EC$ where NS is the net saving.

$GS = GDS - \text{consumption of fixed capital of produced assets} + \text{education expenditure} - \text{air pollution} - \text{water pollution} - \text{depletion of non renewable natural assets} - \text{carbondioxide damages}.$

Rwanda's economy has continued to improve as measured by the GDP and it increased from 7.5% in 2010 to 8.8% in 2011 and agriculture is contributing 8.2% of GDP (BNR 2012 pg 12). Much as there is an increase in contribution of the secondary sector to the total GDP and a reduction of the primary sector, but still many industries in Rwanda are processing industries (REMA 2009 pg 41). This increases the pressure on the environment which need to be reflected the country's measures and policies. Rwanda's economy is linked to environment in many ways; all economic activities including production, consumption, and disposal of waste (REMA 2009, pg 7). Because GDP is measured by the production activities which production activities are affected by environment, if we are to talk of green economy measured by a green GDP in Rwanda there is a need to establish a relationship between the current measures of the economy, environmentally adjusted measures and sustainable development measures.

This study intends to establish a relationship between the macroeconomic indicators, environmental adjusted accounting indicators and sustainable development indicators.

2. Methodology

The researchers collected the data through the use of secondary data by reading manuals, conference reports, Journals, books and reports in order to establish a relationship between macroeconomic indicators, environmental accounting and sustainable development. The independent variable that is the environmental accounting and macroeconomic indicators were measured through the use of GDP, GDI, EDP, EDI and net saving (NS) whereas the dependent variable was measured through the use of GPI/ISEW and GS.

2.1 Environmental accounting indicators (EAI)

They are indicators which incorporate the use and consumption of natural capital in the macro economic indicators in measuring the national economic health of the country. They include environmentally adjusted domestic product (EDP), environmentally adjusted domestic income (EDI), environmentally adjusted balance sheet to mention a least.

$EAI = f(\text{pollution (P)}, \text{depletion of natural assets (DA)}, \text{degradation of natural assets GA})$

$EIA = f(P, DA, GA)$

$EIA = \beta_0 + \beta_1 P + \beta_2 DA + \beta_3 GA$ (2.1.1)

The theory assumes that $\beta_1, \beta_2, \beta_3 > 0$

2.2 Macroeconomic indicators (MI)

These are the tradition economic indicators that measure the economic health of the country. They include the gross domestic product (GDP), net domestic product (NDP), national income (NI), net saving (NS), net borrowing or lending (NB/L) and net worth (NW)

MI = f (output Y, government expenditure G, consumption C, Saving S, exports X and imports M).

$$MI = f(Y, G, C, S, X, M)$$

$$MI = \beta_0 + \beta_1 Y + \beta_2 G + \beta_3 S + \beta_4 X + \beta_5 M \quad (2.2.1)$$

The theory assumes that $\beta_1, \beta_2, \beta_3, \beta_4, >0, \beta_5 <0$

2.3 Sustainable development indicators (SDI)

These indicators measure the economic performance of the country considering the future use of the resources for the future generations. These indicators include genuine savings (GS), genuine progressive indicator (GPI) and index for social economic welfare (ISEW).

SDI = f(income inequality IE, environmental costs EC, private expenditure PE, public expenditure PBE, capital adjustment CA, private consumption PC).

$$SDI = \beta_0 + \beta_1 IE + \beta_2 EC + \beta_3 PE + \beta_4 PBE + \beta_5 CA + \beta_0 PC \quad (2.3.1)$$

3 Main Results

These are the main results of the paper.

1. Relationship between GDP, NDP, EDP and EDI

From the system of national accounts (2008 and 1993, pg 101) the gross domestic product (GDP) is given by;

$$GDP = \text{Gross value added} + \text{taxes} - \text{subsidies} \dots\dots\dots 1.1$$

Incorporating the capital consumption (CC) into the equation

$$NDP = GDP - \text{Capital consumption} \dots\dots\dots 1.2$$

Because the consumption of environment is regarded as a capital expenditure therefore we incorporate the environmental cost (EC) into equation 1.2 to get the environmentally adjusted domestic product (EDP).

$$EDP = NDP - EC \dots\dots\dots 1.3$$

Therefore the Environmentally adjusted domestic product (EDP) for the total economy will be;

$$\sum EDP = \sum NDP - EC \dots\dots\dots 1.4$$

But The Genuine Progressive Indicator (GPI) or Index social economic welfare (ISEW) is given by;

$$ISEW = GDP + \text{Value of domestic labor (VDL)} + \text{Non defensive public Expenditure (NDE} + \text{Capital adjustment (CA)} - \text{Loss from income inequality (LIE)} - \text{Cost of environmental degradation and depreciation}$$

of natural assets (EC) - Defensive private expenditure (DPE)

$$\text{ISEW} = \text{GDP} + \text{VDL} + \text{NDE} + \text{CA} - \text{LIE} - \text{EC} - \text{DPE} \dots\dots\dots 1.5$$

Adjusting for capital consumption (CC)

$$\text{ISEW} = (\text{GDP} - \text{CC} - \text{EC}) - \text{LIC} - \text{DPE} + \text{CA} + \text{VDL} + \text{NDE} \dots\dots\dots 1.6$$

From equation 1.2 and 1.3

$$\text{GDP} - \text{CC} = \text{NDP}$$

but,

$$\text{NDP} - \text{EC} \text{ is EDP therefore,}$$

$$\text{ISEW} = \text{EDP} - \text{LIE} - \text{DPE} + \text{CA} + \text{VDL} + \text{NDE} \dots\dots\dots 1.7$$

From the equation 1.4 if NDP is high especially in the developing countries where we depend too much on natural resources the environmental cost will be high because many resources will be used in production and therefore the EDP will be low. Therefore there is a relationship between EDP and NDP but moving in different direction. But GPI/ISEW is directly related with the EDP but inversely related with the social capital.

If GPI/ISEW is stable or increasing in a given year the implication is that, the stock of natural and social capital on which all goods and services flows depend will at least be as great for the next generation, while if it is falling it implies that the economic system is eroding. Therefore there is a relationship between GDP, NDP, EDP and GPI/ISEW.

2. Relationship between Gross national income (GNI), Net Saving (NS) and the Genuine Saving (GS)

GNI = GDP + NFI where GDP is the gross domestic product and NFI is the net factor income which is equal to income received from abroad minus income sent abroad.

ENI = EDP + NFI - TEC where ENI is the environmentally adjusted national income and TEC is the impact of transnational environmental costs.

Gross national disposable income (GNDI) = GNI + Net capital transfers (NCT)

Gross Saving = GNDI - Final consumption (FC)

$$\text{NS} = \text{GNDI} - \text{FC} - \text{CC} \dots\dots\dots 2.1$$

$$\text{GS} = (\text{GNDI} - \text{FC} - \text{CC}) - \text{EC} \dots\dots\dots 2.2$$

But

$$(\text{GNDI} - \text{FC} - \text{CC}) \text{ is the NS}$$

Therefore $GS = NS - EC$ 2.3

The study identified that there is a relationship between genuine savings, net savings and environmental costs. In conclusion there is a direct relationship between EDP and GDI, and an inverse relationship with the NDP.

$$EDP \propto \frac{1}{NDP} \propto GDI$$

Therefore the environmentally adjusted accounting indicators are directly related to the sustainable development indicators and inversely related to the macroeconomic indicators. This is in relation to the findings of (Grace and Chris 2004 pg 17).

3.1 Advantages

The study will help the developing countries in developing models that can be used in their system of national accounts if they are to talk of sustainable development and green economy.

Theorem 3.1

Gross value added (GVA) = F(Q, IC) where Q is the output and IC is the intermediate consumption

$$GVA = \beta_0 + \beta_1 Q + \beta_2 IC + e \tag{1}$$

The theory assumes that $\beta_1 > 0, \beta_2 < 0$

GDP = f(GVA, T, Sb) where T is the tax and Sb is the subsidies and e is the statistical discrepancy.

$$GDP = \beta_0 + \beta_1 GVA + \beta_2 T + \beta_3 Sb + e. \tag{2}$$

The theory assumes that β_1 and $\beta_2 > 0, \beta_3 < 0$

NDP = f(GDP, CC)

$$NDP = \beta_0 + \beta_1 GDP + \beta_2 CC + e \tag{3}$$

The theory assumes that $\beta_1 > 0, \beta_2 < 0$

EDP = f(NDP, EC)

$$EDP = \beta_0 + \beta_1 NDP + \beta_2 EC + e \tag{4}$$

There theory assumes that $\beta_1 > 0, \beta_2 < 0$

GPI = f(EDP, CA, NDE, LIE)

$$GPI = \beta_0 + \beta_1 EDP + \beta_2 CA + \beta_3 NDE + \beta_4 LIE + e. \tag{5}$$

The theory assumes that β_1, β_2 and $\beta_3 > 0, \beta_4 < 0$

NDS = f(NI, NPIFA, NTr) where NI is the national income, NPIFA is the net property income from abroad, and NTr is the net transfers and NDS is the net domestic savings and FC is the final consumption

$$NDS = \beta_0 + \beta_1 NI + \beta_2 NPIFA + \beta_3 NTr + \beta_4 FC + e. \tag{6}$$

The theory assumes that $\beta_1, \beta_2, \beta_3 > 0, \beta_4 < 0$

$$GS = f(NDS, EC)$$

$$GS = \beta_0 + \beta_1 NDS + \beta_2 EC + e \quad (7)$$

The theory assumes that $\beta_1 > 0$, $\beta_2 < 0$

4. Conclusion and Recommendations

Because there is an inverse relationship between the convention macroeconomic indicators and sustainable development an increase in the GDP does not mean that the economy will continue to grow in the future.

The researchers recommends that developing countries who depends more on natural resources should incorporate the EDP and The GDI in their economies if they are to achieve the millennium development goals of sustainable development and the forecast of future economic growth should be based on the GPI. The study ended by raising empirical questions which require further investigations like do developing countries incorporate the EDP and GDI in their economic policies, How do they collect the information regarding the environment.

Acknowledgements

We would like to pass our gratitude to the Rwanda Environmental Management authority (REMA) for availing us with some reading manuals and the National Bank of Rwanda (BNR) for also providing us with the needful data for this study analysis. As lecturers of Management and Applied Economics at INES RUHENGARI in Rwanda, our heartfelt gratitude also goes to the Vice Rector Academics, Fr. Dr. Fabien Hagenimana and the dean of the faculty for having allowed us some time off station to carry out this research.

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