Examining the Eco-Macroeconomic Performance Index of India: A Data Envelopment Analysis Approach

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Examining the Eco-Macroeconomic Performance Index of India: A Data Envelopment Analysis Approach[1]

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Abstract

The prime objective of the paper is to construct a robust macroeconomic performance (MEP) index of India using Data Envelopment Analysis (DEA) approach. Six major macro indicators, namely, economic growth, employment rate, terms of trade, inflation rate, fiscal deficit, and pollution are used to compute MEP and Eco-MEP index of the Indian economy from 1980-81 to 2015-16. Overall, both the MEP and Eco-MEP index scores have quite similar best performing years, worst performing years, and have also captured the major events that adversely affected the economy during the last 35 years. This shows that the trend in overall performance of Indian economy was better in the 1980s and the 1990s but has deteriorated after the 2000s. The ARDL Bounds Testing approaches to cointegration methods are used to test the robustness/utility of these indices. The estimated results find that MEP and Eco-MEP have a positive impact on private investment, negative effect on current account deficit (CAD), and positive impact on foreign investment inflows (FIIs) and foreign direct investment (FDI). Hence, the suggested composite MEP index is stable, robust and truly captures the economic performance of India.

Keywords: Macroeconomic performance, Eco-macroeconomic performance, Data Envelopment Analysis, Autoregressive Distributed Lag (ARDL), India.

JEL Classification Codes: E60, C14, C32.

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1. Introduction

Measurement of economic performance of a country based on a single indicator is often narrow, biased, inefficient, uneconomical and defective in nature, which may not depict the real picture of an economy. Undoubtedly, single indicator separately provides some useful information, but that might mislead the desired policy target and develop wrong perceptions about the overall performance of the economy.[2] Thus, a comprehensive multidimensional index, consisting of several important indicators, is essential to provide proper signals about the progress or deterioration of the country. This composite index is called macroeconomic performance (MEP) index, which combines several indicators into one single succinct statistic. One simple but vital question about this index is: how the information embedded in the MEP index will benefit the overall economy?

The approach of rating an emerging country like India based on its economic performance assumes a considerable importance in the era of globalization and liberalization. India is one of the fastest growing country in the world with increased potential for investment and trade. Rating agencies find this approach suitable for ratings of different countries and foreign investors may use the MEP index while planning their investment in foreign countries. The composite index (MEP) may provide solutions in a complex situation when different indicators give conflicting signals and sometimes in solving elusive policy issues. In order to attract attention of the country and to focus on various policy debates, policy makers are interested in composite indicators. Within the country, private investors, policy makers, etc., might use the MEP index for their planning and decision-making process.

The objective of this paper is to measure economic performance of Indian economy through a composite MEP index consisting of several key non-commensurate individual indicators over the last 35 years and test the utility of this index in order to verify whether it truly captures the economic performance of India. This approach might help to 'solve' certain debates about comparative macroeconomic performance puzzles.

Some attempts have been made to construct several summary of measures of macroeconomic performance presented in the earlier literature. While the Okun's misery index of a country is obtained as the sum of the unemployment rate and inflation rate, the Calmfors index is measured by adding the unemployment rate and trade balance. The "magic diamond" of OECD is, however, based on four macro parameters such as GDP growth rate, trade balance, inflation rate and unemployment rate. The Calmfors and Okun indices use only two macro indicators, while the OECD's magic diamond considers all the four main macro indicators, but these indicators are assumed to carry equal weights.

[2] There might be a situation, where various single indicators may trend in different directions, which creates confusion about the economic performance of a country.

However, as Cherchye (2001) argues, assigning equal weights to all the macro indicators yields unrealistic measures of MEP. Therefore, a scientific method that helps to determine unequal weights for various macro indicators, with the weight of each indicator reflecting the policy priority assumed by the policy makers, is required to construct a realistic measure of MEP index. In the literature, DEA and econometric approach are used to generate unequal weights for various individual indicators endogenously. The DEA offers, however, a distinct advantage over the econometric approach in generation of unequal weights for various individual indicators depending on their relative importance (Cherchye, 2001, 2007, 2008; Sahoo and Acharya, 2010, 2012, 2017; Sahoo et al., 2017).[3]

1.1 International Studies

Lovell (1995) examined the MEP of 10 Asian economies for the period 1970-1988 using the output-oriented free disposal hull model. Lovell et al. (1995) examined the MEP of 19 Organization for Economic Cooperation and Development (OECD) countries over the period 1970-1990 using four indicators, i.e. real GDP per capita, inflation, unemployment rate and trade balance with the non-radial slack-based measure (SBM) model. Cherchye (2001) analyzed several variants of DEA-based models (both radial and non-radial) to empirically measure and compare the MEP for a sample of 20 OECD countries. Ramanathan (2006) studied the economic and social performance of 18 countries of the Middle East and North Africa region using DEA with seven performance attributes. Christopoulos (2007) examined the impact of human capital and openness on efficiency performance in a sample of 83 OECD and non-OECD countries over six 5-year periods from 1960-1964 to 1985-1989 using DEA. Setterfield (2009) develops a composite index of macroeconomic performance of United States with seven advanced capitalist economies using five components: unemployment, inflation, economic growth, economic inequality and economic insecurity.

1.2 Indian Studies

Sahoo and Acharya (2012) constructed a robust MEP index of 22 Indian State economies covering the period: 1994-1995 to 2001-2002 using both radial and non-radial DEA models. They have used three macroeconomic indicators: growth in gross state domestic product (GSDP), price stability, and fiscal balance for the construction of MEP index. Dholakia (2005) examined the fiscal discipline of 14 Indian states by preparing a composite fiscal performance index out of eight fiscal indicators. Chaudhuri (2004) analyzed the sectoral growth for 22 States of the Union in both 1980s and 1990s. He finds wide differences in the implicit GSDP deflators averaged over five to six years and in the value of the implicit deflator on a year-to-year basis.

[3] DEA was developed by Charnes, Cooper and Rhodes (1978) to evaluate the relative performance of a collection of similar public sector units which provide multiple services that are not all priced on markets. Then, DEA model has been extensively used in the literature to test macroeconomic performance (eg., Melyn and Mosen, 1991; Fare et al., 1994)

In most of the empirical studies, authors have investigated the MEP in advanced and emerging countries by using cross-country data rather than country-specific data. In India, previous studies have focused only on measuring fiscal performance or macroeconomic performance at the State level. To the best of our knowledge, our present paper is the first attempt to develop such a comprehensive composite index in assessing the MEP of India over the last 35 years, using DEA. It is, arguably, the first to incorporate fiscal deficit and pollution as additional indicators for the construction of MEP index of India. Along with MEP, it constructs Eco-MEP index of India for the first time.

As mentioned in the literature (Lovell, 1995; Lovell et al., 1995; Cherchye, 2001), MEP is constructed using four macro indicators such as growth, employment, trade balance, and price stability. Examining economic performance based on only four dimensions is indeed restrictive in nature. Therefore, except these indicators, we have incorporated two additional indicators, namely fiscal deficit and pollution, which are needs of the hour for every country. The mounting fiscal deficit continues to be an area of concern for the policy makers.[4] The Central government of India has enacted the Fiscal Responsibility and Budget Management (FRBM) Act, 2003 to reduce fiscal deficit to achieve sustainable fiscal discipline.[5] That is why we have included fiscal deficit as a measure of fiscal balance for the construction of MEP index. The Environment (Protection) Act[6] was enacted in 1986 with the objective of providing for the protection and improvement of the environment in India. An increase in production at the cost of environment is not at all desirable. Pollution has both direct and indirect (cost) burden on the economy. So, the objective of reduction of environmental pollution should be taken into consideration for measuring MEP. Thus, we have taken pollution as an additional indicator (Lovell et al., 1995).

[4] Mounting fiscal deficit has an adverse effects on Private investment (crowding out controversy, see Pradhan et al., 1990; Apergis, 2000; Alsenia et al., 2002), Interest rate (see Cebula & Cuellar, 2010; Claeys et al., 2012; Tseng, 2000; Aisena & Hauner, 2013; Current account deficit (twin deficit hypothesis, see Salvatore, 2006; Kalou & Paleologou, 2012; Makin & Narayan, 2013), Economic growth (see Cebula, 1995; Easterly & Rebelo, 1993 etc.). Not only the level of fiscal deficit but also the financing pattern of fiscal deficit matter for the economy. As Seigniorage financing (money creation) of fiscal deficit can create inflationary pressure in the economy. Bond financing of fiscal deficit can lead to rise in interest rates (credit squeeze) and in turn can crowd out private investment. External financing of fiscal deficit may lead to current account deficit and appreciation of real exchange rate can lead to a balance of payment crisis (if foreign reserves are run down) or an external debt crisis (if debt is too high) (Easterly and Hebbel, 1993).

[5] Again the Government of India had set up a FRBM Review Committee on 2016 to evaluate the FRBM Act, 2003.

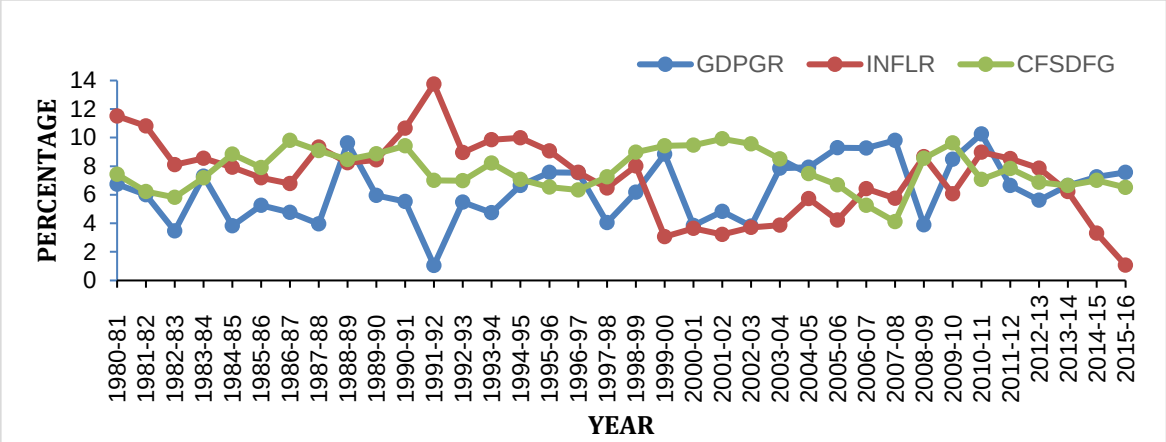
[6] It empowers the Central government to set up authorities [under section 3(3)] charged with the mandate of preventing environmental pollution in all its forms and to tackle specific environmental problems that are peculiar to different parts of the country. The Act was last amended in 1991. (Source: Ministry of Environment, Forest and Climate Change, Government of India).

The rest of the paper proceeds as follows. Section 2 analyses the trends of macro indicators used for the construction of index. Section 3 presents the discussion on data and methodology used for the index. Section 4 deals with the result analysis and testing the utility of the MEP with other indicators. Finally, concluding remarks are discussed in Section 5.

2. Trend Analysis of Selected Indicators

Figure 1 depicts the trends in combined fiscal deficits of Central and State governments, growth rate of GDP and inflation rate in India over the last three and a half decades.[7] The combined fiscal deficit of the Central and State governments as a per cent of GDP rose from 7.19 per cent of GDP in 1980-81 to 9.8 per cent in 1986-87 and then declined to 6.34 percent in 1996-97. During the 1990s, the average combined fiscal deficit as a per cent of GDP was 7.72 per cent. The peak of the combined fiscal deficit was observed (9.91 per cent) during 2001-02. However, after 2003-04, due to the enactment of FRBM Act, the government contained the combined fiscal deficit from 8.51 per cent of GDP to its all-time minimum of 4.12 percent in the year 2007-08. Then it suddenly jumped to 9.63 per cent up to 2009-10 because of the adoption of fiscal stimulus packages for countering the impact of global recession on Indian economy. The trend reversed, and it came down to 6.52 per cent of GDP in 2015-16.

Figure 1: Trends in Combined Fiscal Deficits, GDP Growth, and Inflation



Note: CFSDFG is the combined fiscal deficits of Central and State governments, GDPGR is growth rate of GDP and INFLR is inflation rate in India.

The GDP growth rate declined from 6.74 per cent in 1980-81 to 3.96 per cent in 1986-87. Excellent recovery of agricultural production and sustained industrial growth helped to achieve around 10 per cent growth rate in 1988-89. In beginning of economic crisis during the end period of 1980s, India experienced its all-time low growth rate (1.06 per cent) in 1991-92. During 1990s, the average growth rate was nearly six per cent. The GDP growth rate

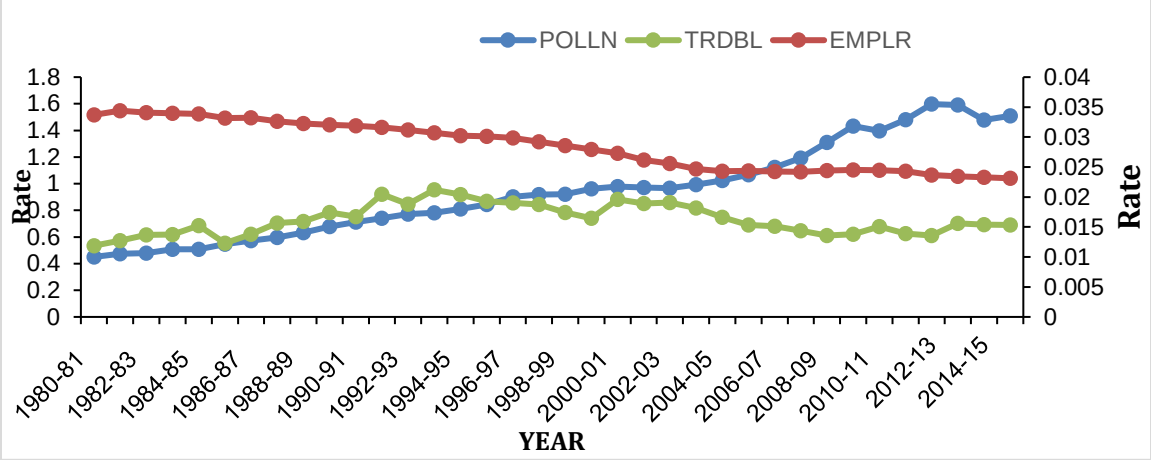
[7] The details of these variables are explained in section 3 of the paper.

reduced from 9.28 per cent in 2005-06 to 3.89 per cent in 2008-09 because of the global financial crisis. The growth rate of GDP was 7.56 per cent in 2015-16. Overall growth rate of GDP during the 11th five-year plan was around 8 per cent as against the targeted level of 9 per cent. It has a slightly increasing trend during the last three and half decades.

The inflation rate was 11.5 per cent in 1980-81 and then declined to 6.8 per cent in 1986-87. It started upward and touched to the highest level of 13.75 per cent in 1991-92. Then, it declined to around 3 per cent in 1999-00 with many variations during that period. The average inflation rate was much higher - nearly 9 per cent during 80s and 90s. This moderation in the rate of inflation might be because of both supply side and demand side factors like a relatively higher rate of monetary expansion, rise in the administered prices of certain petroleum products, shortages of food grain production, etc. Then, the economy faced an increasing trend of inflation rate up to nearly 9 per cent in 2010-11 and reduced to more than 1 per cent in 2015-16.

Figure 2 shows the trend analysis of employment rate, terms of trade and pollution of India over the last three and a half decades.[8] It is seen that pollution has an increasing trend from 0.45 metric tons per capita to nearly 1.6 metric tons per capita during this time. Employment rate showed an unvarying trend in the chosen period. Trend in terms of trade has increased from 1980-81 to 1993-94 with a small variation. Then, it has followed a declining trend for the remaining periods. The reason may have been because of the adoption of economic reforms like liberalization of the policy regime governing international trade in 1991-92, as import has gone up more than the export.

Figure 2: Trends in Employment Rate, Terms of Trade, and Pollution



Note: EMPLR is employment rate, TRDBL is terms of trade, and POLLN is pollution. Here, employment rate is explained in the secondary vertical axis.

[8] The details of these variables are explained in section 3 of the paper.

3. Data Source and Methodology

3.1 The Data

We construct the MEP and Eco-MEP indices for India by using time-series data for the period from 1980-81 to 2015-16. The variables selected for these indices are defined as follows. Economic growth (GDPGR) is defined as the rate of growth of gross domestic product (GDP) at market price, using constant prices. Employment rate (EMPLR) is captured by the ratio of employment in public and organized private sector to the population.[9] The terms of trade (TRDBL) is measured by the ratio of total export prices to total import prices. The inflation rate (INFLR) is measured as annual percentage change in the GDP deflator. The fiscal deficit (CFSDFG) is captured by the combined fiscal deficit of the Central and State governments as percentage of GDP. Pollution (POLLN) is explained by carbon dioxide emissions (metric tons per capita). For the construction of the DEA model, it has chosen to maximize economic growth, employment rate and terms of trade, and to minimize the inflation rate, fiscal deficit and pollution indicators to arrive at MEP indices because these last three indicators are viewed as "economic bads". All nominal variables are deflated by the GDP deflator (base = 2011-12). Data on all variables are obtained from the Hand Book of Statistics on Indian Economy, the database on Indian economy of Reserve Bank of India (RBI), and World Development Indicators (WDI) of the World Bank.

3.2 Methodology

We have adopted DEA approach for calculating the MEP and Eco-MEP of Indian economy. The construction of both these indices for India over the years have been carried out in two phases: first, (for MEP index) with respect to five macro indicators, i.e. economic growth (GDPGR), employment rate (EMPLR), terms of trade (TRDBL), inflation rate (INFLR), fiscal deficit (CFSDFG), and then re-evaluate the MEP (for Eco-MEP index), by adding pollution (POLLN) along with these selected indicators, to examine whether the objective of reducing environmental pollution has any noticeable impact on the MEP of Indian economy.

Before setting up the formal DEA model to construct MEP index, the original indicators are first normalized so that the values of the normalized indicators lie between zero and one; zero corresponding to the worst performance and one corresponding to the best performance in the sample. The normalizations of the selected variables, i.e., GDPGR, EMPLR, TRDBL, CFSDFG, INFLR and POLLN, for each year "t" (t = 1980-81, 1981-82…….2015-16) are computed as follows.[10]

$$GDPGR_t = \frac{GDPGR_t - GDPGR_{min}}{GDPGR_{max} - GDPGR_{min}} \quad (1)$$

$$EMPLR_t = \frac{EMPLR_t - EMPLR_{min}}{EMPLR_{max} - EMPLR_{min}} \quad (2)$$

[9] Time series data on employment in unorganized sectors are not available (data constraint).
[10] The descriptive statistics of the selected variables are given in the appendix section.

$$TRDBL_t = \frac{TRDBL_t - TRDBL_{min}}{TRDBL_{max} - TRDBL_{min}} \quad (3)$$

$$CFSDFG_t = \frac{CFSDFG_{max} - CFSDFG_t}{CFSDFG_{max} - CFSDFG_{min}} \quad (4)$$

$$INFLR_t = \frac{INFLR_{max} - INFLR_t}{INFLR_{max} - INFLR_{min}} \quad (5)$$

$$POLLN_t = \frac{POLLN_{max} - POLLN_t}{POLLN_{max} - POLLN_{min}} \quad (6)$$

Here, as mentioned earlier, growth, employment, and trade balance are considered as "economic goods", whereas fiscal deficit, inflation, and pollution are used as "economic bads". Therefore, different functions have been used in the numerator of equation 4 to 6 to convert "economic bads" to "economic goods".

In the present DEA setting, we deal with this problem by treating the Indian economy for each time period as a distinct DMU where weights are generated by maximizing weighted sum of individual macroeconomic indicators for a given period subject to the condition that the weighted macro indicators for the remaining periods are no more than 1, i.e. essentially looking at a DEA problem of maximizing outputs without any resources or unit resources, which yields an index capturing the maximum macroeconomic policy performance of an economy. The underlying assumption behind this model is that individual macroeconomic indicators are substitutes with each other along the production technology frontier comprising various macro indicators.

In the spirit of Sahoo and Acharya (2012, 2017), here, an attempt is made to combine the various macro indicators such as GDPGR, EMPLR, TRDBL CFSDFG, and INFLR that are produced due to changing economic environment and changing decisions by Government of India, without considering any resources, into a single summary measure of MEP index. Here, the objective function can be interpreted as some utility level associated with holding the optimal portfolio of macro aggregates, and their respective weights reflect the underlying assumption that good performance reflects high policy priority. This MEP index can be theoretically and empirically perceived as competing macro aggregate if it is able to divulge anything on the other major macro variables such as private investment, CAD and FIIs of the Indian economy.

To measure the MEP of Indian economy at any time period t_0, say, 1990-91, we set up the following model under variable returns to scale (VRS) environment as:

$$\left(MEP_{t_0}\right)^{-1} = \max\ 1 + \frac{1}{5}\left(\frac{s^{GDPGR}}{GDPGR^n_{t_0}} + \frac{s^{EMPR}}{EMPLR^n_{t_0}} + \frac{s^{TRDBL}}{TRDBL^n_{t_0}} + \frac{s^{CFSDFG}}{CFSDFG^n_{t_0}} + \frac{s^{INFLR}}{INFLR^n_{t_0}}\right) \quad (7)$$

Subject to

$$\sum_{t=1980\text{-}81}^{2015\text{-}16} GDPGR_t^n \lambda_t - s^{GDPGR} = GDPGR_{t_0}^n, \quad (7.1)$$

$$\sum_{t=1980\text{-}81}^{2015\text{-}16} EMPLR_t^n \lambda_t - s^{EMPLR} = EMPLR_{t_0}^n, \quad (7.2)$$

$$\sum_{t=1980\text{-}81}^{2015\text{-}16} TRDBL_t^n \lambda_t - s^{TRDBL} = TRDBL_{t_0}^n \quad (7.3)$$

$$\sum_{t=1980\text{-}81}^{2015\text{-}16} CFSDFG_t^n \lambda_t - s^{CFSDFG} = CFSDFG_{t_0}^n, \quad (7.4)$$

$$\sum_{t=1980\text{-}81}^{2015\text{-}16} INFLR_t^n \lambda_t - s^{INFLR} = INFLR_{t_0}^n, \quad (7.5)$$

$$\sum_{t=1980\text{-}81}^{2015\text{-}16} \lambda_t = 1, \quad (7.6)$$

$$\lambda_t \geq 0 \text{ for all } t = 1980-81, ..., 2015\text{-}16. \quad (7.7)$$

Where, λ_t s, the intensity coefficients, are interpreted as the shadow prices; and s^{GDPGR}, s^{EMPLR}, s^{TRDBL}, s^{CFSDFG} and s^{INFLR} s^{f} are, respectively, the slacks in normalized macro indicators - $GDPGR_{t_0}^n$, $EMPLR_{t_0}^n$, $TRDBL_{t_0}^n$, $CFSDFG_{t_0}^n$ and $INFLR_{t_0}^n$. If MEP_{t_0} = 1, the economy operates on the macroeconomic performance frontier, and hence, is relatively efficient in the year 1990-91, and if MEP_{t_0} > 1, then the economy is relatively inefficient where its MEP score is represented as $\left(1/MEP_{t_0}\right)$ in 1990-91. The linear program (7) can be run for 35 times to compute MEP index scores of Indian economy over 35 years.

The ECO-MEP scores can be computed in an analogous manner from the same LP program (4) but by adding the pollution constraint, i.e., $\sum_{t=1980\text{-}81}^{2015\text{-}16} POLLN_t^n \lambda_t - s^{POLLN} = POLLN_{t_0}^n$.

4. Empirical Analysis of MEP Index

Table1 shows the MEP and Eco-MEP index scores over the study period of Indian economy. The best and worst values of the comprehensive index helped to evaluate the macroeconomic performance, which implies the progress or deterioration of Indian economy for the period from 1980-81 to 2015-16.

The years that register unit efficiency scores are considered efficient/ performed optimally in that they have the highest values of desirable attributes and the lowest values of undesirable attributes, whereas, the year with efficiency scores less than unit may be considered to operate sub-optimally for a given set of attributes. The MEP scores imply that the

country performed extremely well in from 1981-82 to 1986-87, 1988-89, the first half of the 1990s,[11] 1999-00 to 2001-02, 2003-04, 2005-06, 2007-08, 2010-11 and 2015-16. Thus, India performed sub-optimally or less efficiently in the other remaining years as the scores are less than the unit. According to the MEP score, the year 1982-83 was the best performing year, and the year 2008-09 was the worst performing year for the country. Similarly, during the 1980s, 1982-83 was the best performing year, and the worst one was in 1987-88. Then, in the 1990s, the country fared extremely well in 1999-00 while rather poorly in 1998-99. While in 2007-08 was the best performing year of the 2000s, 2008-09 was the worst performing year of those decades.

Similarly, the Eco-MEP score states that the country performed extremely well in 1980-81 to 1986-87, 1988-89, from 1991-92 to 1996-97, 1999-00 to 2001-02, 2003-04, 2005-06, 2007-08, 2010-11 and 2015-16. Thus, the scores imply that the country operated sub-optimally in the remaining years. It gives the same findings that the year 1982-83 was the best performing year, and the year 2008-09 was the worst performing year for the country. Overall, both the MEP and Eco-MEP index scores have quite similar best performing years and worst performing years. For more clarity, let's analyze the trends of these constructed index scores.

Figure 3 depicts the trends of the overall performance of Indian economy during the last 35 years. Overall in the 1980s and 1990s, both of these indices have performed well consistently. During that period Eco-MEP index was better than the MEP index as the former is flatter than the latter one. However, after the 2000s, the overall performance of Indian economy deteriorated as shown by both indices. Here, it is important to note that the Eco-MEP index is steeper than the MEP index. It implies that pollution has a negative impact on the overall performance of the economy. Environmental pollution act was enacted in 1986, last amended in 1991 and implemented strictly after some years in India. That is why pollution has an effect on the performance of the economy. However, before the mid-90s nobody has much concern about pollution. That is why the Eco-MEP index performed better than the MEP index. Thus, while measuring the macroeconomic performance of a country, the pollution indicator should be taken into consideration.

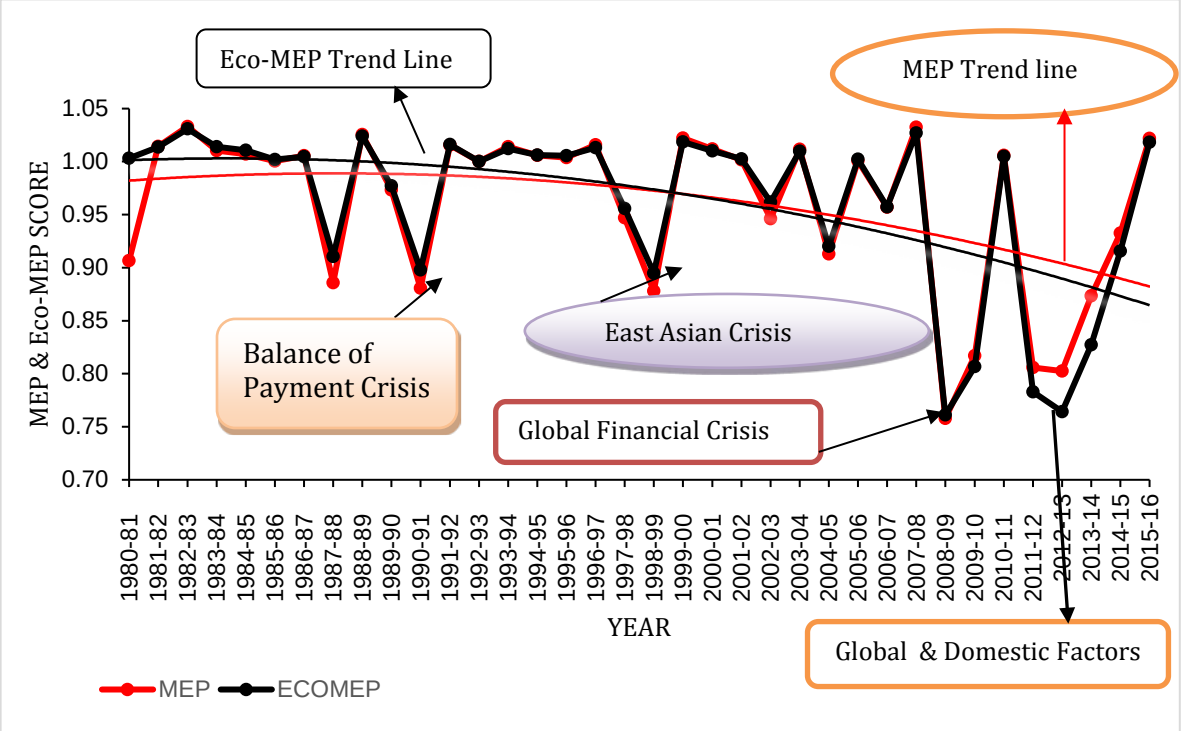
[11] India had faced a severe crisis in 1990-91 (BOP crisis). Aftermath, Indian economy had undergone significant policy shifts (New economic policy - Liberalisation, Privatisation and Globalisation) in the beginning of the 1990s, which brought the country back on the track. During the first half of 1990s on an average, the growth rate of GDP was more than 6 per cent, the export to import ratio was nearly 0.9 percent and most importantly, the combined fiscal deficits were 7 per cent. Thus, these indicators hadn't been badly affected in the first half of 1990s. Therefore, the constructed MEP index indicates very good performance in the first half of the 1990s.

Table 1: Constructed MEP and Eco-MEP Indices

YEAR	MEP	Eco-MEP	YEAR	MEP	Eco-MEP
1980-81	0.9066	1.0031	**1998-99**	0.8780	0.8948
1981-82	1.0143	1.0136	**1999-00**	1.0223	1.0185
1982-83	1.0331	1.0308	**2000-01**	1.0120	1.0100
1983-84	1.0104	1.0139	**2001-02**	1.0017	1.0026
1984-85	1.0071	1.0108	**2002-03**	0.9461	0.9617
1985-86	1.0005	1.0018	**2003-04**	1.0117	1.0099
1986-87	1.0056	1.0046	**2004-05**	0.9129	0.9202
1987-88	0.8859	0.9104	**2005-06**	1.0007	1.0024
1988-89	1.0254	1.0240	**2006-07**	0.9569	0.9573
1989-90	0.9732	0.9771	**2007-08**	1.0324	1.0269
1990-91	0.8806	0.8978	**2008-09**	0.7577	0.7610
1991-92	1.0155	1.0161	**2009-10**	0.8170	0.8067
1992-93	1.0000	1.0000	**2010-11**	1.0059	1.0049
1993-94	1.0141	1.0122	**2011-12**	0.8059	0.7830
1994-95	1.0060	1.0062	**2012-13**	0.8026	0.7643
1995-96	1.0037	1.0057	**2013-14**	0.8734	0.8273
1996-97	1.0159	1.0132	**2014-15**	0.9325	0.9156
1997-98	0.9470	0.9557	**2015-16**	1.0218	1.0181

Source: Author's calculation.

Figure 3: MEP and Eco-MEP Trends of Indian Economy



These indices capture the major events that has been affecting the economy badly during the last 35 years, i.e., balance of payment crisis in 1990-91, East Asian crisis in 1998-99, global financial crisis in 2008-09, global factors especially turmoil in the euro-zone countries along with domestic factors like tightening of monetary policy owing to high and persistent headline inflation, slowing investment and industrial activity etc. in 2011-12. So, these indices are robust as they reflect the economic activity. The simple trend analysis is not enough for checking the robustness of these indices. Therefore, an econometric exercise has been carried out to check the robustness of these indices given below.

4.1 Utility Test of MEP and Eco-MEP

The mere construction of performance index is worthless if it does not truly capture the real performance of the economy. A good index should capture the real performance of the economy. Hence, an empirical investigation is required to verify whether these index scores divulge anything on the other major macro variables, i.e. private investment, CAD and FIIs of the Indian economy. Basically, to examine how these selected major variables behave with these index scores. By using Autoregressive Distributed Lag (ARDL) bounds testing approaches to cointegration, we have examined the relationship between these index scores and other selected major macro variables, i.e. private investment, CAD, FIIs and FDI.

4.1.1 The ARDL Methodology

We have used the ARDL Bounds Testing approaches to cointegration method (Pesaran et al., 2001) to examine the long-run relationships among the selected variables empirically, since we use a mix of I (0) and I (1) types of variables in this study (see Table 2). Earlier tests of cointegration like Johansen-Juselius cointegration test, Dynamic OLS (DOLS) and Fully Modified OLS (FMOLS) require all the variables to be of I (1) type. Therefore, these methods of cointegration are not appropriate for this study. This methodology can be applied to all series regardless of their level of integration, whether purely I (0), purely I (1) or mutually cointegrated. The test is very simple and more efficient in small or finite sample sizes. However, this method cannot be applied to I (2) series. Hence, we adopt the ARDL approach for cointegration analysis.

We have used the following specification to evaluate the effect of MEP and Eco-MEP on the selected macro variables in India.

$$Y_t = \alpha + \beta X_t + \gamma Z_t + \mu_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots (8)$$

Where,

Y_t refers to a set of selected macro variables such as private investment, current account deficit, total foreign investment inflows and foreign direct investment. X_t is the variable of interest, i.e., MEP and Eco-MEP. Z_t stands for a set of other control variables such as interest rate, bank credit, exchange rate and trade openness. μ_t is a random error term.

In order to perform the Bounds Testing procedure, it is essential to model equation (8) as a conditional ARDL as follows:

$$\Delta Y_t = \beta_0 + \beta_1 Y_{t-1} + \beta_2 X_{t-1} + \beta_3 Z_{t-1} + \sum_{i=1}^{m} \delta_1 \Delta Y_{t-i} + \sum_{i=0}^{m} \delta_2 \Delta X_{t-i} + \sum_{i=0}^{m} \delta_3 \Delta Z_{t-i} + \mu_t \ldots.(9)$$

After estimation of equation (9) by ordinary least square (OLS), the Wald test (*F*-statistic) can be conducted on the estimated coefficients of one period lagged level of variables. The long-run relationship among the selected variables can be checked by testing the null hypothesis of no cointegration against its alternative hypothesis of cointegration as follows: $H_0 : \beta_1 = \beta_2 = \beta_3 = 0$ and $H_1 : \beta_1 \neq 0, \beta_2 \neq 0, \beta_3 \neq 0$.

Then, the computed values of *F*-statistic will be compared with the critical values tabulated in Pesaran et al. (2001). If the computed *F*-statistic is smaller than the lower critical bound value [I (0)], then the series are not cointegrated. Conversely, if the calculated *F*-statistic is greater than the upper bound critical value [I (1)], then the series are cointegrated. Finally, if the F-statistic falls between the lower and upper bound critical values, then the decision about cointegration is inconclusive.

After the confirmation of cointegration relationship, both long run and short run dynamics of the cointegration equations will be estimated. The following long run relationships (equation 10) and the corresponding error correction representation of the estimated long-run equations (equation 11) will be estimated respectively.[12]

$$Y_t = \beta_0 + \sum_{i=1}^{m} \beta_1 Y_{t-i} + \sum_{i=0}^{m} \beta_2 X_{t-i} + \sum_{i=0}^{m} \beta_3 Z_{t-i} + \mu_t \ldots\ldots\ldots\ldots\ldots\ldots(10)$$

$$\Delta Y_t = \beta_0 + \sum_{i=1}^{m} \delta_1 \Delta Y_{t-i} + \sum_{i=0}^{m} \delta_2 \Delta X_{t-i} + \sum_{i=0}^{m} \delta_3 \Delta Z_{t-i} + \theta_0 \, ECM_{t-1} + \mu_t \ldots\ldots(11)$$

Where, Δ is the first difference operator, β_0 is intercept, $\beta_1, \beta_2 and \beta_3$ are long-run coefficients, $\delta_1, \delta_2 \; and \; \delta_3$ are short run coefficients, ECM_{t-1} is one period lagged error correction term estimated from equation (10), θ_0 is the speed of adjustment, μ_t is the error term of the estimated models, and all other variables are defined before.

4.1.2 ARDL Model Specifications

In order to test the robustness/utility of our indices, we estimate several specifications from the above equation (7). The details of eight separate models (model A to H) are as follows.[13]

LPVTINV= f (LMEP, ROI, LBCRED) ----------Model (A)
LPVTINV= f (LECOMEP, ROI, LBCRED) ----------Model (B)
CADG= f (LMEP, LREXC) ----------Model (C)
CADG= f (LECOMEP, LREXC) ----------Model (D)
LFII= f (LMEP, LTOPN) ----------Model (E)
LFII= f (LECOMEP, LTOPN) ----------Model (F)
LFDI= f (LMEP, LTOPN) ----------Model (G)
LFDI= f (LECOMEP, LTOPN) ----------Model (H)

Where,

LPVTINV: log of Private Corporate Sector Investment, LMEP: log of Macroeconomic Performance Index, LECOMEP: log of Eco-Macroeconomic Performance Index, ROI- Real Interest Rate,[14] LBCRED: log of Total Bank Credit, CADG: CAD as percentage of GDP, LREXC: log of Real

[12] The orders of the ARDL models have been selected by employing the Schwartz Criteria consistently for all these models.
[13] The justifications of variables are explained in section 4.2.
[14] Real interest rate is the lending interest rate adjusted for inflation as measured by the GDP deflator. Source: World Development Indicators (WDI), World Bank.

Exchange Rate,[15] LFII: log of Foreign Investment Inflows (FIIs), LFDI: log of FDI in India, LTOPN: log of Trade Openness.[16]

The model A & B estimate the relationship between private investment, MEP, Eco-MEP, interest rate and bank credit. Then, models C and D examine the link between CAD, MEP, Eco-MEP and exchange rate. Further, models E to H analyze the relationship between foreign investment (both total and FDI separately), MEP, Eco-MEP and trade openness.[17]

4.2 Empirical Analysis

4.2.1 Unit Root Test

The unit root test might be necessary to check that none of the selected series are of I (2). The results of unit root tests, by using Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests, are reported in Table 2.

It shows that the variables, such as LPVTINV, LBCRED, CADG, LREXC, LFII and LTOPN, are non-stationary at their levels but become stationary at their first difference. Thus, these variables are integrated of the same order, i.e., I (1). The variables LMEP, LECOMEP, ROI and LFDI are stationary at their levels, i.e., I (0), as the null hypothesis of non-stationary are rejected at one per cent level. Hence, the above results find that these variables are a combination of both stationary and non-stationary series, i.e., I (0) and I (1). Therefore, we have used the ARDL Bounds Testing approaches to the cointegration analysis.

4.2.2 Private Investment and MEP

Here, we have examined the economic linkage of MEP with private investment. Private investment plays an important role in an economy. It is expected that better performance of an economy would have a positive impact on private investment activity as it creates a favourable economic environment, boosts up investor's confidence and enhances the aggregate demand in an economy. Thus, it may influence output expectations and it tends to augment private investment in an economy. An increase in real interest rates raises real cost of capital, which may dampen the level of private investment. Alternatively, an increase in real interest rates encourage bank deposits (more funds), which can be used for financing private investment projects. Further, sufficient availability of bank credit to the private sector would facilitate the financing of plants, machinery, equipment, etc., which enhances private investment especially in developing countries like India. Thus, it might have a positive impact on private

[15] Rupees per unit of US Dollar are used as the proxy for exchange rate.
[16] The trade openness is measured from total trade volume (sum of export and import) to GDP ratio.
[17] However, because of data constraint, Models E and H are estimated by using data for the period from 1990-91 to 2015-16.

investment. Hence, along with MEP, interest rate and bank credit are added as other independent variables in the equation. Table 3 displays the impact of MEP and Eco-MEP on private investment separately.

Table 2: Results of Unit Root Test

Variables	ADF Test		PP Test		Decision
	Level	**First Difference**	**Level**	**First Difference**	
LMEP	-4.50* (0.00)	-7.37* (0.00)	-4.57* (0.00)	-13.87* (0.00)	**I(0)**
LECOMEP	-3.78* (0.00)	-6.92* (0.00)	-3.78* (0.00)	-11.58* (0.00)	**I(0)**
LPVTINV	-1.23 (0.65)	-6.66* (0.00)	-1.23 (0.65)	-6.66* (0.00)	**I(1)**
ROI	-3.87* (0.00)	-9.15* (0.00)	-3.96* (0.00)	-9.34* (0.00)	**I(0)**
LBCRED	0.66 (0.99)	-3.82* (0.00)	0.86 (0.99)	-3.92* (0.00)	**I(1)**
CADG	-2.51 (0.12)	-6.82* (0.00)	-2.49 (0.13)	-6.85* (0.00)	**I(1)**
LREXC	-0.59 (0.86)	-4.58* (0.00)	-0.76 (0.82)	-4.59* (0.00)	**I(1)**
LFII	-1.67 (0.44)	-5.28* (0.00)	-1.85 (0.35)	-5.89* (0.00)	**I(1)**
LFDI	-3.32** (0.02)	-2.94** (0.05)	-3.32** (0.02)	-2.95** (0.05)	**I(0)**
LTOPN	-0.49 (0.88)	-4.00* (0.00)	-0.64 (0.85)	-4.09* (0.00)	**I(1)**

Note: * and ** denote 1 and 5 per cent levels of significance respectively. The figures in ( ) are P-values.

The results of ARDL bounds test confirm the long run relationship between the selected variables in both model A and model B.[18] In model A, MEP index has a positive and significant effect on private investment both in the long and short run. Interest rate has a negative and bank credit has a positive impact on private investment both in the long and short run. Similarly, in model B, Eco-MEP has positively and significantly affected the private investment both in the short and long run. Bank credit

[18] The computed F-statistics of model A and model B are 5.85 and 5.43 respectively, which are higher than the upper bound critical value at one per cent for model A and 5 per cent for model B respectively. Thus, the results of ARDL bounds test rejects the null hypothesis of no cointegration at 1 per cent level for model A and at 5 per cent level for model B.

and rate of interest have similar impacts as before. Both of these models pass the diagnostic results, i.e., no serial correlation, normality, no heteroscedasticity, etc. The stability tests (CUSUM and CUSUMQ) are given in the appendix section.

Table 3: Estimated Long Run and Short Run Coefficients for Private Investment

Model A: LPVTINV= f(LMEP, ROI, LBCRED)				Model B: LPVTINV= f(LECOMEP, ROI, LBCRED)			
Long Run Coeff.		**Short Run Coeff.**		**Long Run Coeff.**		**Short Run Coeff.**	
Variable	**Coeff.**	**Variable**	**Coeff.**	**Variable**	**Coeff.**	**Variable**	**Coeff.**
LMEP	2.82** (2.22)	**DLMEP**	1.24** (2.73)	**LCOMEP**	2.87** (2.37)	**DLECOMEP**	1.29* (2.86)
ROI	-0.17** (-2.55)	**DROI**	-0.03*** (-1.93)	**ROI**	-0.17** (-2.68)	**DROI**	-0.03*** (-1.93)
LBCRED	0.84* (8.44)	**DLBCRED**	1.45** (2.68)	**LBCRED**	0.87* (8.94)	**DLBCRED**	1.37** (2.53)
C	1.46 (1.27)	**$ECMT_{t-1}$**	-0.44* (-3.98)	**C**	1.26 (1.15)	**$ECMT_{t-1}$**	-0.45* (-4.14)
Diagnostic Tests				**Diagnostic Tests**			
Serial Correlation Test: 1.30 [0.26]				Serial Correlation Test: 1.03 [.32]			
Normality Test: 4.02 [0.13]				Normality Test: 3.64 [0.16]			
Hetero-Scedasticity Test: 0.37 [0.89]				Hetero-Scedasticity Test: 0.39[0.88]			
ARDL Bounds Test:- F-Statistic: **5.85***				**ARDL Bounds Test:- F-Statistic:** 5.43**			
Critical Value Bounds	**I(0) Bound**	**I(1) Bound**		**Critical Value Bounds**	**I(0) Bound**	**I(1) Bound**	
10%	2.72	3.77		10%	2.72	3.77	
5%	3.23	4.35		5%	3.23	4.35	
1%	4.29	5.61		1%	4.29	5.61	

Note: *, ** and *** denote 1, 5 and 10 per cent levels of significance respectively. Model A: ARDL (1, 0, 1, 1) selected based on Schwarz criterion (SIC). Model B: ARDL (1, 0, 1, 1) selected based on Schwarz criterion (SIC). Coeff. refers to coefficients. The figures in ( ) and [ ] are the t-statistics and P-values respectively.

4.2.3 CAD and MEP

The linkage between MEP and CAD is studied to check the robustness of these indices. The impact of better economic performance on CAD is ambiguous. If it enhances production, exports, etc., then it will reduce CAD. If it increases aggregate demand, imports, etc. because of income increase, then it will augment CAD. The impact of exchange rate is also unclear. Currency appreciation reduces competitiveness in the foreign markets, which helps in fueling

CAD, whereas, currency depreciation induces exports and restricts imports, which helps in reducing CAD. Table 4 displays the impact of MEP and Eco-MEP on CAD separately.

Table 4: Estimated Long Run and Short Run Coefficients for Current Account Deficit

Model C: CADG= f(LMEP, LREXC)				Model D: CADG= f(LECOMEP, LREXC)			
Long Run Coeff.		**Short Run Coeff.**		**Long Run Coeff.**		**Short Run Coeff.**	
Variable	**Coeff.**	**Variable**	**Coeff.**	**Variable**	**Coeff.**	**Variable**	**Coeff.**
LMEP	-7.77** (-2.28)	**DLMEP**	-4.86** (-2.36)	**LECOMEP**	-7.57** (-2.42)	**DLECOMEP**	-4.98** (-2.39)
LREXC	-5.51* (-3.44)	**DLREXC**	-3.45* (-3.01)	**LREXC**	-5.21* (-3.34)	**DLREXC**	-3.43* (-3.00)
C	26.28* (3.65)	**$ECMT_{t-1}$**	-0.63* (-4.83)	**C**	25.01* (3.58)	**$ECMT_{t-1}$**	-0.66* (-4.97)
T	-0.09* (-3.00)			**T**	-0.09* (-3.19)		
Diagnostic Tests				**Diagnostic Tests**			
Serial Correlation Test: 0.002 [0.96]				Serial Correlation Test: 0.05 [0.83]			
Normality Test: 0.84 [0.66]				Normality Test: 1.51 [0.47]			
Hetero-Scedasticity Test: 0.69 [0.60]				Hetero-Scedasticity Test: 0.68 [0.61]			
ARDL Bounds Test:- F-Statistic: **5.60****				**ARDL Bounds Test:- F-Statistic:** 5.68**			
Critical Value Bounds	**I(0) Bound**	**I(1) Bound**		**Critical Value Bounds**	**I(0) Bound**	**I(1) Bound**	
10%	4.19	5.06		10%	4.19	5.06	
5%	4.87	5.85		5%	4.87	5.85	
1%	6.34	7.52		1%	6.34	7.52	

Note: *, ** and *** denote 1, 5 and 10 per cent levels of significance respectively. Model C: ARDL(1, 0, 0) selected based on Schwarz criterion (SIC). Model D: ARDL(1, 0, 0) selected based on Schwarz criterion (SIC). Coeff. refers to coefficients. The figures in ( ) and [ ] are the t-statistics and P-values respectively.

The long-run relationships between the selected variables in both Model C and Model D are confirmed by the ARDL Bounds Testing approach.[19] The results of model C show that the coefficient of MEP is negative and significant at five per cent level. It indicates that an increase in performance of the economy would reduce CAD both in the long and short run. It also illustrates that exchange rate has a negative and statistically significant effect on CAD as depreciation of currency induces exports and restricts imports, which helps in reducing CAD. Model D also confirms the same results, i.e., Eco-MEP and exchange rate have a negative and

[19] The results of ARDL bounds test reject the null hypothesis of no cointegration at 5 per cent level for both model C and D.

significant effect on CAD both in the long run and short run. The estimated equations have also passed all these diagnostic tests like before, and the stability test results of both these models are given in the appendix section.

4.2.4 FIIs and MEP

Finally, we have also examined the relationship between FIIs[20] and MEP to test the utility of these indices. It is expected that better performance in the economy provides relatively better opportunities for making profits for the foreign investors. Thus, it attracts foreign investment. Generally, "Open" economies encourage more foreign investment. The empirical analysis for foreign investment is given in Table 5.

The results of Model E and Model F show that both MEP and Eco-MEP indices have a positive and significant effect on FIIs in the long run. In the short-run, they also have a positive impact on it. The coefficient of trade openness is positive and highly significant in both of these models (both in the long run and short run). Both of these models pass all the diagnostic tests, i.e., no serial correlation, normality, no heteroscedasticity, etc. The stability tests (CUSUM and CUSUMQ) are given in the appendix section.

4.2.5 FDI and MEP

After viewing the above results, it also relates the MEP and Eco-MEP with the FDI. Unlike foreign portfolio investment, FDI is in the form of long-term and planned investment in nature, which cannot be withdrawn in short period. Therefore, it is very important to verify the linkage between FDI, MEP and Eco-MEP. The crucial question is what is the impact of MEP & Eco-MEP on FDI? Do these indices favourably affect the FDI decision of foreign investors? The estimated results are shown in Table 6.

As expected, the results of model G and model H find that MEP and Eco-MEP have positive and highly significant effects on FDI in both the long-run and short-run. It implies that better performance in the economy attracts FDI. The results also confirm that trade openness has a positive impact on it in the long-run. All of these diagnostic results are cleared in these models. The stability tests are given in the appendix section.

Overall, the estimated results find that all the coefficients have theoretically expected signs and also statistically significant. It finds that MEP and Eco-MEP have a positive impact on private investment, negative effect on CAD, and positive impact on both FIIs and FDI. The error correction mechanism (ECM) term represents the speed of adjustment to restore equilibrium in the dynamic model following a disturbance. All the underlying error correction

[20] It is the combination of both FDI and foreign portfolio investment.

terms bear the expected signs in all these models (from Model A to Model H), and highly significant. Hence, all of these regression results show that the estimated MEP and Eco-MEP indices are robust in nature.[21]

Table 5: Estimated Long Run and Short Run Coefficients for FIIs

Model E: LFII= f(LMEP, LTOPN)				Model F: LFII= f(LECOMEP, LTOPN)			
Long Run Coeff.		**Short Run Coeff.**		**Long Run Coeff.**		**Short Run Coeff.**	
Variable	**Coeff.**	**Variable**	**Coeff.**	**Variable**	**Coeff.**	**Variable**	**Coeff.**
LMEP	10.19** (2.43)	**DLMEP**	4.51* (3.04)	**LCOMEP**	9.04** (2.40)	**DLECOMEP**	4.18* (2.78)
LTOPN	4.57* (5.72)	**DLTOPN**	2.02* (3.02)	**LTOPN**	4.71* (5.69)	**DLTOPN**	2.18* (0.01)
C	-7.40* (-3.01)	**$ECMT_{t-1}$**	-0.44* (-3.20)	**C**	-7.89* (-3.11)	**$ECMT_{t-1}$**	-0.46* (-3.22)
Diagnostic Tests				**Diagnostic Tests**			
Serial Correlation Test: 0.001 [0.97]				Serial Correlation Test: 0.003 [0.96]			
Normality Test: 0.93 [0.63]				Normality Test: 0.89 [0.64]			
Hetero-Scedasticity Test: 1.99 [0.14]				Hetero-Scedasticity Test: 2.18 [0.12]			
ARCH Test: 0.26 [0.62]				ARCH Test: 0.32 [0.57]			
ARDL Bounds Test:- F-Statistic: **5.57****				**ARDL Bounds Test:- F-Statistic:** 5.51**			
Critical Value Bounds	**I(0) Bound**	**I(1) Bound**		**Critical Value Bounds**	**I(0) Bound**	**I(1) Bound**	
10%	3.17	4.14		10%	3.17	4.14	
5%	3.79	4.85		5%	3.79	4.85	
1%	5.15	6.36		1%	5.15	6.36	

Note: *, ** and *** denote 1, 5 and 10 per cent levels of significance respectively. Model E: ARDL (1, 0, 0) selected based on Schwarz criterion (SIC). Model F: ARDL (1, 0, 0) selected based on Schwarz criterion (SIC). Coeff. refers to coefficients. The figures in ( ) and [ ] are the t-statistics and P-values respectively.

[21] Due to the unavailability of time series data on other socioeconomic indicators like poverty, inequality, literacy etc., econometric exercises haven't been carried out to verify the economic linkage of these variables with MEP and Eco-MEP.

Table 6: Estimated Long Run and Short Run Coefficients for FDI

Model G: LFDI= f(LMEP, LTOPN)				Model H: LFDI= f(LECOMEP, LTOPN)			
Long Run Coeff.		**Short Run Coeff.**		**Long Run Coeff.**		**Short Run Coeff.**	
Variable	**Coeff.**	**Variable**	**Coeff.**	**Variable**	**Coeff.**	**Variable**	**Coeff.**
LMEP	10.51* (4.92)	**DLMEP**	1.02*** (1.98)	**LECOMEP**	9.60** (5.16)	**DLECOMEP**	0.98*** (1.88)
LTOPN	4.14* (11.92)	**DLTOPN**	-0.42 (-0.84)	**LTOPN**	4.34* (12.15)	**DLTOPN**	-0.57 (0.01)
C	-6.18* (-5.75)	**$ECMT_{t-1}$**	-0.40* (-6.71)	**C**	-6.85* (-6.24)	**$ECMT_{t-1}$**	-0.43* (-6.74)
Diagnostic Tests				**Diagnostic Tests**			
Serial Correlation Test: 0.17 [0.69]				Serial Correlation Test: 0.004 [0.95]			
Normality Test: 0.52 [0.77]				Normality Test: 2.67 [0.12]			
Hetero-Scedasticity Test: 0.21 [0.95]				Hetero-Scedasticity Test: 0.28 [0.92]			
ARDL Bounds Test:- F-Statistic: **24.50***				**ARDL Bounds Test:- F-Statistic:** 22.15*			
Critical Value Bounds	**I(0) Bound**	**I(1) Bound**		**Critical Value Bounds**	**I(0) Bound**	**I(1) Bound**	
10%	3.17	4.14		10%	3.17	4.14	
5%	3.79	4.85		5%	3.79	4.85	
1%	5.15	6.36		1%	5.15	6.36	

Note: *, ** and *** denote 1, 5 and 10 per cent levels of significance respectively. Model G: ARDL (1, 1, 1) selected based on Schwarz criterion (SIC). Model H: ARDL (1, 1, 1) selected based on Schwarz criterion (SIC). Coeff. refers to coefficients. The figures in ( ) and [ ] are the t-statistics and P-values respectively.

5. Concluding Remarks

In this paper, we make a noble attempt to examine the macroeconomic performance of Indian economy over the last 35 years using DEA model. We use six major macro indicators, namely economic growth, employment rate, terms of trade, inflation rate, fiscal deficit, and pollution to compute MEP and Eco-MEP index of the Indian economy from 1980-81 to 2015-16. We construct the MEP index for Indian economy over the years by using five major macro indicators, i.e., economic growth, employment, trade, inflation, and fiscal deficit and the Eco-MEP index by using six major macro indicators, i.e., economic growth, employment, trade, inflation, fiscal deficit, and pollution. As noted in section 3.2, the basic purpose of constructing the Eco-MEP index is to examine whether the objective of reducing environmental pollution has any noticeable impact on the economic performance of Indian economy.

We consider that the years with unit efficiency scores are efficient/ have performed optimally, whereas the year with less than unit efficiency scores operate sub-optimally in the economy. Both the MEP and Eco-MEP index scores imply that the country performed extremely well in 1981-82 to 1986-87, 1988-89, 1991-92 to 1996-97, 1999-00 to 2001-02, 2003-04, 2005-06, 2007-08, 2010-11 and 2015-16. Thus, we infer that India performed sub-optimally or less efficiently in the other remaining years as the scores are less than the unit. The index scores shows that the year 1982-83 was the best performing year, and the year 2008-09 was the worst performing year for the country. Overall, both the MEP and Eco-MEP index scores have quite similar best performing years and worst performing years.

Both indices, discussed above, have performed well consistently in the 1980s and 1990s, and the overall performance of Indian economy has deteriorated after 2000s. Eco-MEP index was better than the MEP index as the former is flatter than the latter during the 1980s and 1990s. However, the Eco-MEP index is steeper than the MEP index after 2000s. It indicates that pollution has a negative impact on the overall performance of the economy. Thus, while measuring macroeconomic performance for a country, the pollution indicator should be taken into consideration. These indices also capture the major events that have been affecting the economy badly during the last 35 years.

The mere construction of performance index is worthless if it does not capture the real performance of the economy. To test the utility of these indices, it has linked these constructed MEP and Eco-MEP index with the other major macro variables, i.e., private investment, CAD, FIIs and FDIs of the Indian economy. We analyze the relationships (long and short run) between these indices and other selected major macro variables by using ARDL Bounds Testing approaches to cointegration methods. The ARDL bounds test confirms the cointegration relationships among the selected variables (Model A to Model H). MEP and Eco-MEP indices have positive and significant impacts on private investment in both long run and short run. They have a negative and significant effect on CAD in long run and short run. Then, both in long and short run, these indices have positive and significant effects on both FIIs and FDI. The test also finds that all other coefficients of selected variables have theoretically expected signs and also statistically significant. Hence, the suggested multidimensional index is more stable, robust and truly captures the economic performance of the country as pointed out by robustness check with other macro indicators. Thus, this MEP composite index may be used by the foreign investors, rating agencies, private investors, and policymakers for their planning and decision-making process.

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APPENDICES

Table 7: Descriptive statistics of the selected variables for the construction of MEP Index

	CFSDFG	EMPLR	GDPGR	INFLR	POLLN	TRDBL
Mean	7.72	0.03	6.32	7.27	0.94	0.73
Median	7.45	0.03	6.41	7.89	0.92	0.70
Maximum	9.91	0.03	10.26	13.75	1.60	0.95
Minimum	4.12	0.02	1.06	1.07	0.45	0.53
Std. Dev.	1.40	0.00	2.14	2.75	0.35	0.11
Jarque-Bera	0.72	3.79	0.40	0.20	2.27	1.92
(Probability)	(0.70)	(0.15)	(0.82)	(0.90)	(0.32)	(0.38)

Figure 4: Cusum and Cusumsq test for Model A

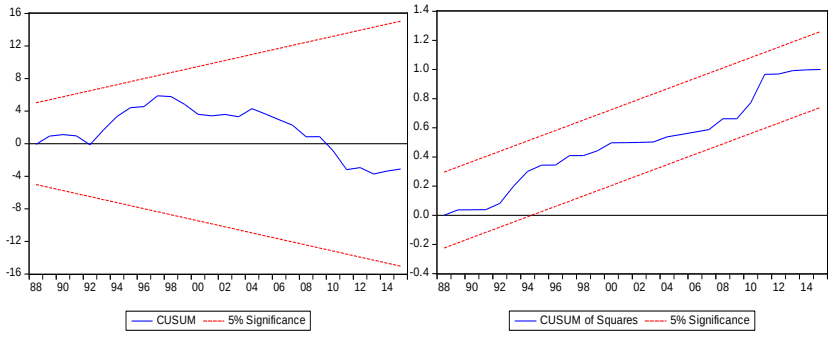


Figure 5: Cusum and Cusumsq test for Model B

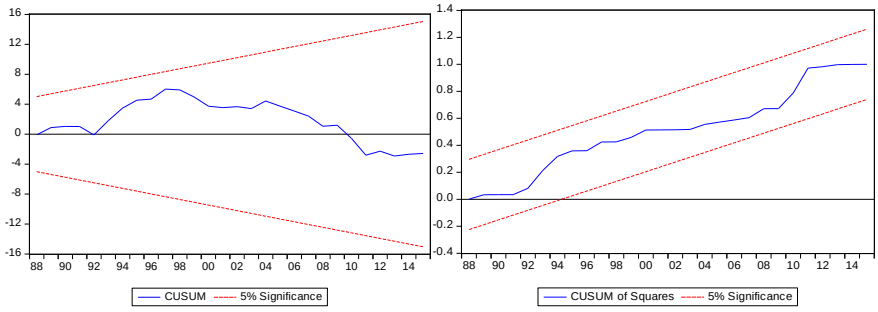


Figure 6: Cusum and Cusumsq test for Model C

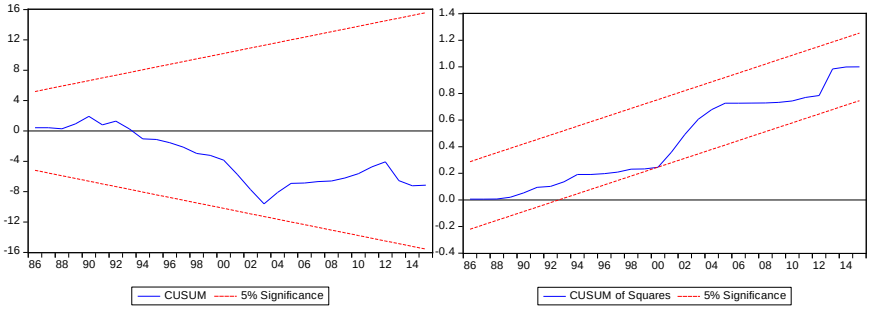


Figure 7: Cusum and Cusumsq test for Model D

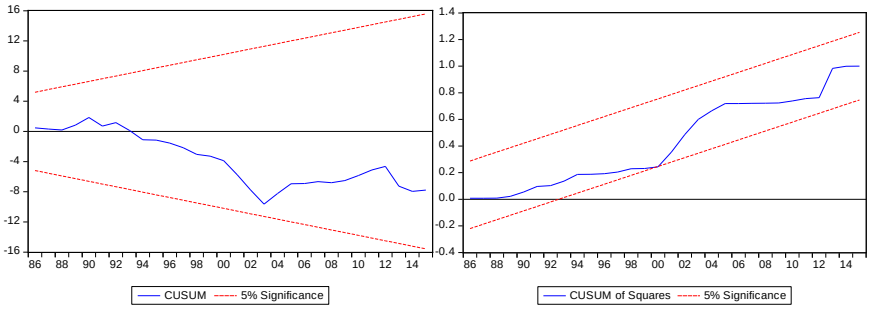


Figure 8: Cusum and Cusumsq test for Model E

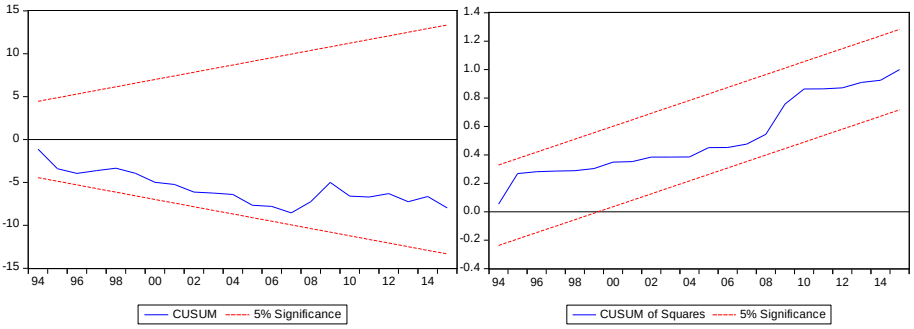


Figure 9: Cusum and Cusumsq test for Model F

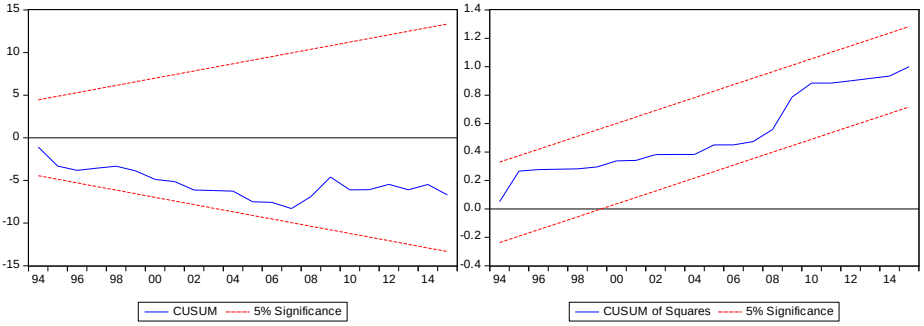


Figure 10: Cusum and Cusumsq test for Model G

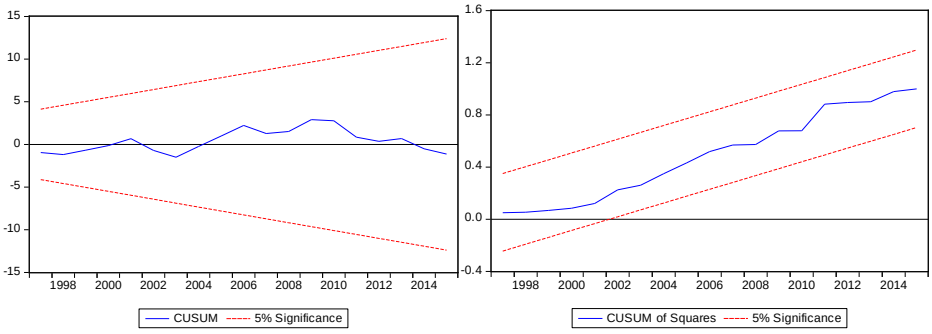
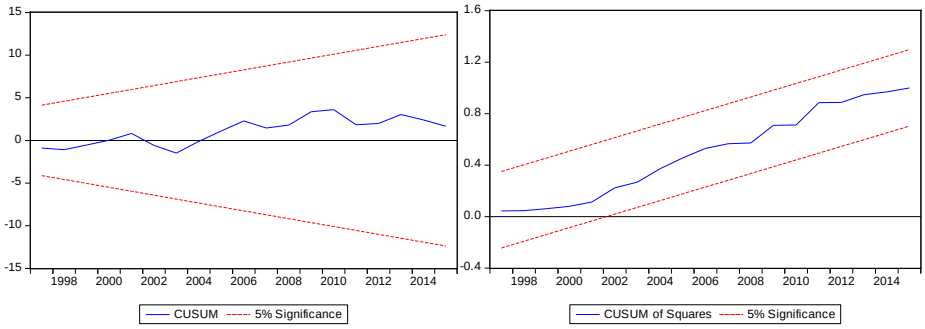


Figure 11: Cusum and Cusumsq test for Model H



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