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TESTING FOR THE LONG-RUN SUSTAINABILITY OF ECONOMIC GROWTH OF SELECTED COUNTRIES USING GENUINE SAVINGS RATE APPROACH

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Abstract

Off late the world has realized that the growth models that believed in growth- environment tradeoff are not sustainable. In the pursuit of increasing their GDP, countries have ignored the negative externalities of growth which would seriously threaten the survival of the future generation. Two kinds of damage are caused by unsustainable growth. Firstly, productive base, particularly natural capital like forest, minerals, energy is depleting. Secondly, environment pollution and climate change caused by excessive CO2 emissions are threatening human lives in terms of deteriorating health conditions and increasing temperature level. In the light of these concerns, sustainable development has become an important goal of nations. This study attempts to assess the sustainability of economic growth of selected countries using Genuine Saving Rate approach.

Keywords: *Sustainable development, negative externalities, and genuine saving rate.*

Introduction

For long economies, in the pursuit of increasing their GDP, have ignored the negative externalities of growth which would seriously threaten the survival of the future generation. However, of late the world has realized that the growth models that believed in growth- environment tradeoff are not sustainable. Economists and environmentalists have questioned the growth models that overlook the serious negative externalities which may diminish the ability of future generations to meet their own needs. In general, economic growth results in two types of negative externalities. Firstly, productive base, particularly natural capital like forest, minerals, and energy get depleted. Secondly, environment pollution and climate change caused by excessive CO_2 emissions threaten human lives in terms of deteriorating health conditions and increasing temperature level. In the light of these concerns, sustainable development has become an important goal of nations which became more explicit ever since United Nations Conference on Environment and Development in 1992 which urged the participant nations to rethink economic development and find ways to halt the destruction of irreplaceable natural resources and pollution of the planet. In order to conceptualize and measure the goal of sustainable development, decision makers need indicators that assist them to understand the current state of the growth and the progress made towards achieving sustainable development. However, traditional national accounts which do not take into account the negative externalities of growth like pollution and resource depletion are found to be both inadequate and misleading. Gross Domestic Product (GDP), the popular measure of economic growth, for example, considers the depreciation in physical capital, whereas it is silent with regard to the depreciation of natural capital and the cost of environment pollution. Therefore, we need better measures of growth that would capture all types of nation's wealth, i.e., physical, human and natural capital and reflect the genuine progress achieved by a nation. Genuine Saving Rate (GSR) is one such alternate national accounting measure which attempts to show the actual saving of a nation after accounting for depreciation in physical and natural capital and investment in human capital. Using this framework, this paper attempts to assess the sustainability of economic growth of selected countries.

Genuine Savings Rate

In order to overcome the deficiency of traditional measures of growth, Genuine Saving Rate (GSR) was introduced originally by Pearce & Atkinson (1993which was popularized by World Bank as one of the indicators of sustainable development. GSR is a simple yet a useful measure to assess the level of an economy's sustainability. It basically broadens the definition of wealth to include natural and human capital along with physical capital. Therefore, GSR is also called adjusted saving rate as it accommodates and modifies the traditional saving rate by including all types of wealth of a nation. Particularly, it corrects for the depletion in natural resources, environmental degradation and investment in human capital which are ignored by the traditional

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indicators of growth. It makes series of adjustments to gross national saving rate by subtracting depreciation in natural resources such as fossil fuels, minerals, and timber, costs of environmental pollution like CO_2 damage and Particulate Matter (PM-10) damage and adding investment in human capital proxied by the spending on education.(Ferreira and Vincent, 2005). With these corrections, GSR can serve as a leading indicator of sustainable economic growth.

Calculation of GSR

As discussed above, GSR is an adjustment to standard national accounting measure of Gross National Savings (GNS). GSR makes four types of adjustments to gross national saving. First, estimates of capital consumption of produced assets are deducted to obtain Net National Savings (NNS). Secondly, current expenditures on education are used as proxy to represent investment in human capital and added to net national saving. Thirdly, the depletion of energy, mineral, and forest resources are estimated and deducted to reflect the decline in natural capital as a result of economic growth. Finally, pollution damages are deducted. Many pollution damages are local in their effects, and therefore difficult to estimate without location-specific data. Here we estimate health damages due to urban air pollution. As for global pollution damages, the estimates include damages from carbon dioxide emissions (World Bank, 2013).Table 1 summarizes the definition and method of calculation of various components of GSR.

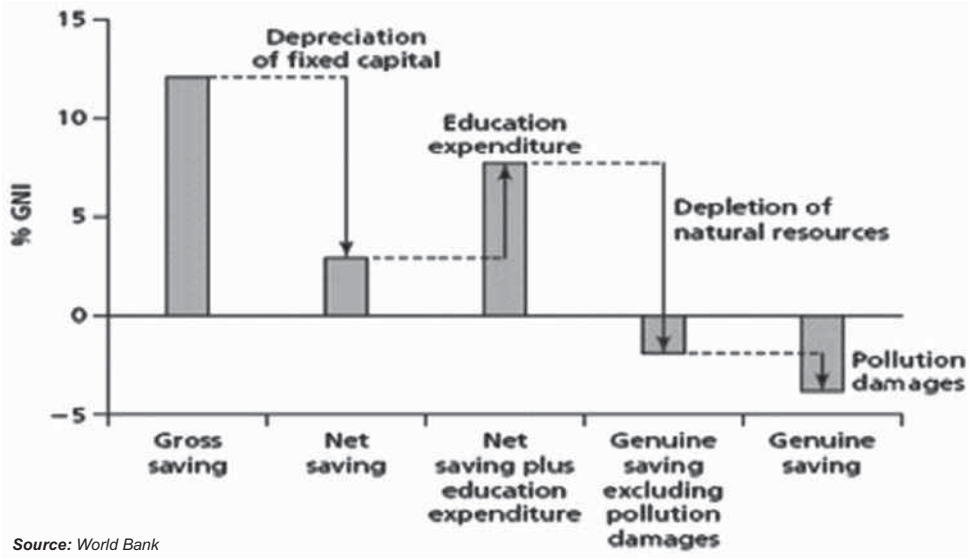


Fig. 1 : Derivation of GSR

Figure 1 explains the concept of GSR. As shown in the figure, four adjustments are made to arrive at GSR. GSR is a better measure of a nation's wealth as it takes into consideration the depletion/creation of all forms of wealth. Depreciation is deducted to account for the depletion in physical capital used in the production. Depletion in natural resources and pollution damages are deducted to account for the depletion in natural capital and environmental pollution. Finally, investment in education is added to GNS in order to account for the human capital. A positive GSR value may indicate the long run economic sustainability of a nation. On the other hand, a negative GSR shows that the extent of depletion in natural capital and cost of environmental pollution is more than saving rate generated by an economy indicating that economy is on the path of unsustainable growth. An economy with persistently negative GSR must lead to declining wellbeing and signals the policy interventions to restore the depletion in natural capital (Hamilton and Clemens, 1999).

Table - 1 : Summary of the Calculation of Genuine Saving Rate

Item	Definition	Formula	Adjustment (Plus or Minus)
Gross national saving (GNS)	Difference between GNI and public and private consumption plus net current transfers.	GNS = GNI - private consumption - public consumption + net current transfers	Base Value
Depreciation	Replacement value of capital used up in the process of production.		-
Net national saving NS)	Difference between gross national saving and the consumption of fixed capital	NNS = GNS - Depreciation	
Education expenditure (EE)	Public current operating expenditures in education, including wages and salaries and excluding capital investments in buildings and equipment	(data taken directly from source or estimated)	+
Energy depletion (ED)	Ratio of present value (PV) of rents, discounted at 4%, to exhaustion time of the resource. Rent is calculated as the product of unit resource rents and the physical quantities of energy resources extracted. It covers coal, crude oil, and natural gas	ED = PV(rent, 4% discount rate, exhaustion time)/exhaustion time rent = production volume x unit resource rent unit rent = unit price - unit cost exhaustion time = min (25 years, reserves/production)	-
Mineral depletion (MD)	Ratio of present value of rents, discounted at 4%, to exhaustion time of the resource. Rent is calculated as the product of unit resource rents and the physical quantities of mineral extracted. It covers tin, gold, lead, zinc, iron, copper, nickel, silver, bauxite, and phosphate.	MD = PV(rent, 4% discount rate, exhaustion time)/exhaustion time rent = production volume x unit resource rent unit rent = unit price - unit cost exhaustion time = min (25 years, reserves/production)	-
Net forest depletion (NFD)	Product of unit resource rents and the excess of round wood harvest over natural growth	NFD = (round wood production - increment) x average price x rental rate	-
CO2 damages (CO2D)	A conservative figure of $20 marginal global damages per ton of carbon emitted was taken.	CO2D = emissions (tons) x $20	-
PM damages (PMD)	Willingness to pay (WTP) to avoid mortality and morbidity attributable to particulate emissions	PMD = disability adjusted life years (DALYs) lost due to PM emissions x WTP	-
Adjusted net saving (ANS)	Net national saving plus education expenditure and minus energy depletion, mineral depletion, net forest depletion, carbon dioxide damage, and particulate emissions damage.	ANS = NNS + EE - ED - MD - NFD - CO2D - PMD	

Source: *Author's Construction based on World Bank*

Empirical Analysis of GSR and its Components

In this section we discuss the genuine rate saving and extent of negative externalities measured in terms of energy depletion, mineral depletion and cost of pollution. We chose ten developed and developing countries based on the size of the economy in terms of GDP. Data on GSR and the components of it has been collected from World Bank. Data on GSR is available till 2014 and the data on the various components of GSR is available only till 2008.

Table 2 and Chart 2 shows the trend in GSR in developed and developing Economies. As evident from the table and figure GSR in developed countries are gradually declining from 13.40 percent during 1995-99 to 8.13 per cent to 8.13 per cent in 2010-14. On the other hand, growth of developing economies has been relatively more sustainable as the GSR increased from 12.50 in 1995-99 to 14.24 per cent in 2010-14.

Table - 2 : Genuine Saving Rate(per cent)

Year	Developed Countries	Developing Countries
1995-99	13.40	12.50
2000-04	12.07	10.69
2005-09	10.69	11.73
2010-14	8.13	14.24

Source: *Author's Calculations*

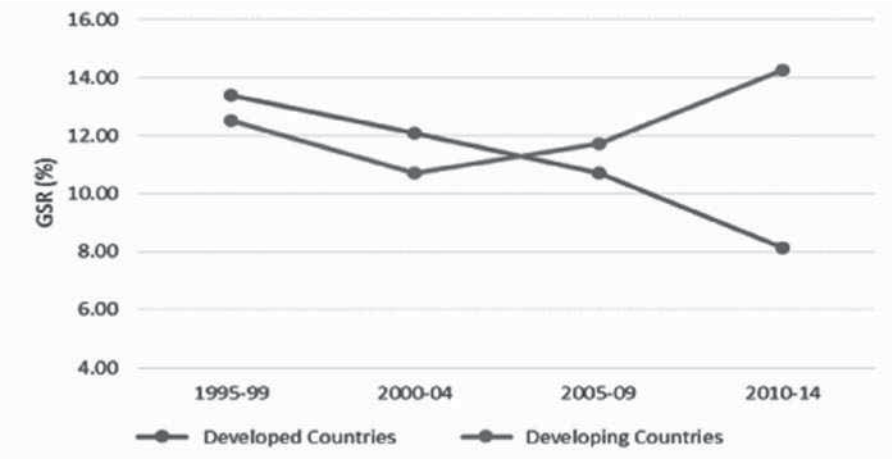


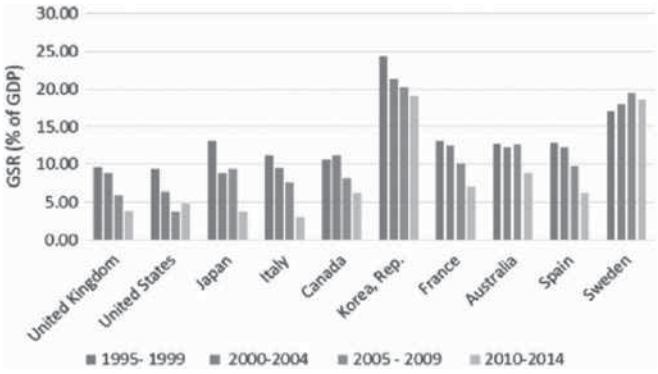
Fig. 2 : GSR in developed in developing countries

Table 3 depicts country wise average GSR. As evident from the table, except for Sweden in all the developed countries GSR has been declining which shows that their saving rate is becoming increasingly insufficient to compensate the declining natural capital and the pollution damages. Among developed countries, Korea and Sweden have reasonably higher GSR. On other hand, most of the developing economies are on sustainable growth path. Fastest developing economies such as China and India are relatively more sustainable with higher GSR. On other hand, GSR in developing economies such as Mexico, Turkey, South Africa, Iran and Thailand is declining which indicates that they are on an unsustainable growth path.

Table - 3 : Genuine Saving Rate

Developed Countries					Developing Countries				
Country	**1995- 99**	**2000-04**	**2005 - 09**	**2010-14**	**Country**	**1995- 99**	**2000-04**	**2005 - 09**	**2010-14**
United Kingdom	9.64	8.81	5.91	3.91	China	29.05	27.64	37.09	33.60
United States	9.33	6.35	3.74	4.78	India	13.56	16.84	23.11	20.04
Japan	13.03	8.79	9.32	3.74	Brazil	5.56	5.54	6.57	8.39
Italy	11.22	9.45	7.54	3.09	Russia	0.78	2.29	2.58	13.19
Canada	10.60	11.12	8.20	6.27	Mexico	11.56	11.90	10.00	7.69
Korea, Rep.	24.35	21.29	20.27	19.03	Indonesia	14.31	5.08	4.44	25.43
France	13.12	12.45	10.07	6.95	Turkey	16.31	11.90	7.60	9.90
Australia	12.76	12.21	12.65	8.73	South Africa	6.49	3.91	1.42	3.08
Spain	12.86	12.27	9.74	6.25	Iran	-1.20	-3.11	3.77	4.55
Sweden	17.06	17.95	19.44	18.54	Thailand	21.86	16.25	17.96	12.68

Source : *Author's Construction*



Source: *Author's construction*

Fig. 3 : GSR in developed countries

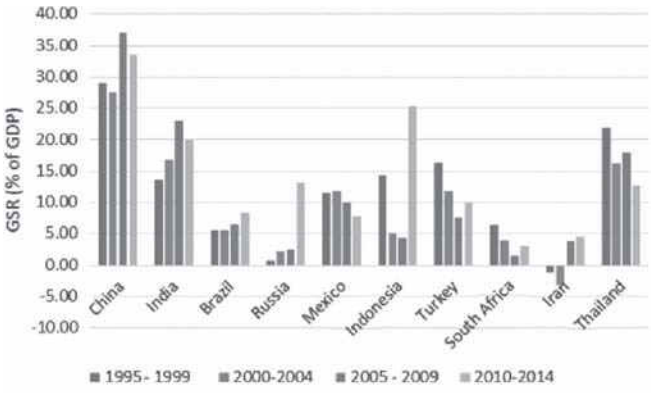


Fig. 4 : GSR in developing countries

Growth and Negative Externalities

As mentioned earlier economic growth also causes negative externalities in the form of environmental pollution and the resulting health hazards and depletion of natural capital like energy, minerals, forest etc. GSR is obtained after deducting these negative externalities from the net national saving. In this section we discuss the extent of these negative externalities in developed and developing countries.

Energy Depletion

Table 4 explains the extent of energy depletion in developed and developing countries.It covers coal, crude oil, and natural gas. It is clear from the table that energy depletion has been very high in developing countries which is also increasing over the period of time. This may be due to the fact that these countries are growing at higher phase and hence exploit more energy resources. This may also be due to relatively lower efficiency in energy usage in developing countries as compared to developed countries. Among developing countries, Iran and Russia have experienced higher level of energy depletion as shown in the table 5. For instance, average energy depletion during 2004-08 was 28.76 per cent and 21 per cent of GNI in Iran and Russia

Table - 4 : Energy Depletion (% of GNI)

Year	Developed Countries	Developing Countries
1990-94	0.40	4.11
1995-99	0.37	3.84
2000-04	0.66	6.43
2004-08	1.08	8.59

Source: *Author's construction*

Table - 5 : Energy Depletion (per cent GNI)

Developed Countries					Developing Countries				
Country	**1990-94**	**1995-99**	**2000-04**	**2004-08**	**Country**	**1990-94**	**1995-99**	**2000-04**	**2004-08**
United Kingdom	1.10	1.12	1.50	1.80	China	4.52	2.18	2.71	4.91
United States	0.55	0.36	0.62	1.35	India	1.84	1.47	1.97	3.17
Japan	0.00	0.00	0.01	0.02	Brazil	0.54	0.38	1.52	2.43
Italy	0.09	0.10	0.14	0.20	Russia	10.49	12.32	22.34	21.47
Canada	1.25	1.40	2.68	4.54	Mexico	3.27	3.02	3.89	7.23
Korea, Rep.	0.00	0.00	0.00	0.01	Indonesia	5.47	4.35	7.29	9.97
France	0.03	0.02	0.02	0.02	Turkey	0.23	0.13	0.15	0.22
Australia	0.94	0.70	1.64	2.86	Iran	13.27	12.98	20.53	28.76
Spain	0.02	0.01	0.02	0.03	South Africa	0.94	0.85	1.85	3.46
Sweden	0.00	0.00	0.00	0.00	Thailand	0.52	0.70	2.06	4.23

Source : *Author's Construction*

Respectively which indicates that these countries are on an unsustainable path as far as the energy consumption is concerned? Indonesia has also experienced higher energy depletion with energy depletion of 9.97 per cent of GNI. On other hand, Turkey maintained higher energy efficiency (0.22 per cent) which is comparable to that developed countries. Among developed countries Canada and Australia have experienced higher energy depletion with 4.54 per cent and 2.86 per cent respectively during 2004-08.

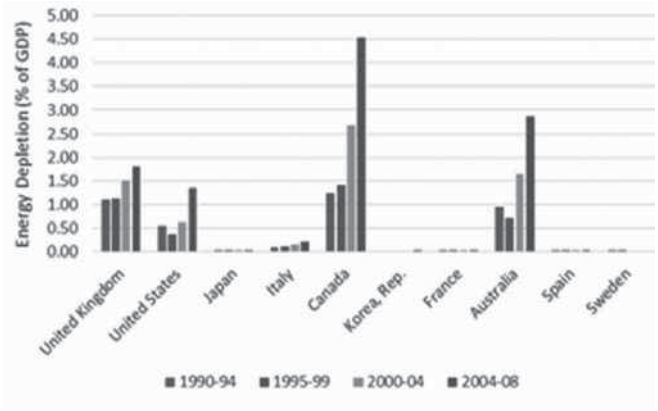


Fig. 5 : Energy depletion in developed countries

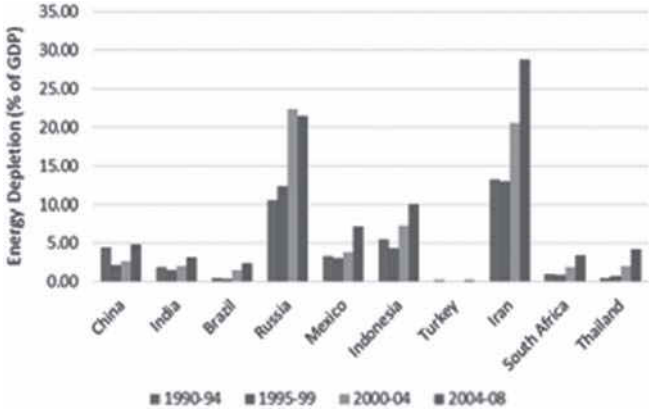


Fig. 6 : Energy depletion in developing countries

Mineral Depletion

GSR takes into account the depletion of minerals such as tin, gold, lead, zinc, iron, copper, nickel, silver, bauxite, and phosphate in the process of economic growth. Table 6 explains the extent of depletion in minerals which is measured in terms of per cent of GNI. As shown in the table, both developed and developing economies have experienced higher mineral depletion from 1995-99. However, the extent of mineral depletion was slightly higher in developing economies than developed countries. Among developing countries, China, Brazil, Indonesia, and South Africa have witnessed higher level of mineral depletion. Among developed countries, Australia has been experiencing greater mineral depletion with 3.06 per cent during 2004-08. Table also shows that most of the developed countries are sustainable in terms of mineral depletion which may indicate that at higher level of development there exists a negative correlation between development and depletion.

Table - 6 : Mineral Depletion (% of GNI)

Year	Developed Countries	Developing Countries
1990-94	0.11	0.25
1995-99	0.09	0.20
2000-04	0.12	0.30
2004-08	0.40	0.88

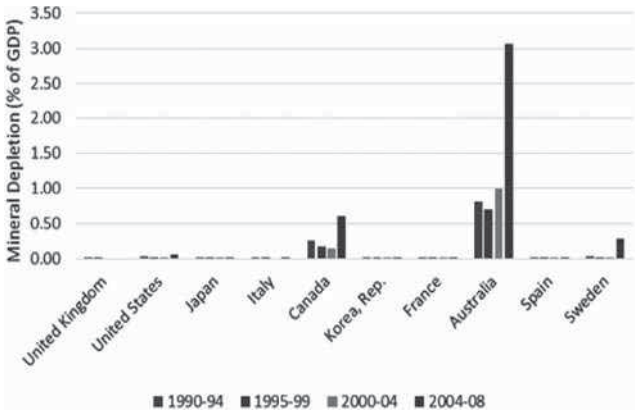
Source: *Author's construction*

Table - 7 : Mineral Depletion (per cent GNI)

Developed Countries					Developing Countries				
Country	**1990-94**	**1995-99**	**2000-04**	**2004-08**	**Country**	**1990-94**	**1995-99**	**2000-04**	**2004-08**
United Kingdom	0.00	0.00	0.00	0.00	China	0.29	0.15	0.17	1.09
United States	0.02	0.02	0.01	0.06	India	0.19	0.15	0.22	0.83
Japan	0.00	0.00	0.00	0.00	Brazil	0.39	0.29	0.64	1.61
Italy	0.00	0.00	0.00	0.00	Russia	0.08	0.15	0.29	0.94
Canada	0.26	0.17	0.14	0.60	Mexico	0.14	0.09	0.04	0.26
Korea, Rep.	0.00	0.00	0.00	0.02	Indonesia	0.42	0.69	1.01	1.80
France	0.00	0.00	0.00	0.00	Turkey	0.04	0.02	0.02	0.05

Australia	0.81	0.70	0.99	3.06	Iran	0.08	0.09	0.11	0.47
Spain	0.01	0.00	0.00	0.00	South Africa	0.84	0.38	0.52	1.71
Sweden	0.03	0.02	0.01	0.28	Thailand	0.04	0.00	0.00	0.02

Source : *Author's Construction*



Source: *Author's construction*

Fig. 7 : Mineral Depletion in developed countries

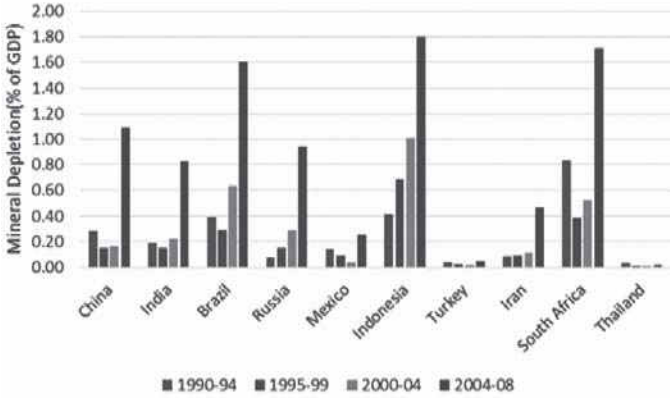


Fig. 8 : Mineral Depletion in developing countries

CO_2 Emission

Environmental pollution is another negative externality caused by economic growth. Pollution cots of CO_2 emission is deducted from Net National saving to get the GSR. Table 8 shows the extent of CO_2 emissions in developed and developing countries. It is clear from the table that

Table - 8 : CO_2 (% of GNI)

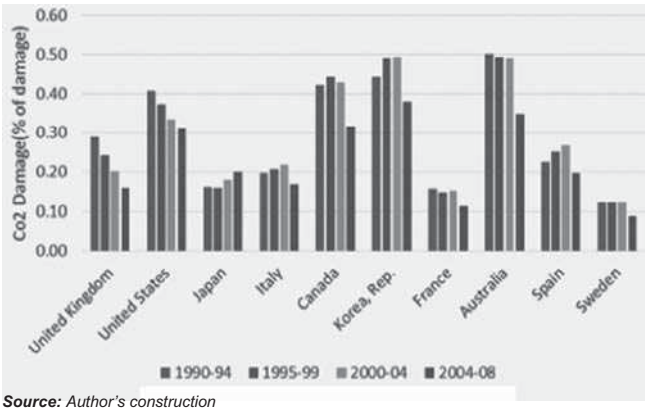
Year	Developed Countries	Developing Countries
1990-94	0.29	1.27
1995-99	0.29	1.25
2000-04	0.29	1.26
2004-08	0.23	0.85

Source: *Author's construction*

Table - 9 : CO_2 Damage (per cent GNI)

Developed Countries					Developing Countries				
Country	**1990-94**	**1995-99**	**2000-04**	**2004-08**	**Country**	**1990-94**	**1995-99**	**2000-04**	**2004-08**
United Kingdom	0.29	0.24	0.20	0.16	China	3.20	2.07	1.66	1.49
United States	0.41	0.37	0.33	0.31	India	1.43	1.46	1.45	1.14
Japan	0.16	0.16	0.18	0.20	Brazil	0.26	0.23	0.37	0.22
Italy	0.20	0.21	0.22	0.17	Russia	2.25	2.80	2.56	1.09
Canada	0.42	0.44	0.43	0.32	Mexico	0.59	0.61	0.38	0.33
Korea, Rep.	0.44	0.49	0.49	0.38	Indonesia	0.76	0.85	0.98	0.72
France	0.15	0.15	0.15	0.11	Turkey	0.53	0.54	0.51	0.32
Australia	0.50	0.49	0.49	0.35	Iran	1.64	1.65	1.88	1.42
Spain	0.22	0.25	0.27	0.20	South Africa	1.42	1.49	1.67	1.19
Sweden	0.12	0.12	0.12	0.09	Thailand	0.59	0.80	1.12	0.94

Source : *Author's Construction*



Source: Author's construction

Fig. 9 : CO2 damage in developed countries

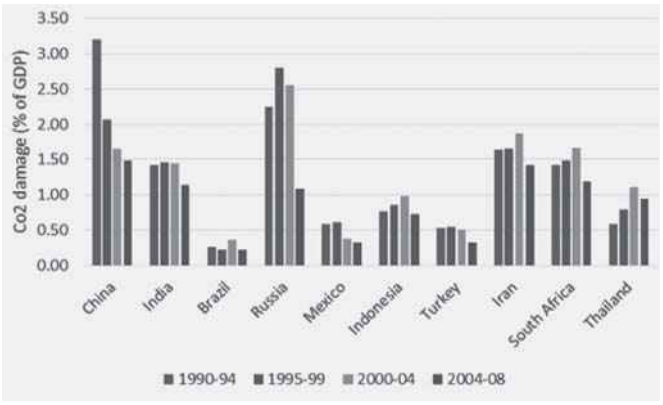


Fig. 10: CO2 damage in developing countries

CO_2emission as per cent of GNI was higher in developing countries. However, during 2004-08 CO_2 emission has come down to 0.85 per cent in developing countries. On other hand, developed countries have stabilized CO_2 costs at 0.29 per cent till 2000-04 which slightly came down to 0.23 per cent during 2004-08. Among the developing countries, China, Iran, South Africa, and Russia are found to have higher CO_2emission in terms of percentage of GNI. On the other hand, all the developed countries have CO_2 emission below 1 per cent as shown in the table 9.

PM 10 Damages

PM 10 damages are another important negative externality caused by economic growth which has to be compensated and hence deducted from NNS. Table depicts the extent of PM damages which is measured in terms of percentage of GNI. As shown in the table, magnitude of PM damage has been declining in both developed and developing countries. However, developing countries are found to have higher PM damages as compared to developed countries. Table also shows that all the countries have PM damages below 1 per cent, though

Table - 10 : PM Damage (% of GDP)

Year	Developed Countries	Developing Countries
1990-94	0.31	0.75
1995-99	0.28	0.66
2000-04	0.20	0.57
2005-08	0.11	0.37

***Source:** Author's construction*

Table - 11 : PM Damage (per cent GDP)

Developed Countries					Developing Countries				
Country	**1990-94**	**1995-99**	**2000-04**	**2004-08**	**Country**	**1990-94**	**1995-99**	**2000-04**	**2004-08**
United Kingdom	0.29	0.16	0.05	0.01	China	0.98	1.03	0.98	0.80
United States	0.46	0.37	0.27	0.15	India	0.89	0.88	0.72	0.49
Japan	0.56	0.52	0.39	0.26	Brazil	0.46	0.36	0.33	0.17
Italy	0.25	0.23	0.17	0.08	Russia	1.41	0.80	0.59	0.14
Canada	0.26	0.24	0.16	0.08	Mexico	0.57	0.50	0.35	0.27
Korea, Rep.	0.62	0.66	0.52	0.29	Indonesia	0.47	0.57	0.63	0.54
France	0.02	0.02	0.01	0.01	Turkey	1.23	1.09	0.95	0.58
Australia	0.18	0.13	0.07	0.02	Iran	1.05	0.95	0.74	0.43
Spain	0.46	0.47	0.37	0.18	South Africa	0.13	0.11	0.08	0.08
Sweden	0.01	0.01	0.00	0.00	Thailand	0.32	0.35	0.31	0.24

***Source :** Author's Construction*

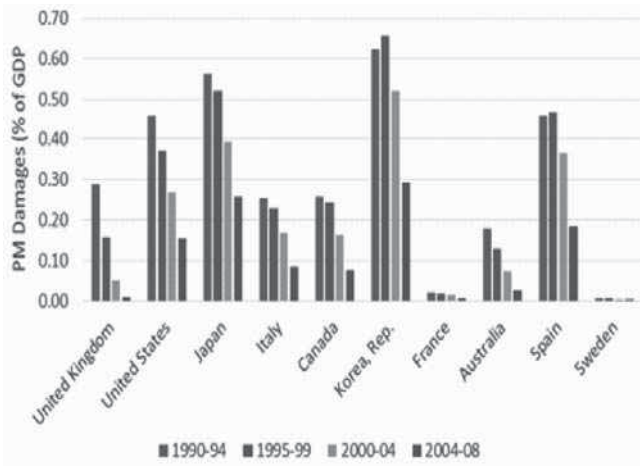


Fig. 11 : PM 10 Damages in developed countries

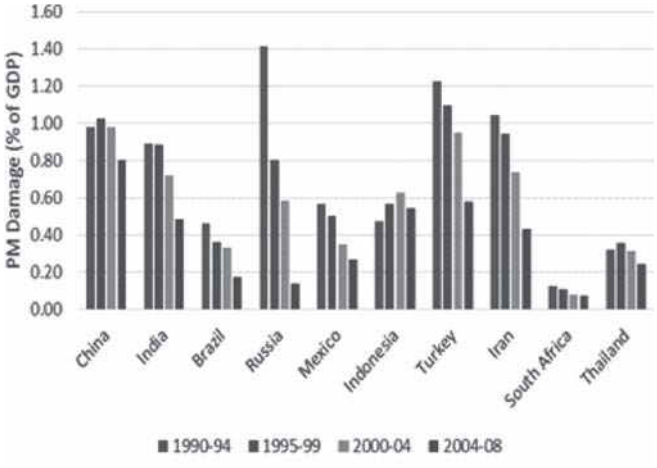


Fig. 12 : PM 10 damages in developing countries

Table - 12 : Countries like China, India, Indonesia, and Turkey are found to have higher percentage of PM damages

Year	Gross National Saving (% of GDP)		Depreciation (% of GDP)		Education (% of GDP)	
	Developed Countries	Developing Countries	Developed Countries	Developing Countries	Developed Countries	Developing Countries
1990-94	21.88	27.79	13.55	10.99	5.09	3.56
1995-99	23.14	26.03	13.75	11.22	5.04	3.88
2000-04	22.68	26.50	14.18	10.85	4.83	4.11
2004-08	22.88	28.04	14.13	11.11	4.68	4.12

Source : *Author's Construction*

It is clear from the above discussion that developing countries are found to have higher level of negative externalities in terms of energy depletion, mineral depletion, Co2 emission and PM 10 damages which shows that their growth is less sustainable than developed countries. On other hand developed countries are found to have lesser negative externality. However, in terms GSR, developing countries are found to have higher level of GSR as compared to developed countries. This inconsistency is due to the fact that developing countries have higher level of Gross National Saving and lower depreciation allowance. This indicates that, though developing countries are causing more negative externalities, they generate sufficiently higher level of Gross national saving to compensate. Hence, in terms the extent of negative externalities, developed countries are found to be more sustainable as they cause less of them in terms of the percentage of GNI. However, in terms GSR developing countries are found to be more sustainable as they create more saving to compensate these negative externalities.

Conclusion

The concept of GSR provides an alternate measure of an economy's growth which takes into accounts all forms of wealth. This measure will help signal early indicators of unsustainability in the growth path of an economy. Using this measure, the study attempted to understand the long term sustainability of major developed and developing countries and found that developed countries are more sustainable in terms of the extent of negative externalities caused by them. On other hand developing countries are found to be more sustainable in terms of GSR as they generate higher saving rate to compensate the negative externalities. Studies like this help policy makers to understand the current growth path and take appropriate policy interventions to achieve sustainable economic growth.

References

1. **Ferreira, Susana and Vincent, Jeffrey R. (2005)**, Genuine Savings: Leading Indicator of Sustainable Development?, Economic Development and Cultural Change, Vol. 53, No. 3 (April 2005), pp. 737-754.

2. **Hamilton, Kirk and Clemens, Michael (1999),** Genuine Savings Rates in Developing Countries, The World Bank Economic Review, Vol. 13, NO. 2,pp.333–56.
3. **Pearce, David W., and Giles Atkinson (1993)**, Capital Theory and the Measurement of Sustainable Development, EcologicalEconomics,8, pp. 103–8.
4. **World Bank**, Adjusted net savings, including particulate emission damage (% of GNI), available in http://data.worldbank.org/indicator/NY.ADJ.SVNG.GN.ZS.
5. **World Bank (2013),** A More Accurate Pulse on Sustainability, available in http://www.worldbank.org/en/news/feature/2013/06/05/accurate-pulse-sustainability.
6. **World Bank**, Calculating Adjusted Net Saving, available in http://siteresources.worldbank.org/ENVIRONMENT/Resources/Calculating_Adjusted_Net_Saving.pdf.