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Economic Growth and Negative Externalities in India

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1. Introduction

Economic growth results in broadly two types of negative externalities. Firstly, productive base, particularly, natural capital like forest, minerals, and energy, gets depleted. Secondly, environmental pollution and climate change caused by excessive CO_2 emissions threaten human lives in terms of deteriorating health conditions and increasing temperature level (OECD, 2012). For long economies, in the pursuit of achieving higher economic growth, seem to have ignored these negative externalities of growth. However, of late, there seems to be an international consensus that the growth models that believed in growth-environment trade-off 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 needs (UN, 2011). In the light of these concerns, sustainable development has become an important goal of nations which became more unequivocal ever since UNCED (1992) 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. 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 environmental pollution (Hamilton & Clemens, 1999). Therefore, countries need better measures of growth that would capture all types of the 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

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accounting for depreciation in physical and natural capital and investment in human capital (World Bank, 1997). Using this framework, this paper attempts to assess the sustainability of economic growth of India and examines the relationship between negative externalities and growth of Gross National income (GNI) in India.

The remainder of the paper is presented as follows. Section II includes a brief note on the related literature. Section III discusses the concept of Genuine Saving and its components. Section IV describes the source of data and research methodology. In section V presents the extent of negative externalities and genuine saving in high, middle, and low-income countries and in India. Section VI examines the relationship between negative externalities and GNI growth rate in India. Section VII contains the conclusion.

II. Related Literature

Alarmed by increasing negative externalities caused by economic growth, the United Nations Conference on Environment and Development (UNCED, 1992) urged nations to rethink economic development and find ways to halt the destruction of irreplaceable natural resources and pollution of the planet. Decision makers need indicators that will help them understand the current state of economic growth and the progress made towards achieving sustainable development. The UNCED's appeal has motivated policymakers to search for better and measurable indicators of sustainable development. One popular approach to measuring sustainable development comes from a broader capital theory, which defines sustainability as transferring a constant aggregate stock of capital for future generations, both manufactured and natural capital (Victor 1991). For example, Hartwick (1977) emphasizes achieving intergenerational equity in consumption by transferring constant aggregate capital to future generations. This, according to him, is achievable by investing the rent or profit from exhaustible resources in reproducible resources such as machines so that constant aggregate capital stock is maintained and transferred to future generations. Later, the Brundtland Commission (1987) also defined sustainability as 'development that meets the needs of the present without compromising the ability of future generations to meet their own needs'. Similarly, the World Bank (1995) suggests that countries that are concerned with sustainable development must pay attention to the creation and maintenance of wealth. These concepts together led to the development of indicators to measure capital stock or wealth.

Building on Hartwick's (1977) conceptualization, Pearce and Atkinson (1993) developed an indicator of sustainability, which later came to be known as the adjusted saving rate. They specify an empirical measure of Hartwick's idea of sustainability, in which the standard saving is adjusted for depreciation in physical and natural capital. Adjusted saving is specified as,

$$\textit{Adjusted Saving} = (S/Y) - (\delta m/Y) - (\delta n/Y) \qquad (1)$$

where *S* is the saving rate, *Y* is income, δ*m* is depreciation of physical capital and δ*n* is depreciation of natural capital. Equation (1) indicates that an economy is on a sustainable growth path if its savings are more than the combined depreciation of fixed capital and depletion of natural resources. The model by Pearce & Atkinson (1993) implies that countries with adjusted savings above zero would satisfy Hartwick's rule of sustainability as the value of their aggregate capital stock does not diminish. Hence, Equation (1) implies that changes in the value of capital measured by adjusted saving method should indicate if an economy is on a sustainable path (Atkinson & Hamilton, 2007). Based on Equation (1), Pearce & Atkinson (1993) estimate the adjusted savings for 20 countries and find that these countries are on an unsustainable path as their gross savings were less than the depletion in the physical and natural capital. Later, Hamilton (1994) extends the adjusted saving framework to include investment in human capital and damages caused by varieties of pollutants. He termed the measure as 'genuine saving' as it includes all kinds of capital — physical, natural and human. Hence, adjusted saving rate came to be known as the genuine saving rate, GSR hereafter. Subsequently, the World Bank (1995) adopted GSR as the leading indicator of sustainability and defined it as true saving after due account is taken of the depletion of natural resources and the damages caused by pollution. The World Bank (2006) defines genuine saving rate (GSR) as;

Genuine Saving Rate= Gross Domestic Saving – Consumption of Fixed Capital (Depreciation) + Investment in Human Capital (Education Expenditure) – Depletion of Non-renewable Natural Resources – Pollution Costs… (2)

The World Bank (1995) suggests that if the genuine saving is negative, it is a clear signal of unsustainability. Hamilton and Clemens (1999) also argue that an economy with persistently negative GSR would lead to declining well-being and signal the need for policy interventions to restore the depletion in natural capital. Similarly, Asheim (1994), and Pezzey and Withagen (1995) claim that an economy with persistent negative GSR would find it difficult to achieve sustainability even if it has a positive GSR at some later point. Therefore, the aim of policymakers should be to maintain GSR above or equal to zero, which satisfies Hartwick's (1977) rule of sustainability. The World Bank (1995) estimates region-wise GSR between 1962 and 1989 and reports that there has been a substantial decline in GSR in sub-Saharan Africa, the Middle East, North Africa, Latin America and the Caribbean regions in the post-1970s. In contrast, South and East Asia recorded a positive and steady GSR in the 1980s. Almost similar trends continued throughout the 1990s and 2000s as is evident from data released by the World Bank (2013a).

The genuine saving approach, however, is criticized for being a weak form of sustainability as it is based on the assumption of unlimited substitutability between natural capital and other forms of capital (Stern 1997; Billah 2005; Hanley et al. 2016). GSR essentially posits that reduction in natural capital can be compensated for by an increase in the stock of physical and human capital.

Criticizing this approach of sustainability, advocates of strong sustainability argue that natural capital and physical capital should be considered separately, as depletion in natural capital cannot be offset by an increase in physical capital (Pillarisetti et al. 2010). Hence, proponents of strong sustainability reject the idea of maintaining constant aggregate capital stock and instead emphasize that minimum stock of all natural resources should be maintained (Stern 1997). In spite of this criticism, GSR has been used in a number of studies to measure sustainability and is found to be a useful measure to understand whether economies are on the path of sustainability (for instance, World Bank, 1995; Hamilton & Clemens, 1999; Hamilton 2000; Grace & Chris, 2004; Brown et al. 2005, Mota et al. 2010; Dosmagambet, 2010; Frederick, 2010; Othman et al. 2012; World Bank, 2013; Blum et al. 2016; Lin and Hope, 2004).

III. Components of Genuine Savings Rate

GSR basically broadens the definition of wealth to include natural and human capital along with physical capital. 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 of natural resources, environmental degradation and investment in human capital, which are ignored by the traditional indicators of growth. GSR makes four types of adjustments to gross national saving. First, estimates of capital consumption of physical are deducted to obtain Net National Savings (NNS). Secondly, current expenditures on education are used as proxy to represent the 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 (World Bank, 2013). Table 1 summarizes the components of GSR.

Figure 1 explains the concept of GSR. As shown in the figure, four adjustments are made to arrive at GSR. The 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 of 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 the cost of environmental pollution is more than the saving rate generated by an economy, indicating that the 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).

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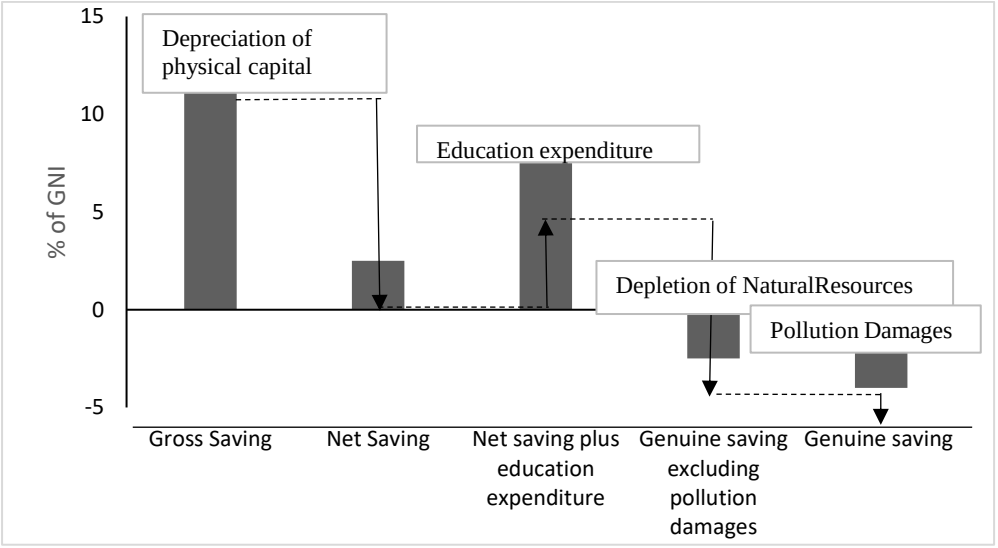
Figure 1 – Derivation of GSR



Source: Demos (2011)

Table 1: Components of Genuine Saving Rate

Item	Rationale	Adjustment (Add or Subtract)
Gross national saving (GNS)	Base Value	
Depreciation	Accounts for the depletion of physical capital employed in the process of production.	-
Education expenditure (EE)	Investment in Human Capital	+
Energy depletion (ED)	Accounts for depletion in energy resources	-
Mineral depletion (MD)	Accounts for depletion of mineral resources	-
Net forest depletion (NFD)	Accounts for depletion of forest resources	-
CO_2 damages (CO_2)	Accounts for the costs of air pollution.	-
PM damages (PMD)	Accounts for the costs of air pollution.	-
Adjusted net saving (ANS)	Genuine Saving Rate	

Source: Author's construction

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IV. Source of Data and Research Methodology

The primary objective of this study is to understand the extent and trend in the negative externalities created by high, middle, and low income countries, and India. Data on different components of negative externalities has been obtained from World Development Indicators published by the World Bank (World Bank, 2018). Except for PM damages, data for all other components of negative externalities is available from the 1970 till 2016 for high, middle, and low income countries. In the case of India, data are available for all the components of negative externalities, except PM damages, is available from the year 1970 till 2016. All the components of negative externalities and

GSR are measured in terms of percentage of Gross National Income (GNI). Total Negative externalities are the summation of energy depletion, mineral depletion, net forest depletion, CO2 damages, and PM damages. Five year average value of negative externalities and its components has been computed to understand the extent and trend of these variables.

The second objective is to understand the interrelationship between GNI growth and negative externalities in India. To examine this dynamic relationship, the study employs Vector Autoregressive (VAR) and Granger Causality techniques.

Table 2: Depletion of Natural Resources (% of GNI)

Year	Energy Depletion			Mineral Depletion			Net Forest Depletion		
	High Income countries	Middle Income countries	Low Income countries	High Income countries	Middle Income countries	Low Income countries	High Income countries	Middle Income countries	Low Income countries
1970-74	0.408	0.844	0.203	0.114	0.270	0.413	0.006	0.160	0.925
1974-79	1.391	4.036	1.633	0.064	0.216	0.257	0.004	0.246	1.465
1979-84	1.648	4.320	1.492	0.048	0.336	0.195	0.004	0.221	2.211
1985-89	0.618	2.536	1.244	0.045	0.264	0.195	0.006	0.226	2.491
1990-94	0.430	2.271	3.082	0.030	0.156	0.125	0.004	0.233	3.389
1995-99	0.333	1.495	3.565	0.026	0.123	0.072	0.001	0.193	4.713
2000-04	0.581	2.651	5.108	0.027	0.166	0.132	0.000	0.138	3.476
2005-09	0.793	3.840	4.433	0.124	0.776	0.490	0.001	0.111	4.314
2010-14	0.728	2.912	1.647	0.166	0.982	2.249	0.002	0.101	4.415
2015-16	0.309	1.069	0.252	0.109	0.388	2.026	0.002	0.117	5.457

Source: Author's calculations based on World Bank Data

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V. Negative Externalities of Growth

This section discusses the extent of negative externalities caused by economic growth. Table 2 presents the extent of natural resource depletion in high, middle, and lower income countries. The Table shows that, on an average, middle- and lower-income countries experienced higher depletion of natural resources. Two possible explanations would explain this phenomenon. First, middle income countries are growing at a higher rate, which requires more resources. Secondly, higher income countries have become more efficient in using these resources, resulting in lower depletion of these resources. However, all three categories of countries have experienced significant decline in energy depletion during 2015-16. Lower income countries have recorded a significant increase in mineral and net forest resource depletion in the last one and half decade.

Table 3: Pollution Damages (% of GNI)

Year	Carbon Dioxide Damages (CO2)			Particulate Emission Damage (PM)			Total Negative Externalities		
	High Income countries	Middle Income countries	Low Income countries	High Income countries	Middle Income countries	Low Income countries	High Income countries	Middle Income countries	Low Income countries
1970-74	0.596	0.789	0.239	-	-	-	1.124	2.064	1.780
1974-79	0.549	0.862	0.272	-	-	-	2.007	5.360	3.627
1980-84	0.572	1.124	0.417	-	-	-	2.272	6.002	4.316
1985-89	0.553	1.691	0.663	-	-	-	1.222	4.716	4.593
1990-94	0.539	2.318	1.079	0.141	1.035	3.934	1.145	6.013	11.609
1995-99	0.601	2.572	1.324	0.118	0.838	2.995	1.080	5.221	12.668
2000-04	0.706	2.993	1.395	0.107	0.692	2.642	1.421	6.640	12.751
2005-09	0.678	2.554	1.085	0.093	0.515	2.093	1.688	7.796	12.415
2010-14	0.708	2.202	0.861	0.088	0.463	1.711	1.691	6.659	10.881
2015-16	0.826	2.637	1.114	0.090	0.460	1.566	1.336	4.670	10.415

Source: Author's calculations based on World Bank Data

Table 3 presents the extent of pollution damages in terms of the percentage of GNI. Middle income countries have experienced significantly higher CO_2 emission damage, particularly, after 1990s, suggesting that rapid expansion in the middle income countries in the post-1990s has resulted in higher CO_2 costs. On the other hand, CO_2 emission cost of low income countries is relatively lower than middle income countries and has remained stable in the last two decades. However, low income countries have recorded higher PM damage costs as compared to high and middle income countries, though it has significantly declined in the recent years. Both high income and middle income countries are able to constantly reduce the PM damage costs in the post-1990s. Table 3 also presents the total amount of negative externalities. High income countries have reported the least negative externalities, followed by middle income countries and low income countries. However, in terms of GSR middle income countries are more sustainable as shown in Table 4. This indicates that, though these countries create higher negative externalities than the high income countries, they compensate this with

investment in physical and human capital. On the other hand, economic growth of low income countries is clearly on an unsustainable path as they have recorded negative GSR. These countries, on the one hand, generate more negative externalities, and on the other hand, they do not have enough savings to compensate the same. This should be a serious concern for these countries as they embark upon a higher level of economic growth.

Table 4: Genuine Saving Rate (GSR)

Year	Gross Saving (% of GNI)			Net Saving (% of GNI)			Genuine Saving Rate (% of GNI)		
	High Income countries	Middle Income countries	Low Income countries	High Income countries	Middle Income countries	Low Income countries	High Income countries	Middle Income countries	Low Income countries
1980-84	23.02	23.21	9.89	7.84	13.53	2.60	10.63	10.79	1.33
1985-89	21.92	24.47	11.25	6.50	13.16	4.33	9.88	11.65	3.18
1990-94	20.86	25.17	11.72	4.79	10.00	4.86	8.12	7.52	-1.90
1995-99	23.09	24.90	11.61	7.12	12.42	4.06	10.42	10.52	-3.04
2000-04	22.13	28.17	12.38	6.00	16.40	4.54	8.96	13.03	-5.41
2005-09	21.89	33.51	15.84	5.43	21.40	7.41	8.19	16.91	-1.88
2010-14	21.63	34.44	15.16	4.89	20.55	5.98	7.84	17.15	-1.67
2015-16	21.94	34.87	15.93	5.26	18.55	5.75	8.61	16.85	-1.45

Source: Author's calculations based on World Bank Data

Table 5 and 6 present the extent negative externalities and the GSR in India. India experienced a significant increase in negative externalities in the post reform period, suggesting higher economic growth was also accompanied by higher negative externalities. However, the total natural resource depletion has witnessed a significant decline in the recent years as evident from table 5. As a result, the total cost of negative externalities has decreased. For instance, the average annual cost of negative externalities was 6.88 per cent of GNI over 1990-1994 which declined to 5.54 per cent during 2015-16. The decline in the costs of negative externalities happened even though the economy has rapidly expanded in the last couple of decades. This suggests that India has been serous in making growth more sustainable. Further, India's negative externalities are lower than the average negative externalities of both middle income countries. It is also evident from the table 6 that India has a higher GSR as compared to the average GSR of all three categories of countries, suggesting that economic growth in India is more sustainable. This comes from both sides; on the one hand the extent of negative externalities is lower and declining over the period of time, and on the other hand, the gross saving rate has also significantly increased over time.

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VI. Dynamic Relationship between Negative Externalities and Economic Growth

In this section the dynamic relationship between growth of negative externalities (GNE) and growth of GNI in India is examined using VAR analysis. Table 7 shows that the variables, Growth of negative externalities and GNI growth are stationary. Therefore, we can proceed with VAR model. As there was a structural break in India's economic growth in 1991, the sample is split into two sub samples; a) 1970 - 1990, b) 1991 - 2016. The model is specified as;

$$\mathrm{GNI} = \mathrm{a} + \mathrm{b}GNE_{\mathrm{t-i}} + cGNI_{\mathrm{t-i}} + \epsilon_t \quad (3)$$

$$\mathrm{GNE} = \mathrm{a} + \mathrm{b}\mathrm{G}NE_{\mathrm{t-i}} + cGNI_{\mathrm{t-i}} + \epsilon_t \quad (4)$$

Table 5: Negative Externalities of Economic Growth in India (% of GNI)

Year	Carbon Dioxide Damages (CO2)	Particulate Emission Damage (PM)	Energy Depletion	Mineral Depletion	Net Forest Depletion	Total Natural Resource Depletion
1970-74	0.56	-	0.06	0.09	0.34	0.48
1975-79	0.73	-	0.56	0.14	0.98	1.68
1980-84	0.94	-	1.34	0.11	0.52	1.97
1985-89	1.36	-	1.07	0.09	0.38	1.55
1990-94	2.39	2.99	0.88	0.1	0.5	1.49
1995-99	2.86	2.26	0.72	0.09	0.36	1.17
2000-04	3.21	1.83	0.94	0.14	0.29	1.37
2005-09	2.85	1.3	1.24	0.91	0.24	2.39
2010-14	2.88	1.82	1.13	0.56	0.28	1.96
2015-16	3.58	1.06	0.45	0.17	0.28	0.91

Source: Author's calculations based on World Bank Data

Table 6: Genuine Saving Rate in India (% of GNI)

Year	Gross Saving	Net Saving	Education Expenditure	Negative Externalities	Genuine Saving Rate
1970-74	-	-	2.4	**1.05**	-
1975-79	21.48	13.67	2.44	**2.42**	**13.07**
1980-84	20.12	11.22	2.82	**2.92**	**11.12**
1985-89	23.12	13.4	2.96	**2.92**[1]	**13.64**
1990-94	26.35	16.31	3.3	**6.88**	**12.73**
1995-99	28.59	18.24	3.39	**6.3**	**15.34**
2000-04	31.11	20.51	3.65	**6.4**	**17.76**
2005-09	38.73	28.79	3.09	**6.54**	**25.33**

[1] Negative externalities till 1989 do not include PM damage costs due non-availability of data before 1990. However, even if we exclude average PM damage costs of post 1990s period, we see significant increase in negative externalities in the post- reform period.

2010-15	35.31	24.64	3.08	**6.02**	**21.67**
2015-16	31.71	19.65	3.08	**5.54**	**17.17**

Source: Author's calculations based on World Bank Data

Table 8 presents the VAR results for 1970-1990 samples. As evident from the table, though, the lagged GNI and GNE are positively related, the relationship is not significant. This indicates that he economic growth did not produce significant negative externalities before 1990s. This is also evident from the table 6, which shows that the extent negative externality was lower in pre-1990s. Similarly, GNI is not significantly affected by lagged GNE

Table 7: Augmented Dickey-Fuller test statistic for Stationarity of Variables

Null Hypothesis: GNE has a unit root				Null Hypothesis: GNI has a unit root		
		T Stat	Prob*		T Stat	Prob*
Augmented Dickey-Fuller test statistic		-6.18	0.000	Augmented Dickey-Fuller test statistic	-6.04	0.000
Test critical values	1%	-3.58		1%		-3.58
	5%	-2.93		5%		-2.93
	10%	-2.60		10%		-2.60

Source: Author's computation

which indicates the problem of negative externalities was not severe before the 1990s. The VAR Granger causality tests presented in table 9 confirm these results, as it does not produce any significant relationship between GNE, and GNI in the pre-1990s.

Table 8: VAR Results (1970-1990)

	Dependent Variables	
	GNE	**GNI**
GNE(-1)	0.080 (0.196)	0.004 (0.105)
GNE(-2)	0.015 (0.035)	-0.068 (-1.75)
GNI(-1)	0.327 (0.119)	-0.252 (-1.00)
GNI(-2)	2.703 (1.00)	0.129 (0.520)
C	1.345 (0.072)	5.750 (3.366)

t value in parentheses.

Table 9 presents the VAR results in the post 1990s period. As depicted in the table, one year lagged growth of GNI is positively related to negative externalities, suggesting that higher economic growth leads to higher negative externalities in the post 1990s period. Similarly, GNI is also negatively affected by the past negative externalities. Therefore, there is a bidirectional relationship between GNI and GNE in the post-1990s period , suggesting that the higher growth creates more negative externalities, which in turn negatively affects the growth of GNI. However, in spite of the negative effect of externalities India has experienced substantial expansion in

Table 9 VAR Granger Causality (1971-1990)

Dependent variable: GNI			
Excluded	Chi-sq	df	Prob.
GNE	3.27	2	0.19
All	3.27	2	0.19
Dependent variable: GNE			
Excluded	Chi-sq	df	Prob.
GNI	1.023	2	0.59
All	1.023	2	0.59

Table 10: VAR Results (1991-2016)

	Dependent Variables	
	GNE	**GNI**
GNE(-1)	0.019 (0.390)	-0.052 (-2.680)
GNE(-2)	0.115 (2.025)	-0.011 (-0.509)
GNI(-1)	2.698 (4.752)	0.025 (0.115)
GNI(-2)	-0.489 (-0.976)	0.090 (0.471)
C	-15.784 (-3.270)	6.119 (3.309)

t value in bracket.

the economy in the post-reform period. This shows that India invests more in physical and human capital to offset the adverse effect of negative externalities on economic growth. This is consistent with Hartwick (1977)'s idea that intergenerational equity in consumption can be achieved by transferring constant aggregate capital to future generations by investing the rent or profit from exhaustible resources in reproducible resources such as machines. GSR also believes that depletion in natural capital can be compensated by creating more physical

Table 11: VAR Granger Causality (1991-2016).

Dependent variable: GNI

Excluded	Chi-sq	df	Prob.
GNE	7.98	2	0.018
All	7.98	2	0.018
Dependent variable: GNE			
Excluded	Chi-sq	df	Prob.
GNI	22.66	2	0.000
All	22.66	2	0.000

Table 12: VAR Residual Normality Tests			**VAR Stability Condition Check**	
Null Hypothesis: residuals are multivariate normal			Root	Modulus
1971-1990				
Component	Jarque-Bera	Prob.	-0.552845 - 0.393i	0.678
1	0.139	0.932	-0.552845 + 0.393i	0.678
2	4.249	0.119	0.466923 - 0.433i	0.636
Joint	4.388	0.355	0.466923 + 0.433i	0.636
1991-2016				
Component	Jarque-Bera	Prob.	0.239320 - 0.167i	0.292
1	1.009	0.603	0.239320 + 0.167i	0.292
2	0.220	0.895	-0.216750 – 0.107i	0.241
Joint	1.230	0.873	-0.216750 + 0.107i	0.241

No root lies outside the unit circle.
VAR satisfies the stability condition.

capital through higher saving thereby arresting the adverse impact of negative externality on future economic growth. In that sense, we could argue that India's

economic growth is sustainable even in the post-1990s. The Granger causality test results presented in table 11 confirm that in the post-1990s, there is a bidirectional relationship between GNI and GNE. Table 12 shows that the residuals of VAR estimates are normal and the VAR also satisfies the stability condition.

VII. Conclusion

The study attempts to understand the extent of negative externalities and the relationship between negative externalities and GNI growth in India. The study reveals that low income countries have higher negative externalities. Further, in terms of GSR, low income countries are on an unsustainable path as they have negative GSR, suggesting that investment in physical and human capital is not sufficient to offset the costs of negative externalities. On the other hand, both high income and middle income countries are on a sustainable growth path. The study finds that the extent of negative externalities in India is lower as compared to all income categories countries. The study also attempts to understand the dynamic relationship between negative externalities and growth of GNI in India. Bidirectional relationship between negative externalities and GNI growth is found in the post-1990s. However, it must be noted that GSR is the weak measure sustainability as it believes in substitutability of physical and natural capital. Increasingly, countries should focus more on reducing negative externalities rather than compensating it with physical or human capital. In spite of its criticisms as a weak measure of sustainability, 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 signaling early indicators of unsustainability in the growth path of an economy, thereby inducing appropriate policy measures.

References

Atkinson, G., and Hamilton K., (2007), Progress Along the Path: Evolving Issues in the Measurement of Genuine Saving, Environmental Resource Economics, Vol. 37, pp 43–61.

Asheim, G., (1994), Net National Product as an Indicator of Sustainability, Scandinavian Journal of Economics, Vol. 96, pp 257–265.

Billah, M., (2005), Measuring the Economic Sustainability: A Case of Forest Extraction in Malaysia, Indian Journal of Agricultural Economics, Vol. 60, no.4, pp 698–708.

Blum, M., and McLaughlin, E., (2016), A Sustainable Century? Genuine Savings in Developing and Developed Countries, 1900–2000, Discussion Papers in Environmental Economics, University of St Andrews, available online at https://www.st-andrews.ac.uk/media/dept-of-geography-and-sustainable-development/pdf-s/DP%202016-15%20Blum%20et%20al.pdf

Brown, R.P.C., Asafu-Adjaye, J., Draca, M., and Straton, A., (2005), How Useful is the Genuine Savings Rate as a Sustainability Indicator for Regions Within Countries? Australia and Queensland Compared, The Australian Economic Review, Vol. 38, no. 4, pp 370–388.

Brundtland Commission, (1987), Report of World Commission on Environment and Development: Our Common Future, available online at http://www.un-documents.net/ocf-02.htm#I.

Demos, (2011), Beyond GDP: New Measures for New Economy, available online at http://www.demos.org/sites/default/files/publications/BeyondGDP_0.pdf.

Dosmagambet, Y., (2010), Calculating Genuine Saving for Kazakhstan, Economic and Environmental Studies, Vol.10, no. 2, pp 271–282.

Ferreira, S., and Vincent, J.R., (2005), Genuine Savings: Leading Indicator of Sustainable Development?, Economic Development and Cultural Change, Vol. 53, no. 3, pp. 737–754.

Frederick, V. P., (2010), Why Do Many Resource-Rich Countries Have Negative Genuine Saving? Anticipation of Better Times or Rapacious Rent Seeking, Resource and Energy Economics, Vol. 32, no 1, pp 28–44.

Glyn, E., and Wilks, A., (1999), The World Bank's Genuine Savings Indicator: A Useful Measure of Sustainability?, Bretton Woods Project, available online at http://old.brettonwoods project.org /topic /environment / gensavings.pdf.

Hamilton, K., (1994), Green Adjustments to GDP, Resources Policy, Vol. 20, pp. 155–168.

Hamilton, K., (2000), Genuine Saving as a Sustainability Indicator, Environmental Economics Series. 77, Washington, DC: The World Bank.

Hamilton, K., and Clemens, M., (1999), Genuine Savings Rates in Developing Countries, The World Bank Economic Review, Vol. 13. No. 2, pp 333–356.

Hanley, N., Dupuy, L., and McLaughlin, E., (2014), Genuine Savings and Sustainability, Discussion Papers in Environmental Economics. Paper 2014-09. University of St. Andrews, available online at https://www.st-andrews.ac.uk/media/dept-of-geography-and-sustainable-development/pdf-s/DP%202014-09%20Hanley, %20Dupuy%20&%20McLaughlin.pdf

Hanley, N., Oxley, L., Greasley, D., McLaughlin, E., and Blum, M., (2016), Empirical Testing of Genuine Savings as an Indicator of Weak Sustainability: A Three-Country Analysis of Long-Run Trends, Environmental Resources Economics, vol. 63, pp. 313–338.

Hartwick, J. M., (1977), Intergenerational Equity and The Investing of Rents from Exhaustible Resources, The American Economic Review, vol. 67. no. 5, pp 972–974.

Lin, G.T.R., and Hope, C., (2004), The Genuine Saving Measurement and its Application to United Kingdom and Taiwan, The Developing Economies, vol.42. no.1, pp 3-41.

Mota, R.P., Domingos, T., and Martins, V. (2010). Analysis of Genuine Saving and Potential Green Net National Income: Portugal, 1990–2005, Ecological Economics, vol. 69, pp 1934–1942.

OECD, (2012), Green Growth and Developing Countries: A Summary for Policy Makers, Organisation for Economic Cooperation & Development, available online at https://www.oecd. org/ greengrowth/ green-development/50526354.pdf.

Othman, J., Falatehan, R., and Jafari, Y., (2012), Genuine Savings for Malaysia: What Does it Tell?, International Journal of Management Studies, vol. 19, no. 1, pp 151–174.

Pearce, D.W., and Atkinson, G., (1993), Capital Theory and the Measurement of Sustainable Development, Ecological Economics, vol. 8, pp 103–108.

Pezzey, J., and Withagen, C., (1995), The Rise, Fall And Sustainability of Capital Resource Economies, Scandinavian Journal of Economics, Vol. 100, pp. 513–527.

Pillarisetti, J.R., Jeroen, C.J.M., and Van den Bergh, (2010), Sustainable Nations: What Do Aggregate Indexes Tell Us?, Environmental Development and Sustainability, vol. 12, pp 49–62.

Stern, D.I., (1997), The Capital Theory Approach to Sustainability: A Critical Appraisal, Journal of Economic Issues, vol. 31, no. 1, pp 145–173.

Stern, N., (2007), *The Economics of Climate Change: The Stern Review*. Cambridge and New York: Cambridge University Press.

UNCED., (1992), UN Conference on Environment and Development, United Nations, available online at http://www.un.org/ geninfo/ bp/enviro.html.

UN, (2011). Not Too Late To Change Unsustainable Economic Growth Model, Improve Relationship With Mother Earth, but Time is Running Short, United Nations. available online at https://www. un. Org / press /en /2011 /ga 11075.doc.htm.

Victor, P.A., (1991), Indicators of Sustainable Development: Some Lessons From Capital Theory, Ecological Economics, Vol. 4. no. 3, pp. 191–213.

World Bank. (2018). World Development Indicators, The World Bank. Retrieved from https://datacatalog.worldbank.org/dataset/world-development-indicators.

World Bank, (2013a), A More Accurate Pulse on Sustainability, World Bank, avialble online at http ://www. worldbank.org/en/news/feature/2013/06/05/accurate-pulse-sustainability.

World Bank, (2013b), The Little Green Data Book. Washington, DC: World Bank.

World Bank, (2011), The Changing Wealth of Nations: Measuring Sustainable Development in The New Millennium, World Bank, avialble online at https://siteresources.worldbank.org/ ENVIRONMENT/ Resources/ Changing Wealth Nations.pdf

World Bank, (2006), Where is the Wealth of Nations? Washington, DC: World Bank.

World Bank, (1997), Expanding the Measure of Wealth: Indicators of Environmentally Sustainable Development. Washington, D.C:. World Bank.

World Bank, (1995). Monitoring Environmental Progress, Environmentally Sustainable Development. Washington, DC: World Bank.

WCED, (1987), Our Common Future. World Commission on Environment and Development. New York: Oxford.