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Contents

Accumulation, Adequacy and Utilisation of India's Foreign Exchange Reserves
Sparsh Thakur and Raghavender Raju G. 2

Phillips Curve Estimation: Accounting Qualitative and Quantitative Expectations
Swati Singh 18

Policy Response Towards Low Carbon Transition of Power Sector in India
Nandini Das and Kuheli Mukhopadhyay 32

Tertiary Sector's Performance in India
V. Nirmal Rajkumar 49

A Review on the Farmer Suicides in India – An Unsolved Problem
N. Rajendra Prasad 56

The Relationship between Public Expenditure and Economic Growth in South India: An Econometric Analysis
K. Murugan 68

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Accumulation, Adequacy and Utilisation of India's Foreign Exchange Reserves

Sparsh Thakur[1]
Raghavender Raju G[2]

Abstract

The RBI's main objectives of foreign exchange reserve management is to ensure liquidity, safety and yield on deployment of foreign exchange reserves. The stated objective of India's exchange rate policy is to manage the volatility arising in the exchange rate with absolutely no fixed rate target while allowing the supply and demand forces to determine India's exchange rate. But if there is excessive volatility arising in the exchange rate which has a detrimental effect on the macroeconomic fundamentals, the RBI intervenes in the foreign exchange market by buying or selling the foreign exchange reserves, thus stabilizing the exchange rate. The analysis also aims to identify the factors that determine international reserve hoarding in India on the basis of annual time series data during the period 1990-91 to 2015-16. Utilization and adequacy of the foreign exchange reserves have also been dwelled upon in this study. The analysis shows that the intervention operations of the RBI is successful in stabilizing the exchange rate. The study also shows that trade deficit and exchange rate are the two most significant variables determining the need for hoarding foreign exchange reserves. India currently holds close to $400 billion worth of foreign exchange reserves. The reserve adequacy ratios have been assessed and it has been found that the accumulation of foreign exchange reserves by India has crossed the minimum required level by substantially a huge margin with respect to most of the indicators.

Keywords: Econometric Modelling, Foreign Exchange Reserves, RBI Intervention

Introduction

The two biggest achievements of India during the 20th century were that of India winning its Independence and crossing the mark of $100 billion in foreign exchange reserves. The RBI gets the credit for placing India in such a strong position in terms of foreign exchange reserves. But RBI now has a new problem, the policymakers are being questioned whether the existing amount of reserves have grown in excess compared to what actually is required and stern questions are being raised about using these reserves for the development of the country.

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Over the past two decades, especially after the East Asian crisis of 1997, there has been an upsurge in the accretion of foreign exchange reserves more so by the developing economies. Foreign exchange reserves are used to stabilize the exchange rate and monetary policies in compliance with the monetary authority's objective of safeguarding the stability of the currency. The management of enormous reserves and the cost associated with the holding of these reserves are the major challenges encountered by the monetary authorities of developing countries. As an emerging economy, for the past few years, India has amassed enormous amounts of foreign exchange reserves. India holds close to $400 billion of FOREX reserves and currently occupies ninth spot in the holding of foreign exchange reserves.

Sound reserve management practices are very much necessary as they can raise a country's overall resilience to the jolts and blows arising in the foreign exchange market. The significance of rigorous reserve management practices have been highlighted by numerous instances where feeble or risky reserve management practices have limited the ability of the authorities to respond efficiently to financial crises, which may have aggravated the severity of these crises. Also risky or weak reserve management practices can have major reputational and financial costs.

Amassing foreign exchange reserves much above the required level is a 'problem of plenty'. This 'problem of plenty' is a pleasant problem to have as there are plenty of options to put these reserves to use in such a manner that it can help in strengthening the external sector and the overall economy. This problem remains pleasant only until it does not have a detrimental impact on the economy. This problem of plenty becomes unpleasant if it begins to have a deleterious effect on the fundamentals of the economy. This calls for the monetary authority to intervene. The central bank must manage the reserves in such a manner that the adequacy of reserves is maintained and there is optimum utilization of reserves.

The Objectives of the Study are Three-Fold

- To analyze the accumulation, adequacy and utilization of India's foreign exchange reserves.
- To find the factors for hoarding foreign exchange reserves.
- To empirically assess the effectiveness of RBI's intervention operations in India's foreign exchange market.

The next section discusses the evolution of India's foreign exchange reserve management over the years. The subsequent section presents, from the existing wealth of literature, issues relating to the effectiveness of intervention operations and also adequacy and need for hoarding foreign exchange reserves. Empirical findings regarding the need for hoarding foreign exchange reserves and the intervention operations of the RBI is presented in the subsequent section. Also the accumulation, adequacy and utilization of India's foreign exchange reserves have been discussed in this section. Finally, the last section presents the conclusions drawn from the study and also certain policy implications.

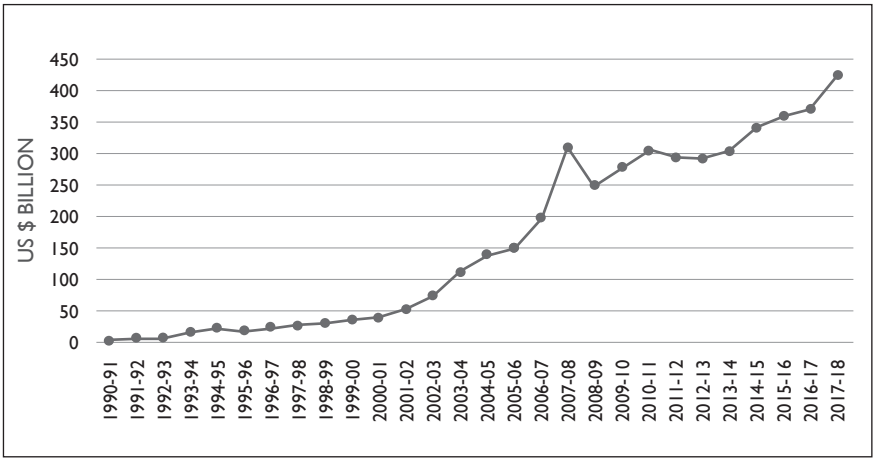
Evolution of India's Foreign Exchange Reserve Management

The process of foreign exchange reserves management ensures that management entity have requisite amount of foreign assets which is easily available and is

in control of entities, so as to meet extensive objectives of an economy. It's the responsibility of the reserves management entity to look after the management of reserves and the risk associated with this. The reserves management has gained due importance in recent time due to various factors like (a) the arrival of Euro currency as a substitute/ an alternative currency to US dollar thereby reducing the dominance of US dollar, (b) switching or moving away from the existing exchange rate regimes, (c) dynamic prospective on adequacy of reserves and its function in prevention of crisis. The reserve management is receiving due importance which is evident from the fact that there is more stress on unambiguity, answerability in multiple forums and most important the recent suggestion provided/issued by IMF for reserve management.

Prior to BOP crisis 1991 India was an inward looking country. The BOP crisis has laid down the path for India to open the gate of its economic frontiers. The current and capital account was also liberalised slowly and carefully in 1994. The following figure unveils the accretion in foreign exchange reserves post the reform period. The graph displays that there has been continuous increase in India's reserves since the beginning of 21st century except for 2007-08, as we know that during that period Global Financial Crisis had set in leading to decrease in India's reserves, and ever since reserves have been on a continuous rise.

Graph-1: India's Foreign Exchange Reserves



Sources: RBI Handbook of Statistics

The accretion of foreign exchange reserves in India has been a key spectacle in the post-1991 period. The foreign exchange reserves rose from close to zero to $20 billion in 1995 and then to $75 billion in 2002 with a rise of roughly 10% of GDP. India is now the ninth largest holder of international reserves in the world. While reserves accumulation was seldom done by using debt inflows, for the major part, it was linked with stable external debt.

In 2002-03 alone, India accumulated close to $20 billion of foreign exchange reserves. This scale of accretion to forex reserves is an exceptional phenomenon when related with India's historical experience. In India's case, some of the growth in reserves during 2002-03 was due to the appreciation of the Euro and the Japanese Yen against the USD. However, foreign exchange intervention

by the RBI was the chief reason for the accretion of reserves during 2002-03. According to RBI data, out of $20.8 billion that were added to reserves during April-December 2002, $3.8 billion were added due to valuation changes, while $13.3 billion signify capital inflows and 3.7 the current account surplus. Indian policy makers have taken into account changes in indicators of reserve adequacy. In 1997, the Report of the Committee on Capital account Convertibility under the chairmanship of S.S. Tarapore suggested four alternative measures of adequacy of reserves, which in addition to trade- based indicators, also included money-based and debt-based indicators.

Review of Literature

Intervention operations of the monetary authorities could be effective in containing the volatility of the exchange rates. The study carried out by Sitikantha Pattnaik, Satyananda Sahoo, Amit Kulkarni, N. K. Unnikrishnan, P.R. Ravi Roshan, H.K. Behra, V. Narasimhan, K.N. Murty, Michael Debabrata Patra and Sitikantha Pattnaik indicate that the intervention operations of the RBI have been effective in containing the exchange rate volatility of the Indian Rupee. However, the empirical results of Sumon Kumar Bhaumik and Hiranya Mukhopadhyay study indicates that the impact of the RBI's intervention in the forex market is at best ambiguous. Ashima Goyal, R. Ayyapan Nair and Amresh Samantaraya carried out a study to test the effectiveness of intervention operations of the RBI and found that the intervention affects both the levels as well the volatility of the exchange rate. According to them since intervention affects both the volatility and also the levels of exchange rate, an independent exchange rate policy is achievable. Indrani Chakraborty remarks that since 1993, the changes in the real exchange rate in India were primarily due to the intervention in the foreign exchange market by the RBI.

India holds reserves far in excess of what is actually necessary. The reserve holding in India has crossed the almost all the adequacy ratios. The same is felt by Suvojit Lahiri Chakravarty and Sanjay Sehgal after they obtained the results from their respective studies on the adequacy of reserves in India. Prabeesh. K. P opines that holding excess reserves is a costly affair as there is an opportunity cost associated with alternative uses.

Researchers across the globe have used several different models to determine the variables that have significant influence on the foreign exchange reserve holdings. They are called the determinants of the dependent variable. Abhijit Sen concludes that the most significant variables that affect the foreign exchange reserve holdings are economic size, current account openness, the degree of financial liberalization, exchange rate regime and financial depth. Gab je jo from his study comes to the conclusion that the above variables, more or less, determine the need for hoarding forex reserves. The determinants of foreign exchange reserves have been estimated by Donghyun Park and Gemma B. Estrada and the result that they get are in accord with the literature. They find that the variables that play a significant role as the determining factor of foreign exchange reserve holdings are size of the economy, vulnerability in the current account vulnerability, flexibility in the exchange rate, GDP Per capita. Aizenman and Marion believe that governments tend to hold large stocks of reserves if the people are loss averse.

Empirical Analysis

The variables taken under consideration are taken in log form in order to measure the order of elasticity. The exercise is to empirically test the relationship of the independent variable with the dependent variable in the long run. Before verifying the economic relationships using ordinary least Squares (OLS) method, it is required to check for the stationarity of the variables under consideration. Many economic and financial variables based on time series data exhibit certain trend and pattern or non-stationarity in the mean. Hence it is necessary to make the data stationary by removing the pattern and trend from the data. It is done through the Augmented Dickey Fuller Test. Also to avoid spurious regression it is necessary to check the time series data for stationarity using unit root tests.

With this as the motive, unit root test has been carried out for each of the series using Augmented Dickey-Fuller test. The null hypothesis of this test is that the series has a unit root. The null hypothesis of the non-stationary is rejected if the t-statistic is less than the critical value. The result of the ADF test for all the variables is given below.

Table-1: Results of Augmented Dickey-Fuller Test

Variables	Levels	1St Difference	Inference Stationary at
LnRES		-5.202892*	I(1)
LnEXR	-4.417142*		I(0)
LnTD		-7.279904*	I(1)
LnGDP		-5.057763*	I(1)
LnOPEN		-3.233910***	I(1)
LnSALE	-5.891842*		I(0)
LnPURCHASE	-6.984078*		I(0)

Source: - author's calculation

*τ-values significant at 1%, 5% and 10% level of significance *, **, *** Critical τ-values: 1%= -4.3743, 5%= -3.6032, 10%= -3.2380*

The result of the ADF test indicates that sale and purchase of dollars and exchange rate are at stationary levels at 1% level of significance. Trade Deficit, reserves and GDP are stationary at first difference I(1) at 1% level of significance. Openness is also stationary at first difference but at 10% level of significance. Stationarity indicates that mean, variance and autocovariance of the individual series is time invariant.

Major Factors for Hoarding Foreign Exchange Reserves

After having satisfactory results of the unit root test for all the variables and making sure that all the variables are stationary, emphasis now shifts in trying to understand the need for hoarding foreign exchange reserves.

Foreign Reserves = f (GDP, Trade Deficit, Exchange Rate, Openness)
(+) (–) (–) (+)

Equation I

This equation analyses the factors determining the need for hoarding reserves.

$$D(LnRES) = 1.3973 + 0.8202*D(LnGDP) - 0.1398*D(LnTD) - 0.3395*LnEXR + 0.2815*DUM$$
$$(3.82) \quad (2.33) \quad (-2.26) \quad (-3.47)$$

Adj. $R^2 = 0.68$ D–W Stat. = 1.87

The results obtained above shows a significant relationship among the variables which is in accordance with the theory. About 68% of the variations in the dependent variable are explained by the independent variables. The explanatory variables taken in this equation are exchange rate, trade deficit and GDP. Stabilizing the exchange rate is considered to be the most significant factor in terms of hoarding foreign exchange reserves from this equation. This is shown by the t-statistic (mentioned in parentheses) of trade deficit which is the highest among all the t-statistics of the explanatory variables. All the t-values of the other variables are significant in the model. The coefficient of GDP shows that for a percentage of change in the level of economic activity there is 0.82% change in the hoarding of foreign exchange reserves. In the same way the RBI hoards foreign exchange reserves to finance the trade deficit. The F-statistic of 14.11 shows that the overall model is good. Dummies have been used for the years 1993, 1995, 2002 and 2008.

The reason for using dummy for the years 1993 and 1995 is that the process of opening up of the economy had just taken place and the foreign exchange market was still at an infant stage. It was still in the stage of evolution. There was no stability in the forex market. Also the year 1995 witnessed the first major episode of volatility in the wake of the Mexican crisis when volatility touched a level of 13% - 14%. During the period 2001-2004, the current account witnessed a surplus. There was heavy inflow of foreign exchange reserves. In the year 2008, the Indian economy too faced the repercussions of the Global Financial Crisis which was considered one of the worst since the Great Depression of 1929. Thus dummies have been used for these years.

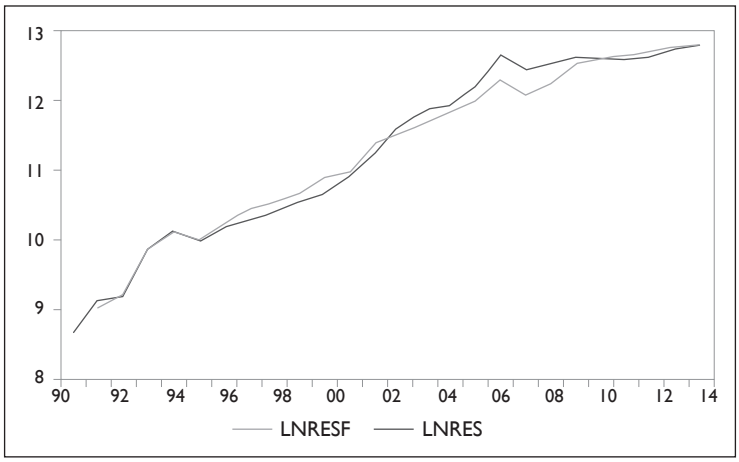
Apart from estimating the equations, the In-Sample Forecast has also been conducted to test the usefulness and robustness of the model. This technique is used to forecast the dependent variable and compare it with the actual data to see how much the model is able to capture the reality. It also shows whether this model can be used to forecast in the future or not. The two important forecast error statistics are Root Mean Square Error (RMSE) and Theil's Inequality Coefficient (TIC).

In terms of RMSE the smaller the error the better the forecast ability of the model. Typically, this value should be less than 3. In the above model the RMSE is 0.1555. This indicates a good forecasting ability of the model.

TIC studies the predictive ability of the model. This value should typically be less than 1. In the above model the TIC is 0.0068 which is much less than the threshold value. This implies that the forecasted series of the model is close to the actual data. In the Figure above, the blue line represents the forecasted output and the red line represents the actual data. The figure shows that there isn't much gap between the two lines. This indicates that the model is much closer to accuracy in

forecasting the trend of the variable foreign exchange reserves given the data of the other explanatory variables.

Graph-2: In–Sample Forecast of Equation I



Source: Author's calculation

RMSE = 0.1555 TIC – 0.0068

Having identified an accurate and efficient model for forecasting, the model should be assessed for its stability. A model can be called stable if it can be applied to different samples from the same population without losing any accuracy of the model.

The next figure shows the results of the stability test that was run for the Equation I. This shows that the residuals are well within the limit of ± 2 S.E. From this it can be concluded that the explanatory variables i.e. GDP, exchange rate and Trade Deficit will continue to influence the foreign exchange reserves of India in the long run. It can also be seen that the model is stable and can be applied to other samples from the same population with no effect on the accuracy.

Graph-3: Stability Test for Equation I

Source: Author's calculation

Next, the factors responsible for hoarding reserves are analysed by taking into consideration the economic openness of India. This indicates the amount of integration India has with the rest of the world. To analyse the impact of openness on the hoarding of reserves, the variable openness has been chosen in place of GDP. The other variables are the same as in the previous equation.

Equation II

This equation analyses the factors determining the need for hoarding reserves by taking openness as one of the independent variables.

$$D(LnRES) = 1.1587 + 0.4742*D(LnOPEN) - 0.1375*D(LnTD) - 0.2676*LnEXR + 0.2800*DUM$$

(2.82) (1.78) (-3.28) (-2.47)

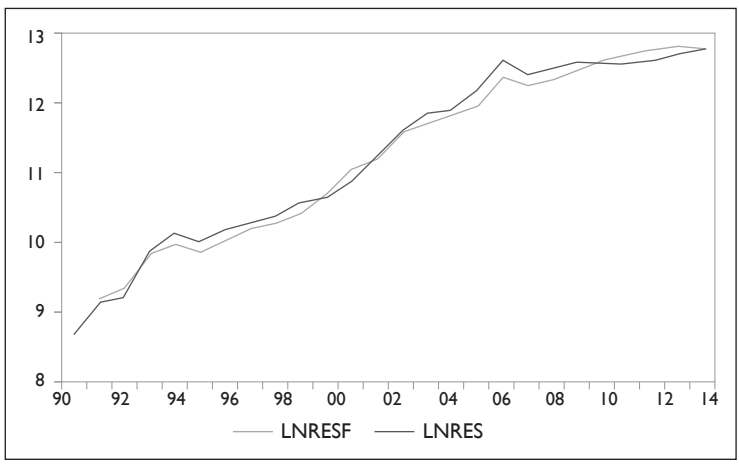
Adj. $R^2 = 0.68$ D–W Stat. = 1.80

About 68% of the variations in the dependent variable are explained by the independent variables. The explanatory variables taken in this equation are openness, trade deficit and exchange rate. To finance trade deficit is considered to be the most significant factor in terms of hoarding foreign exchange reserves. This is shown by the t–statistic of trade deficit which is the highest among all the t–statistics of the explanatory variables. All the t–values of the other variables are significant in the model. The F–statistic of 13.96 shows that the overall model is good. The Durbin –Watson statistic of 1.80 indicates that there is acceptable level of autocorrelation in the model. Same dummy variable has been used as was used in the case of Equation I.

In–Sample Forecast has also been conducted to test the usefulness and robustness of the model. The next figure shows the forecast ability of the model.

In the above model the RMSE is 0.1301. This indicates a good forecasting ability of the model. Also the TIC is 0.0057 which is much less than the threshold value. This implies that the forecasted series of the model is close to the actual data.

Graph-4: In-Sample Forecast for Equation II



Source: Author's calculation

RMSE = 0.1301 TIC – 0.0057

This figure shows that there isn't much gap between the two lines. This indicates that the model is much closer to accuracy in forecasting the trend of the variable foreign exchange reserves given the data of the other explanatory variables i.e. exchange rate, trade deficit and capital openness.

Stability test was conducted for Equation II. The next figure indicates the results of the stability test. This figure shows that the residuals are well within the limit of ± 2 S.E.

Graph-5: Stability Test for Equation II

Recursive Residuals ± 2 S.E.

Source: Author's calculation

From this it can be concluded that the explanatory variables i.e. trade deficit, exchange rate and Openness will continue to influence the foreign exchange reserve holdings of India in the long run. It can also be seen that the model is stable and can be applied to other samples from the same population with no effect on the accuracy.

From the analysis of the two equations above, it can be inferred that the two most significant factors responsible for hoarding foreign exchange reserves are exchange rate and trade deficit. As the currency depreciates, the need for hoarding reserves increases. This is due to the reason that as the rupee depreciates continuously, the RBI would intervene in the foreign exchange market by selling foreign currency in the market thereby preventing the rupee from further depreciating. Also as the trade deficit widens, it becomes necessary for the RBI to hoard more foreign exchange reserves. India being a net importer can use these reserves to finance the deficits arising from trade when there is not enough inflow of capital from other countries.

Effectiveness of Direct Intervention by the RBI

Intervention which is the official sale and purchase of foreign currencies by the monetary authority could be of two types – direct intervention or indirect intervention. These measures have an important role to play in the direction of the exchange rate. Indirect interventions are those that influence the exchange rate indirectly whereas the direct interventions influence the exchange rate directly.

Depending on whether this sale or purchase would impact the monetary base or not, currency interventions could be distinguished between sterilized interventions and non-sterilized interventions. A non-sterilized intervention is a policy that alters the monetary base. Sterilized intervention is a policy that aims at influencing the exchange rate without changing the monetary base. They do not influence the exchange rate through monetary disequilibrium. Only the impact of direct intervention on the exchange rate has been considered for the analysis.

At times there is excessive capital flow into the economy. This excessive inflow of capital would cause the rupee to appreciate i.e. the exchange rate to fall. This appreciation of the rupee would hurt the sentiments of the exporters and would lead to a fall in the exports. To protect the interest of the exporters, the RBI would intervene into the market by purchasing the excess foreign currency from the market. This would lead the rupee to depreciate and the exchange rate would return to normal. Thus an increase in the purchase of foreign currency from the market would lead the exchange rate to rise. Hence there is a positive relationship between the purchase of foreign currency and the exchange rate.

On the contrary when there are excessive capital reversals, the rupee would depreciate leading the exchange rate to rise. To stop the rupee from further depreciating, the RBI would intervene in the market by selling foreign currency. As a result, the rupee would appreciate and the exchange rate would return to normal again. Hence an increase in the sale of foreign currency would cause the exchange rate to fall. Thus there is a negative relationship between the sale of foreign currency and the exchange rate.

The economic relation between the sale and purchase of foreign currency by the RBI and its impact on the exchange rate can be established through the estimation of the following two equations.

Effectiveness of Sale of Dollars by the RBI on the Exchange Rate

This equation analyses the effectiveness of sale of dollars by RBI on the exchange rate.

$$D(LnER) = 0.0223 - 0.0029*LnSALE(-1) + 0.0260*DUM$$

(2.05) (-1.98)

Adj. $R^2 = 0.15$ D-W Stat. = 1.78

The explained variable is exchange rate and the explanatory variable is the sale of dollars. The model is in accordance with the theory, i.e. the exchange rate and the sale of dollars have a negative relation. There is only one explanatory variable which is statistically and equally significant to explain the dependent variable. It is evident from the analysis that there is a lagged relationship of 1 period between exchange rate and sale of dollars. This implies that the sale of dollars in the economy takes a lag of 1 period to have a significant impact on the exchange rate. Around 15% of the variations in the exchange rate are explained by the sale of dollars in the foreign exchange market. More than the intervention, it is the macroeconomic policy variables which have a greater impact on the exchange rate. This is the main reason for the independent variable to explain only 15% of the variations in the

dependent variable. Another reason for this could be that interventions are resorted to only during occasional phases of strong and extreme exchange market pressures and not on a regular basis. D-W Statistics of 1.78 shows that there is low level of autocorrelation among the disturbance terms involved in the model. A dummy variable is used to capture the abnormal fluctuations arising in the model.

Dummies were used for the months of December 1997, June, July, August and September 1998, July, August, September and November 2008, June, July and August 2013. December 1997 was the month during which there was excessive volatility in the exchange rate in the wake of outbreak of East Asian Crisis. Improved stint of volatility appeared in June 1998 on the back of excessive uncertainties originating from the spread of the crisis, and certain other industrialized countries, downgrading of India's rating by international rating agencies and reduction in investments by FIIs. During the above mentioned months of 2008 there was excessive volatility in the exchange rate due to the Global Financial Crisis. During the above mentioned months of 2013 there were fears of Quantitative Easing due to the announcements made by Federal Reserve chairman Ben Bernanke. There was a substantial slowdown in the capital Inflows and as a result the rupee experienced significant depreciating pressure from the second half of May 2013 where the rupee depreciated sharply by around 19.4% against the US dollar between May 22, 2013 when it stood at ₹55.4 per US dollar and August 28, 2013 when it touched historic low of ₹68.85 per US dollar.

Effectiveness of Purchase of Dollars by the RBI on the Exchange Rate

This equation analyses the effectiveness of purchase of dollars by the RBI on the exchange rate.

$$D(LnER) = -0.0142 + 0.0019*LnPURCHASE(-3) + 0.0367*DUM$$

(-2.00) (2.10)

Adj. $R^2 = 0.29$ D-W Stat. = 1.87

The explained variable is exchange rate and the explanatory variable is purchase of dollars. The model is in accordance with the theory, i.e. the exchange rate and the purchase of dollars have a positive relation. It is evident from the analysis that there is a lagged relationship of 3 periods between exchange rate and purchase of dollars. This implies that the purchase of dollars in the economy takes a lag of 3 periods to have a substantial influence on the exchange rate. Around 29% of the variations in the exchange rate is explained by the purchase of dollars from the foreign exchange market. D–W Statistics of 1.87 implies that there is acceptable level of autocorrelation among the disturbance terms in the model. The same dummy variable is used as in case of sale of dollars to explain the abnormal fluctuations.

Utilization of Reserves

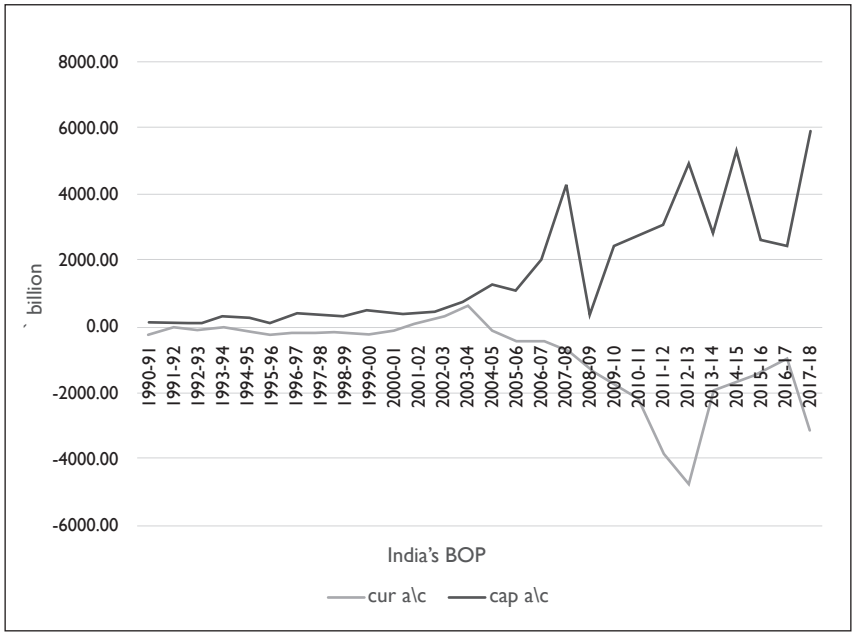
India's foreign exchange reserves have grown healthily over the last two decades and are in a way a reflection of India's success as an economy. With close to $360 billion India's coffers are enormously padded to challenge any crisis coming its way. But what is unacceptable is that the RBI is reluctant to put to use these reserves in resourceful ways. Given the pace with which reserves are increasing, a portion of India's reserves can be utilized to invest in the capital deficit sectors of the economy, especially in social sectors and infrastructure. The returns in these sectors may be higher than what the RBI gets from foreign treasuries and thus imposing another social opportunity cost of holding the foreign reserves. These investments in the social sectors may help to raise the economy's absorptive capacity and can also help in the sustenance of higher growth rates. Especially investing some bit of these reserves for the improvement of agriculture sector and manufacturing productivity or for rural development and urbanization can have a tremendous impact on the growth rates of the economy. A share of the forex reserves can also be used for the investments in the education sector. Education sector in India is a strong pillar of the economy and thus utilization of these reserves in the education sector could possibly transform the country into a knowledge haven and in turn boost the growth prospects of the nation.

The Singaporean pattern of enhancing the return on investment can be pursued in India only if the reserves are huge in comparison to the size of the economy and the liquidity of investments is not the prime reason for amassing reserves. There is significant consensus that the improvements in India's infrastructure would have a strong influence on the GDP growth. The infrastructure sector in India covers communications, electricity, transportation and many other services like water supply, sanitation, solid waste management, etc. But there are certain issues and concerns that have to be looked into before the foreign exchange reserves can be used to finance infrastructure.

But, since the prime objective in amassing foreign exchange reserves is the precautionary motive with liquidity as a major feature, it is not appropriate to utilize reserves for financing infrastructure projects or for strengthening the financial system. Moreover, infrastructure projects in India have long gestation periods and usually need considerable amount of investment but yield relatively low returns owing to low user charges in India, out-of-date labour laws and inefficient technology. Most literature with regard to adequacy of reserves concludes that India has surpassed almost all the measures of reserve adequacy and is in a position to rest in more or less a protected zone. But if one analyses the situation from a macroeconomic perspective, the utilization of reserves for purposes such as infrastructure development, providing support to the financial institutions, etc. would not sound convincing. This is purely due to the unpredictability of future uncertainties.

Analyzing the trends in the current account and capital account of India's Balance of Payments (BOP) it is found that the current account has always been in negative figures barring the years 2001-02 – 2003-04. On the other hand, the capital account has remained positive.

Graph-6: Trends in Current and Capital Accounts



Source: - RBI – Handbook of Statistics

Both the current account and the capital account have remained stable for several years. The deficit in the current account over the years was being financed by the capital account. This was possible only for the reason that the capital account itself was stable. It is due to this extended help by the capital account that India has a favourable BOP.

The graph shows that there has been excessive volatility in the current account over the last decade. Not only is there volatility in the current account but even the capital account exhibits extreme volatility during the same period.

Since the capital account itself exhibits excessive volatility, relying on the capital account for financing the deficits in the current account would be deleterious for the economy at large. Reserves as a result could thus be used for funding the deficits in the current account. Therefore, utilization of reserves for various other purposes could be detrimental for the economy as a whole.

Adequacy of Reserves

Adequacy in terms of foreign exchange reserves can be seen as an essential part of exchange rate policy of any economy functioning under a managed exchange rate. Adequacy of reserves have arisen as a significant factor in judging the economy's capability to absorb external jolts. Many countries do not have any set targets for accretion of foreign exchange reserves. It is however difficult to determine what an optimal level of reserve a country should amass. Different researchers have arrived at various models to ascertain the adequacy of foreign exchange reserves. Typically, the policy makers of an economy follow a set of broad indicators to decide on what should be the adequate level of reserves an economy should hold.

Table-2: Benchmark Comparison of Reserve Adequacy Ratios

Parameters	Reserves-To-Import	Reserves-To-Sted	Reserves-To-M3
Ideal Benchmark	3-4 Months	100%	15% - 20%
India's Position In 2015-16	11.48 Months	405.99%	19.26%

Source: - author's calculation

With respect to India, the economy of India has experienced a very eventful transformation from an extremely regulated economy to a one which is more market-oriented. The economic impact of this transformation has been so exceptional that a crisis hit economy which was unable to finance three weeks of imports and had amassed such a huge stock of reserves that it could now fund around 11 months of imports.

Reserve adequacy has been analysed with respect to three broad indicators namely Reserves to Import ratio (R/M), Reserves to Short Term External Debt ratio (R/STED) and Reserves to Broad Money ratio (R/M3). India's Reserves to Import ratio at end-March 2016 was 11.48, i.e., India has sufficient amount of foreign exchange reserves to finance more than 11 months of imports. Reserves to Short Term External Debt ratio at end-March 2016 was 405.99%. This is more than 4 times the minimum required level. With respect to Reserves to Broad Money, the ratio was 19.26%.

From the above table it can be observed that apart from the R/M3 ratio which is within the ideal level, the other two ratios are much beyond the ideal benchmark. This analysis of reserve adequacy indicates that the existing stock of foreign exchange reserves has crossed the minimum required level by a substantially huge margin.

The foreign exchange reserves exchange reserves must be deployed appropriately such that the cost of hoarding these reserves is minimized to the maximum extent possible. In India's case, a share of the foreign exchange reserves can be utilized for infrastructure development and also for social sector enhancement. Emulating other countries in terms of utilization of foreign exchange reserves could be injurious to the economy as India, it may not have amassed these reserves to the extent that other countries have. Bearing in mind the recent volatility in the capital account, which is used to finance the current account, the policy makers must use their discretion in deploying these reserves.

Conclusion

As the custodian of foreign exchange reserves, the RBI's main objectives are to ensure liquidity, safety and yield on deployment of reserves. In considering the management of reserves, the benefits and costs of holding reserves are constantly assessed.

The RBI has done a phenomenal job with respect to the management of foreign exchange reserves in the recent past. On 28th August 2013, the exchange rate tumbled to its all-time low of ₹68.85 per dollar. The rupee had been on a depreciation spree. But with Raghuram Rajan taking over the reins of the apex bank, the situation came under control. To bring stability to the wobbly exchange

rate, the RBI introduced a swap deal between September 2013 and November 2013 that was meant to encourage banks to attract sizeable dollar inflows in the form of FCNR(B) deposits. At the end of 3 years this would be redeemed. The policy makers were under the impression that this redemption of FCNR(B) bonds would lead to the depletion of the foreign exchange reserves, burning a hole in the reserve coffers of the nation. The redemptions were met with no significant hiccups. The FCNR(B) redemption has been well managed and India has close to $360 billion of reserves.

There are certain policy implications which can be drawn from this study. Firstly, stabilizing the exchange rate and financing the deficit arising from trade are the most significant reasons for hoarding foreign exchange reserves. Accretion of reserves far in excess of the need could be harmful for the economy. The study shows that India holds forex reserves far in excess of the adequacy requirements.

With respect to the intervention operations of the RBI, the study shows that both the sale and purchase of dollars have an impact on the exchange rate in terms of smoothening the volatility. The RBI must hold sufficient amount of forex reserves for meeting its intervention operations. Utilization of reserves is as important as accumulating them. Idle reserves do not yield any returns but rather cause damage to the economy. Foreign exchange reserves could be utilized for improving the social sectors such as the education sector or they could be utilized for infrastructural developments. But keeping in view the of late volatility in the capital account, these reserves must be appropriately deployed only after keeping aside a share to finance the deficits in the current account.

The story of India's foreign exchange reserves has undeniably been a dream affair. This is one such dream which the Reserve Bank of India and various other policy makers would like to live for eternity. Unanticipated situations might lead the Indian economy to tread a challenging path or it might well happen that India, following its growth pattern from the last decade, could usher in a successful era. Whatever the situation might be, India, at this point in time, is in a place to define its own future. Instead of sitting idle and enjoying this position, India has to take a stand with respect to what it wants to do with the foreign exchange reserve situation.

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Phillips Curve Estimation: Accounting Qualitative and Quantitative Expectations

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Abstract

A number of studies have been conducted to examine the existence of Phillips curve for India however; most of the studies have argued that the Phillips curve exists but only in the short run and that too after controlling for supply shocks. It is not only the past values of inflation that are crucial for the determination of inflation but the forward looking inflation expectations play an equally important role. However, most of the studies that have been conducted till now have only focused on the quantitative estimates of the inflation expectations. In this context, this paper attempts to estimate a different series of inflation expectations that have been generated by accounting qualitative estimates of expectations along with the quantitative figures. Empirical findings show the evidence of the existence of the NKPC for India. The results also indicate a significant role of inflation expectations in affecting inflation, thus providing credibility to monetary policy making.

Keywords: Inflation Expectation, Output Gap, Phillips Curve

Introduction

One of the most significant parts of economic activities of a nation is controlling the inflation. The unrestrained rise in the prices may lead to hyperinflation and on the other hand excessive fall in prices may lead to deflation. Both are not good signs for the overall growth and development of a country's economy. The most powerful tool 'inflation' promotes high employment and growth along with financial stability by focusing on the goal of price stability. Well anchored inflation enables labor and product market to function more smoothly in face of shocks thus protecting the economy from low output and employment phase. It is very important for the central banks to stabilize inflation as low inflation and well anchored inflation expectations have enhanced the ability to respond to declines in output growth and financial upsets that have occurred and it has been observed for various economies.

The crucial relation between inflation and unemployment or output gap has been well defined by the Phillips curve. The Phillips curve underpins how decision

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makers or the central banks think or respond to inflation. The assessment of inflation, both forward and backward looking is important for an effective conduct and formulation of monetary policy. A lot of studies undertaken have been successful in exploring the relationship between inflation and economic activity both in India and across countries.

However, no study have been successful in explaining this relationship for the long run and mainly focus that a Phillips curve does exists only for the short run.

In India, majority of the studies have been on wholesale price index (WPI) as an indicator of inflation. Some of the studies have taken consumer price index (CPI) into account and more specifically have modeled CPI for industrial workers (CPI-IW). This paper also models CPI-IW as inflation and attempts to draw the relationship between inflation and output gap with forward looking inflation expectations.

This paper differs from previous studies in the following terms. First, we know that there is large number of uncertainty about the estimation of the output gap. We have thus estimated the output gap using four different approaches in order to examine the NKPC. Second, we have used a different set of inflation expectation series that accounts for both the quantitative responses and the quantified expectations from the qualitative forecasts. This has been done since the qualitative forecasts track the actual inflation better than the quantitative forecasts. Thirdly, since the supply shock variables along with the demand shock variables affect the inflation, we have modeled three different such variables. This has been done to examine the impact and extent of different supply shock variables on inflation. Finally, to deduce the robustness of estimated parameters, we have modeled the traditional Phillips curve, pure NKPC and hybrid NKPC (all with and without supply shocks).

The structure of the paper is as follows: The next section presents a brief review of the studies on Phillips curve both in India and across nations so far. A brief discussion about the methodology involved and description about the data is explained in the section titled "Methodology". This is followed by the section titled "Empirical Analysis" which discusses the empirical findings and its analyses. Lastly, the concluding remarks along with few policy implications are presented in the final section.

Literature Review

The big debate about what solves for the price level or the inflation rate could not be answered by Keynesian model as it could not solve for the inflation rate completely. A.W. Philllips in 1958 then came up with a negative relationship between growth rate of nominal wage rate and the unemployment rate which came to be known as the famous Phillips Curve (PC) that solved for the inflation rate. Similar to what Phillips did, the US data was also studied and was discussed by Samuelson and Solow (1960). Both of them used time series data for inflation and unemployment rate and came to the result that by tolerating a high average rate of inflation society could lower the average level of unemployment thus concluding a permanent or long run trade off between inflation and unemployment. The framework put up by them faced a lot of questions because it could not pass the empirical evidence tests due to model miss-specifications.

Friedman and Phelps (1968) pointed that the original Phillips curve had problems. Due to the rational nature of agents they would base their decision on how much labor output to supply depending upon the basis of anticipated real wage and not on the actual real wage leading to no long run impact of inflation and thus unemployment. Friedman and Phelps formulated this through adaptive expectations and ignored rational expectations. Due to adaptive expectations, the model put by them faced a lot of criticism. Lucas (1972, 1973) extended their model by introducing the concept of rational expectations. He argued that real GDP cannot be changed by anticipated monetary policy in a predictable way and this came to be popularly known as the policy ineffectiveness proposition. Later, Sargent and Wallace (1975) came up with a formal development of the proposition. But by the end of the 1970's Lucas approach was criticized because of the assumptions of the Friedman-Phelps model. The year 1975 is thus considered as a break in history of the Phillips curve with the demise of the short run PC. Around the same time dynamic stochastic disequilibrium approach was put forward by Tobin (1972). He had an entirely different view of the Phillips curve as that put forward by the neo-classical. His point of view was that aggregate nominal demand is the cause for inflation in sectors with full employment but helps in reducing unemployment in the concerned sectors. This pattern was observed to produce the negatively sloped Phillips curve which cannot be possible in a single market economy and due to this he used a multi-sector framework with multi-segmented labor markets to explain the model.

The post 1975 period has two paths; the left side and the right side. The left side is the Keynesian resurrection or the mainstream PC. A new model was developed by Gordon (1975) and Phelps (1978) of policy responses to supply shocks. The Gordon-Phelps model led to the supply shocks being incorporated in the natural rate exceptional PC by 1977. The mainstream specification of the inflation process was similar to this and viewed inflation as having three roots – built in inflation, demand-pull inflation and cost push inflation. This mainstream specification of the inflation became popularly known as the Gordon's Triangle Model. On the other hand, the right side of the post 1975 period emphasized jumps in the expectations in response to policy actions along with absence of backward looking inflation inertia.

Kydland and Prescott in their 1977 paper have clearly distinguished between policy discretions and rules. They showed that inflation rate is higher under discretionary policy rather than that under a rules based policy. This approach is important in knowing the relationship between inflation and unemployment because many economists began with the assumption that choices made under discretionary policy would make the PC to shift and change policy options. Thus without prior knowledge about the position of the PC it would yield to persistently high inflation outcomes. This model also had a lot of loopholes and problems associated with it. Thus, to retain the rational expectations but at the same time generate short run net neutrality of macro policies, Keynesians had to strike back.

Stan Fischer (1977) introduced the concept of overlapping non-contingent wage contracts so as to come up with a model which results in the break-down of the policy neutrality result. He introduced the Fischer overlapping wage contract PC. Later, J.Rotemberg (1982) and Calvo (1983) through their quadratic adjustment cost model came up with the Calvo Rotemberg PC. This PC related the current

inflation with expectations of future inflation and the real marginal cost of production. Since there is no data available for real marginal cost of production, we proxy it with output gap. Thus, the relation of inflation is now with expectation of future inflation and output gap and this is known as the New Keynesian Phillips Curve (NKPC). The NKPC considers only forward looking inflation inertia and ignores the backward looking inertia. Many macroeconomists have come up with different forms of the NKPC by using different proxy measures either for both the gap and real marginal cost. Gali' and Gertler (1999) came up with another kind of PC which they called the hybrid NKPC which had both the forward looking and backward looking agents and current inflation is dependent upon both lagged and future inflation.

An altogether different version of the Phillips curve was proposed by Palley (2003) as the backward bending Phillips curve which has been based on the approach given by Tobin.[1] The backward bending PC is based on the key theoretical assumption of the Tobin approach that nominal wage adjustment is different in labor sector with full employment and one with unemployment. In a multi sector economy, initially the nominal demand growth causes inflation in sectors with full employment and creates jobs in sectors with level of unemployment. However, the workers in the sector with unemployment start indexing their wages thus reducing the grease effect caused by the nominal demand growth. The grease effect is eroded as the inflation is increased in these sectors because workers with unemployment start resisting real wage reduction. Thus adding more of nominal demand growth which causes inflation is outweighed by the indexation by the workers thus making the PC bend backward at some stage. Inflation is pushed to such a high level that all workers are indexing making the Phillips curve to eventually become vertical.

Another version of the NKPC as the closed form of NKPC was estimated by Sbordone (2002) with just pure forward-looking model estimates. He proposed the testing of relative importance of forward versus backward looking behavior. Rudd and Whelan (2005) also examined similar results but using a very different methodology. They questioned the work of Gali' and Gertler (1999) and tested that forward- looking behavior have very low power against the alternative backward-looking behavior. They also presented that the previous results interpreted for NKPC are also consistent with backward-looking PC. The results matched with those of Fuhrer (1997) where he tested for unimportance of forward-looking component in the inflation process.

On the contrary, Kurmann (2004) estimated the NKPC using maximum likelihood (ML) estimates that indicated the important role of forward-looking behavior. He used labor income share as a proxy for the real marginal cost to estimate the NKPC. In order to get robust estimates of parameters of NKPC, Linde' (2005) used the full information maximum likelihood procedure. He proposed to use this method because of the non linear nature in the parameters. However, his estimates proved out to be inconsistent with the results in a number of recent papers that have used ML estimates.

1 The backward bending PC is defined to be negative at low levels of inflation that becomes positive at high levels of inflation and finally becomes vertical at even higher levels of inflation.

A number of views have been put up against the estimation of the NKPC as inflation expectations needs to be modeled accurately to come up with robust results. Due to this, some authors have interpreted the production as allowing for non-rational price setting. Thus to augment the NKPC, inflation expectations were specified as a combination of rational and survey expectations. This not only led to an augmented version of NKPC but also lack of dynamic model for inflation expectations which turned out to be a disadvantage. Some papers related to this literature are Nunes (2010), Fuhrer and Olivei (2010) and Fuhrer (2012). Till date a lot of studies have been carried forward to estimate the robustness of the parameters of the Phillips curve or the NKPC in particular. Different versions of these have been put forward to study the exact nature of parameters that influence the inflation of a country so that counter- cyclical monetary actions can be taken to control for inflation.

Empirical Evidence: India

The search for the Phillips curve in India has a long history attached to it. Although the early findings did not find a significant relation between inflation and growth, a horizontal Phillips curve came into light during the late 1900s (Rangarajan 1983; Chatterjee 1989; Dholakia 1990; Ghani 1991). However, the first studies to support the existence of the Phillips curve for India had shown the effect of both demand and supply shocks on inflation (Kapur and Patra, 2000; RBI, 2002, 2004); this did not end here the quest for the essence of the Phillips curve as many findings after this showed the non-existence of a definite relation between inflation and growth. Srinivasan et al. (2006) found an insignificant yet positive coefficient of output gap and thus could not support for the Phillips curve.

The impact of supply shocks have also been well addressed to study the Phillips curve for India and the findings of the studies have been in favor of the Phillips curve. The studies emphasized that not only the demand side factors but the supply side factors also play a major role in determining inflation (Dua and Gaur,2009; Paul,2009; Singh et al.,2011; Mazumder, 2011). The framework behind all these empirical finding however, have not taken into account the explicit role of inflation expectations in influencing inflation. Inflation trends in India have however highlighted the importance of inflation expectations in determining inflation. Patra and Ray (2010) estimated the Phillips curve by taking into account the role of inflation expectations.[2]

Many different range of Phillips curve have been estimated for India and it have been some support for the traditional backward looking PC and purely forward looking NKPC along with the hybrid NKPC using the New Keynesian model framework (Patra and Kapur,2012). Other such studies include Kapur (2013), Patra et al. (2014) and Chowdhury and Sarkar(2016). However, Das (2014) explores alternative interpretations of inflation expectations in explaining inflation in India using a household survey data to examine the nature of households. The results indicate the presence of NKPC in India and also throw light on the important role of forward looking inflation expectations. Not only expectations, but the results also make it clear that both demand and supply side factors play equally important role as drivers of inflation. Very recently, RBI (2017) revisits the issue

2 Instead of using the RBI forecasts for the expectations they generated a monthly inflation series of expectations by modeling the actual inflation and generating a time series of expectations of next period inflation and found support in favor of the Phillips curve.

of the Phillips curve at the sub national level using the CPI-C and CPI-IW as the anchor. The study confirms the conventional Phillips curve for both the core and headline inflation and also affirms the impact of supply side factors on inflation.[3] Overall, the paper finds that demand/supply side factors impact the CPI and thus suggests counter monetary policies to control inflation. In the overall perspective, the recent literature provides adequate support for the existence of the Phillips curve for India.

Methodology

The Phillips curve framework relates inflation to both demand and supply side factors. Demand side pressures are observed through the movements in the output gap whereas the supply factors are captured through shocks from oil price movements, changes in exchange rate and or rainfall patterns during a year, etc. The traditional Phillips curve takes the form; $\pi_t = \alpha\pi_{t-1} + \beta y_t + u_t$; where, π_t and π_{t-1} is inflation of current period and lagged period respectively, y_t is the output gap, u_t is the stochastic error term and α, β are functions of parameters.

The paper attempts to model inflation through CPI-IW core inflation which have been calculated as the CPI-IW basket using weights of all the food and non-food items. Using Calvo-Rotemberg price mechanism the basic NKPC have also been modeled in the paper and is given as; $\pi_t = \alpha E_t(\pi_{t+1}) + \beta y_t + u_t$, $E_t(\pi_{t+1})$ is the expected future inflation at time *t*. In order to account for the persistent nature of lagged inflation, the original NKPC have been modified by inclusion of lagged inflation. This is known as the hybrid-NKPC that includes both the forward looking as well as backward looking inflation component.

The hybrid-NKPC takes the following form: $\pi_t = \alpha\pi_{t-1} + \beta E_t(\pi_{t+1}) + \delta y_t + u_t$, α, β and δ are functions of parameters. As mentioned before, this form of the Phillips curve have been augmented a number of times to include other variables. This paper as well tests for the augmented hybrid NKPC have been estimated by including both demand and supply variables.

Although the choice of variables to be included in the estimation is quite difficult, selection of an appropriate output gap series is challenging itself.[4] However, in practice there is no data of potential output that is available and as a result have to be calculated using various statistical techniques. Thus, to get robust parameters in calculation of the Phillips curve, different methods are used to estimate the output gap. In this paper, four different methods have been used for the calculation of the output gap; Unobserved Component Model (UCM), Hodrick-Prescott (HP) filter, Christiano-Fitzgerald (CF) filter and Baxter-King (BK) filter.

Unobserved Component Model (UCM)

The UCM is a useful concept in filtering, smoothing and signal extraction. UCM tends to explicit modeling of the fluctuations around the trend.[5] The model is

3 Although there have been differences between CPI-C and CPI-IW in the inflationary process, CPI-C Phillips Curve has come out to be flatter than the other.

4 Output gap is an economic measure of the difference between the actual output and the potential output of the economy.

5 The unobserved component time series have a natural state space representation and have its statistics based on the Kalman filter and related methods.

estimated by the maximum likelihood method through the use of Kalman filter algorithm. The key advantage of UCM and underlying state space approach is that all the different components of the time series can be individually modeled and later combined under state space modeling.

UCM method models the potential GDP as a stochastic trend through a random walk process or a local level linear trend model using the actual GDP. In our estimation, we have modeled the log of GDP component using the UCM approach to arrive at the trend component from the series. The trend or the potential output thus obtained has been used to calculate the output gap.

Hodrick-Prescott (HP) Filter

Proposed in 1997 by Hodrick and Prescott, it is the most popular mechanical filter used to identify permanent and cyclical components of a time series. It is widely used to estimate the potential output and thus the output gap. A major take of HP filter above all the techniques of estimating output gap is that it fits a trend line through all the observations regardless of any structural breaks by making the regression coefficients themselves vary over time.[6] This is also denoted as the loss function which is minimized to obtain the trend output.

The most important part of the HP filter is 'λ'- smoothening paramater, as it penalizes the growth pattern. Since we have quarterly data we have used the λ value as 1600. The weight of the smoothening factor not only influences the size of the gap but also the relative scale and timing of peak and trough of trend output as well. Advantage factor of HP filter over others is that it is a simple method and provides a uniform framework that can be applied to different countries in timely manner. Also the stationary is retained for output gap over wide range of smoothening values and allows trend to change over time.

Baxter-King (BK) Filter

BK filter is a band pass filter based on the moving averages that specifies weights and the filter removes the cyclic component from the time series based on this technique. It is a method of smoothing the time series and is a modification over the HP filter.

The method is transparent over the range of frequencies it aims to extract and thus proves to be better than other methods. While calculating the potential output, we faced the problem of trimmed observations and we have mitigated this problem by selecting the smoothing order as 3 years.

The adjusted series thus generated have more observations and as seen in Figure-1 (Appendix); the potential output calculated from this series produces much better business cycles like the GDP than the one with lost values. The adjusted series have an advantage as it have been successful in explaining the sharp rise or fall in the potential output better than the original series.

Christiano-Fitzgerald (CF) Filter

The CF random walk filter is also a band pass filter that was built on the same principles as the BK filter. In the frequency domain it formulates the de-trending

6 The econometrics behind the procedure is that the trend output is fit such that it minimizes the combination of the gap between the actual and trend output at any point of time and the rate of change in trend output at the last point in time.

and smoothing problem. It overcomes the shortcomings of the BK filter as it uses the whole time series for the calculation of each filtered data point.

It is designed to work well on large time series data sets than the latter. Since it is an asymmetric filter it converges in the long run to optimal filter and outperforms the BK filter in real time applications. While calculating the potential output through this filter, we observed some outlier values at the end of the series that could not be explained by any theory. Thus for our estimation process we have ignored 3 of the end values to make the series consistent as per the data. The trimming of the series have been done so as to get the movement of the actual and the trend output in line. The CF adjusted series is obtained from this trimming and have been plotted in Figure-2b (Appendix) which shows that unlike Figure-2a (Appendix) there is no unexplained fall in the potential output at the end of the series.

Data

This paper estimates both the traditional and the hybrid NKPC for empirical applications. We have used core CPI-IW to model inflation. Due to the non availability of weights for both food and non food products in the CPI-IW basket before 2006 (base: 2001=100), the data available for core CPI-IW inflation is from 2007-2017. This data have been collected as year-on-year basis from the Labor Bureau.

The inflations expectations data have been gathered from the series generated in a paper by Das et.al (2018). 7 The expectations of inflations series used both the quantitative data and the quantified qualitative data of peoples' expectations about the inflation.

Apart from these state-specific variables, few supply side shocks variables have been used for the estimation. These include, real effective exchange rate (REER), the growth in crude oil price of the Indian basket in dollar terms and a dummy indicating deficient rainfall during a year. The crude oil basket is obtained from Indian Oil Corporation Limited (IOCL) website. The data for REER, GDP and various other macroeconomic variables are obtained from the handbook of statistics on Indian economy, Reserve Bank of India (RBI). All the variables used in estimation are seasonally adjusted as appropriate and the lags in the model are selected using standard AIC. The variables enter into the model as quarterly data and span the period 2004-2017.

Empirical Analysis

Results of the Estimation of Phillips Curve

The results for the augmented Phillips curve with and without supply shocks are present in Table-1. The potential output is estimated using four different methods as mentioned above. The first column in each panel shows the augmented Phillips curve without supply shocks. The second column estimates the augmented Phillips curve along with various supply shocks.

The estimates for the Phillips curve without the supply shocks do not turn out to be fully in support of the theory. The estimated results show that the coefficient

for the output gap is negative in the case of BK and CF estimates. However, the coefficients are positive and insignificant in case of HP filter thus proving weak result. Only in case of UCM coefficient of output gap is positive and statistically significant.

However the size of the gap coefficient varies across measures.

The coefficient of lagged inflation along with the sum of lagged coefficients around .86 - .92 is positive suggesting that the process of inflation is persistent and is driven by its past values. All this suggest that the traditional Philips curve that considers immediate lag of inflation as an independent variable along with macro parameters proves to be true for our estimates. This leads to the fact that monetary policy actions might affect inflation with lags.

In terms of the effect of supply shocks on the inflation, we have come across mixed estimates. The coefficients of crude oil price have significant impact across the HP, BK and UCM gap models. A 1% increase in the crude oil price brings about 9-10 bps increase in CPI-IW inflation. Although the coefficients for REER are not significant, they too show a negative relation with the inflation i.e an increase in one percentage point in REER would lead to an increase in inflation.

Table-1: Phillips Curve Estimates

Parameters	Potential Output estimated by							
	HP	Filter	BK	Filter	CF	Filter	UCM	
Π_{t-1}	0.798***	.0761***	0.785***	0.758***	0.802***	0.768***	0.794***	0.761***
	(0.142)	(0.149)	(0.151)	(0.154)	(0.142)	(0.146)	(0.139)	(0.148)
Π_{t-2}	0.227	0.276	0.227	0.276	0.240	0.290	0.229	0.287
	(0.318)	(0.338)	(0.314)	(0.337)	(0.314)	(0.333)	(0.321)	(0.345)
Π_{t-3}	-0.143	-0.157	-0.147	-0.158	-0.120	-0.122	-0.144	-0.166
	(0.298)	(0.305)	(0.292)	(0.304)	(0.304)	(0.310)	(0.301)	(0.310)
Output Gap	0.298	0.182	-1.807	-0.875	-2.222	-2.479	0.0487**	0.385**
	(0.772)	(0.899)	(3.619)	(4.000)	(1.662)	(1.719)	(0.488)	(0.715)
Crude Oil		0.00964*		0.00915*		0.00909		0.0101*
		(0.0056)		(0.00503)		(0.00587)		(.00538)
REER		-0.00705		-0.00783		-0.0146		-0.00422
		(0.0171)		(0.0181)		(0.0163)		(0.168)
Rain		-0.703		-0.669		-0.635		-0.866
Dummy		(0.707)		(0.772)		(0.597)		(0.794)
Constant	0.839	0.677	0.999	0.721	0.506	0.217	0.854	0.563
	(0.659)	(0.806)	(0.767)	(0.882)	(0.525)	(0.808)	(0.701)	(0.958)
R^2	.772	.770	.774	.760	.776	.775	.771	.772
Durbin h	.73	-.68	-.85	-.76	-.69	-.74	.83	-.79
N	41	39	38	38	41	39	41	39

Note: Robust standard errors in parentheses- *** p<0.01, ** p<0.05, * p<0.1

Results of the Estimation of New Keynesian Phillips Curve (NKPC)

The empirical results for the estimation of the NKPC for core CPI-IW are present in Table-2. The coefficients of expected inflation are all statistically significant and lie in the range of .37-.73 highlighting the importance of inflation expectations

in influencing the current level of inflation. The coefficient of the output gap is also consistent with the theory but statistically significant only in the case of CF model. The coefficient of the output gap is statistically significant for CF estimates albeit higher at around 1.24 to 1.26. Therefore, empirical results suggest that a 1 percentage point increase in the output gap results in a 1.24-1.26 percentage point increase in inflation and vice versa. However, these estimates turn out to be too high as compared to other studies.

The REER coefficient is estimated to be highly significant for all the models suggesting that appreciation (depreciation) of rupee decreases (increases) inflation. The coefficient of crude oil price is insignificant for most of the cases yet shows positive relation with inflation. However, the impact of deficient rainfall is much higher in most of the cases with an exception for the UCM model. The estimated coefficients however, are insignificant for all the cases. The estimated results for NKPC show that expectations play an important role in influencing the current inflation. Along with this it also reflects the credibility of RBI through higher coefficients of inflation expectations.

Table-2: NKPC Estimates

Parameters	Potential Output estimated by							
	HP Filter		BK Filter		CF Filter		UCM	
$E_t\pi_{t+1}$	0.598***	0.736***	0.584***	0.714***	0.530***	0.676***	0.602***	0.370**
	(0.0912)	(0.0926)	(0.0885)	(0.0903)	(0.0885)	(0.0976)	(0.0896)	(0.139)
Output Gap	0.979	0.222	2.454	1.802	1.267***	1.246*	0.421	0.535
	(1.127)	(1.075)	(4.842)	(4.165)	(2.161)	(2.363)	(0.847)	(0.692)
Crude Oil		0.00860		0.00880		0.0104		0.0100*
		(0.00800)		(0.00795)		(0.00777)		(0.00570)
REER		-0.116***		-0.117***		-0.097**		-0.053*
		(0.0386)		(0.0386)		(0.0356)		(0.0272)
Rain		-0.217		-0.350		-0.0382		0.727
Dummy		(0.652)		(0.643)		(0.599)		(0.578)
Constant	2.702***	1.409*	2.868***	1.690**	3.490***	2.009**	2.588***	0.0963
	(0.649)	(0.753)	(0.626)	(0.700)	(0.605)	(0.806)	(0.634)	(0.875)
R^2	.518	.701	.505	.708	.601	.720	.512	.817
N	36	36	35	35	36	36	36	36

Note: Robust standard errors in parentheses- *** p<0.01, ** p<0.05, * p<0.1

Results of the Estimation of the Hybrid NKPC

The paper also makes an attempt in estimating the hybrid NKPC which estimates inflation as dependent upon both the backward and forward looking inflation. Table-3 depicts the regression results for the hybrid NKPC with and without supply shocks. However, the findings for core CPI-IW inflation are not on the expected lines for all the cases. The output gap however, does not support the theory for some models. Since none of the coefficient is significant there is no evidence of a hybrid NKPC for India in our study.

We have come across some unexplained coefficients of the output gap estimated using BK and CF models. Surprisingly, the sign of coefficient for BK and CF model change sign with the inclusion of supply shocks in the model. It is only under UCM and HP filter that we are able to see positive relation between output gap and inflation but that too is insignificant

The coefficient of lagged inflation and the sum of lagged inflation are significant

and lie in between .53-.66. The important roles of lagged inflation in estimation of the Phillips curve have been prominent through these results. Not only lagged inflation but the inflation expectations also are highly significant throughout the different models. The coefficient for crude oil price shows weak estimates since despite the sign of the coefficient is in line with the theory but they are mostly insignificant. On the other hand, coefficients for REER are statistically significant and as per theoretical knowledge.

Table-3: Hybrid NKPC Estimates

Para meters	Potential Output estimated by							
	HP Filter		BK Filter		CF Filter		UCM	
π_{t-1}	0.682***	0.542***	0.677***	0.522**	0.673***	0.545***	0.682***	0.547***
	(0.190)	(0.180)	(0.193)	(0.190)	(0.188)	(0.179)	(0.190)	(0.185)
π_{t-2}	0.177	0.164	0.182	0.154	0.159	0.170	0.174	0.165
	(0.344)	(0.329)	(0.343)	(0.331)	(0.334)	(0.329)	(0.345)	(0.338)
π_{t-3}	-0.197	-0.178	-0.197	-0.180	-0.223	-0.169	-0.195	-0.174
	(0.305)	(0.287)	(0.301)	(0.285)	(0.344)	(0.316)	(0.309)	(0.291)
$E_t\pi_{t+1}$	0.213*	0.370**	0.210*	0.383**	0.232*	0.365**	0.215*	0.370**
	(0.107)	(0.145)	(0.113)	(0.150)	(0.131)	(0.154)	(0.106)	(0.139)
Output Gap	0.0575	0.0308	-1.032	0.109	1.121	-0.402	0.155	0.535
	(0.977)	(0.944)	(4.704)	(4.197)	(2.818)	(2.759)	(0.601)	(0.692)
Crude Oil		0.00908		0.00874		0.00903		0.0100*
		(0.0061)		(0.0057)		(0.00647)		(0.00570)
REER		-0.0558*		-0.059*		-0.0561*		-0.0535*
		(0.0284)		(0.0298)		(0.0276)		(0.0272)
Rain Dummy		-0.510		-0.410		-0.00903		0.727
		(0.503)		(0.527)		(0.00647)		(0.578)
Constant	0.789	0.309	0.844	0.490	1.077	0.205	0.770	0.0963
	(0.684)	(0.748)	(0.752)	(0.789)	(1.124)	(1.190)	(0.717)	(0.875)
R^2	.766	.813	.755	.806	.766	.813	.766	.817
N	36	36	35	35	36	36	36	36

Note: Robust standard errors in parentheses- *** p<0.01, ** p<0.05, * p<0.1

Conclusion

Through this paper we have made an attempt to revisit the issue of determinants of inflation in India through a Phillips curve framework. In this paper we have attempted to estimate the traditional Phillips curve, NKPC and the hybrid NKPC all with and without supply shocks. Attempts have been made to estimate the parameters affecting CPI-IW core inflation through various models.

We know inflation expectations reflect the credibility of the monetary authority's commitment and the effectiveness of monetary policy is likely to be greater if inflation expectations remain anchored. NKPC provides the framework for analysis of inflation dynamics and this paper attempts to present evidence of the existence of NKPC in India to a greater extent. The empirical results in this paper confirm the presence of NKPC for India for CPI-IW inflation. However, no firm results have been found for the traditional Phillips curve and the hybrid NKPC.

Although it is clearly evident from the results that inflation expectations modeled in this paper which include both the qualitative and quantitative estimates of expectations is very important for monetary policy as they reflect the credibility of the authorities' commitment. In our estimation, expectations have a significant

role to play, providing credibility to the monetary policy making. Inflation persistence also have important role in monetary policy decisions as they affect the current inflation. Not only demand factors, but supply factors have too played an important role though the impacts have been low.

Although we know that expectation plays a vital role but they carry along with them some errors. As more and more variables uncertainties prevail, devising a perfect model that accurately predicts the future inflation keeping in mind all the factors is not possible. This paper made an attempt to explain the relation and in no way is the perfect model as a lot of different changes can be made addressing various conditions.

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7 The paper used large household survey conducted by RBI since 2005 to estimate the aggregate inflation expectations over a volatile inflation regime. They used reported directional responses to estimate expectations by quantifying through the Hierarchical Ordered Probit (HOPIT) model in addition to the balance statistics.

Appendix

Figure-1: GDP and Potential Output (BK and BK Adjusted)

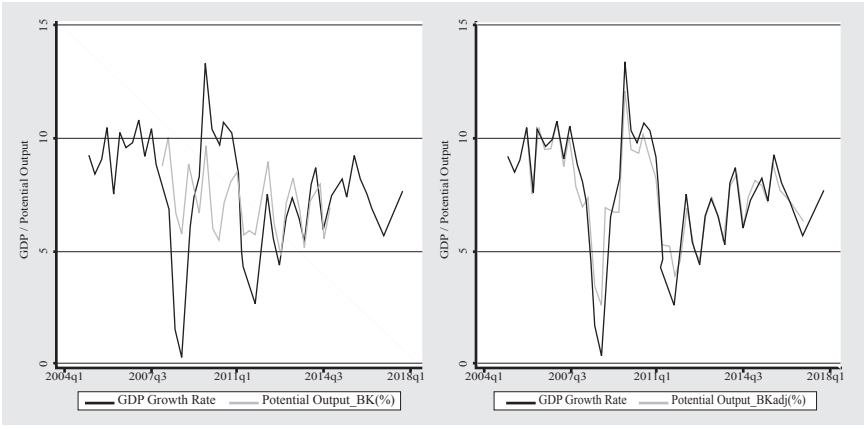
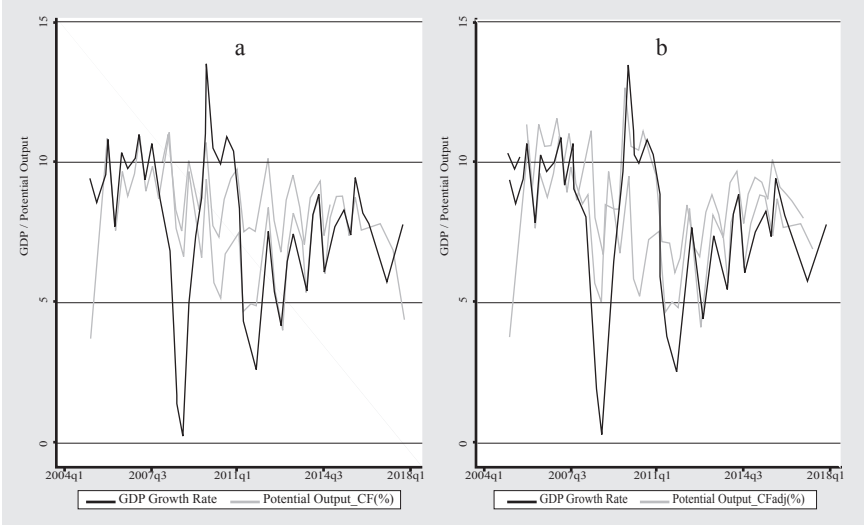


Figure-2: GDP and Potential Output (CF and CF adjusted)



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Policy Response Towards Low Carbon Transition of Power Sector in India

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Abstract

Climate change poses one of the direst threats that the humanity faces today. Increased concentration of greenhouse gases (GHGs) from economic activities like energy, industry, transport and land use over time has led to climate change. Globally, energy sector has been identified as one of the important mitigating sectors. Climate change mitigation initiatives and the resultant reduction of the emission of GHGs require a deep transformation of the power supply sector. This is particularly true for developing countries like India which is highly dependent on fossil fuel for its power generation. However this cannot be achieved with climate policy only as universal access to energy is a big development agenda for India. This requires integration of both climate and development strategies across sectors. Power generation from renewable energy sector in India needs to be scaled up and this can be done by replacing coal and other fossil fuels with non-fossil energy sources. Government of India has given special importance to energy mix for power generation mainly through solar, wind and use of super critical technology in coal fired power plants. This paper aims to overview this gradual shift of Indian power sector towards renewable sources. The paper also deals with recent developments at the policy level to achieve the objective of low carbon transition.

Keywords: Climate Change, Energy Transition, India, Power Sector, Renewable Energy

Introduction

Power has been universally recognized as a critical input, having utmost importance for both economic and human development. Access to electricity is an indicator of a country's growth and prosperity. Furthermore, access to affordable, reliable and sustainable energy is also put on the agenda of Sustainable Development Goal (SDG) of United Nations Development Programme (UNDP). However, it has been emphasised that this goal can be achieved by employing methods which are not only economically practicable but also environmentally sustainable by using emerging energy sources-both conventional and non-conventional. Globally energy sector contributes to almost two third of the total GHGs emission (IEA,

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2015). Estimates reveal that combustion of fossil fuel contributes to around 80 percent of global energy supply. As a result total greenhouse gas (GHG) emissions from energy sector continue to exhibit a rising trend (IPCC, 2007).

Between 2014 to 2040, there will be over half of the increase in the consumption of primary energy resources which will be used for generating electricity (IEA, 2015). The alleviation of climate change is accordingly poised on the reduction of GHG emission and a modification of the electricity system. Technological innovation along with the advent of new economic systems between energy suppliers and consumers has ensured an unprecedented reform in the power supply sector.

India being a developing country is highly dependent on fossil fuel for power generation. Currently coal based power alone accounts for 60.8 percent of India's installed capacity (INDC, 2015). Hence coal is the highest contributor to energy, related to CO_2 emission in India. Although per capita energy consumption in India is substantially low as compared to developed countries (World Bank, 2014), yet emissions from the electricity sector alone makes up about 38 percent of India's total CO_2 emissions during 2011-12 (GOI, 2011), (CEA, 2014). As India aspires to grow at 9 percent rate annually (INDC, 2015), the share of emission from electricity production is going to rise in coming years. India has the option of choosing long term development pathways which will put a lesser burden on environment by shifting to a low carbon growth trajectory and energy supply sector is going to play a significant role in this transition process.

Paris Agreement is based on national commitment, where India along with other one hundred and forty seven countries submitted its national climate goals to United Nations Framework Convention on Climate Change (UNFCCC) in the form of Intended Nationally Determined Contribution (INDC). India's INDC projects its ambition towards a low carbon future and as it is built on a trend which is already happening, the goals mentioned here are not unachievable (Heller, 2015). It could be analysed as a source of several financing policy components towards sustainability transition of energy sector in India. India's INDC truly shows interest in bringing about economic growth in line with minimal climate change risk. In INDC, India has promised to reduce the emissions intensity of its GDP by 33-35 per cent from 2005 levels by 2030 and clean energy and energy efficient industrial sector is one of the major concerns of India. But at the same time it is clearly mentioned in INDC that given to its socio-economic context, it is not possible to abandon coal to generate electricity in near future.

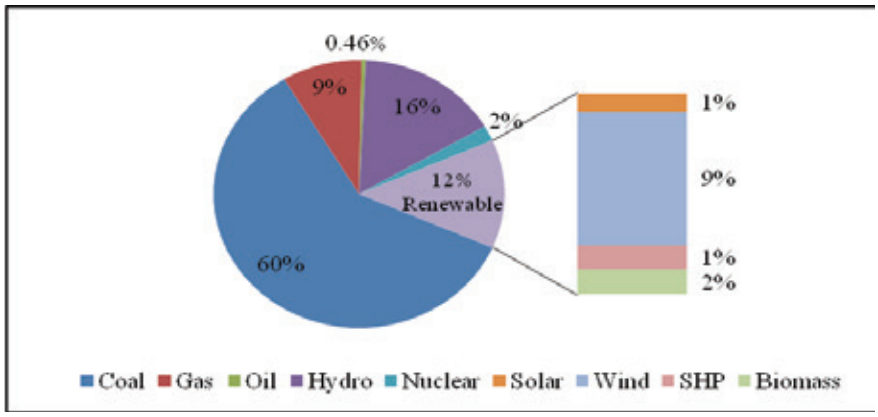
This paper tries to understand how a gradual transition of Indian power sector is taking place by replacing coal and other fossil fuel with non-fossil based sources of energy in generation of power and its potential of achieving a low carbon energy future for India. The next section presents an overview of the current demand and supply scenario of power sector in India. The subsequent section highlights the status of alternative energy sources in India. The section that follows it reviews India's policy response towards alternative energy. The last section evaluates and concludes India's transition to this low carbon energy supply paradigm.

Current Scenario of Power Sector in India: An Overview

Following close behind China and USA, India ranks third in power production

worldwide. The production figures amounted to 1208.4 tera watt hours (Twh) in 2014 and there was around 9.5 percent growth over the preceding year. In India electricity has been generated from both conventional sources which include coal, lignite, natural gas, oil and non-conventional sources comprising of hydro, nuclear, wind, solar, small hydro power (SHP), bio-power, waste to power (Figure-1).

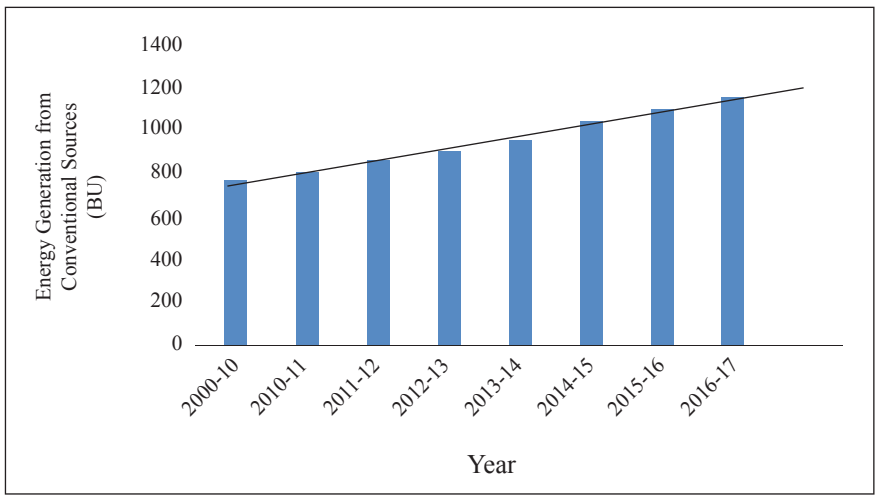
Figure-1: Source wise total installed capacity in India as on 31.12.2014



Source: MNRE, 2014-15

In the year 2017-18 power generation from the conventional sources was 1229.4 Billion Unit (BU) with a growth rate that hovered around 5.97 percent from the previous year of 2016-17 (1160.14 BU). Electricity generated from conventional sources during 2016-17 was 1160.141 BU. This is as against 1107.822 BU generated during 2015-16, indicating a growth of around 4.72 percent (Ministry of Power, Government of India, 2017).Power generation from conventional sources and its growth rate in the country during 2009-10 to 2016-17 is shown in figure 2 below. This conventional source is comprised of coal, gas, hydro and nuclear.

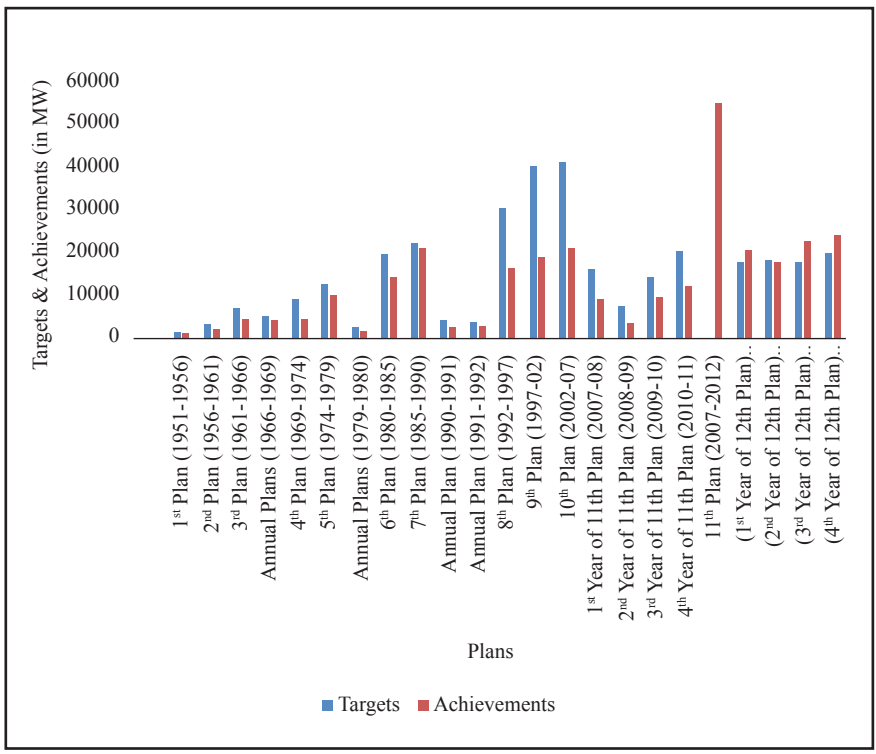
Figure-2: Power generation (BU) (in conventional generation):2009-10 to 2016-17



Source: Ministry of Power, Government of India, 2017

India's power sector has undergone some changes in the last decades. The Government of India introduced the "Electricity Act" in the year 2003. Its primary aim was to reform the unorganized power sector in India and bring about an improvement in the overall power sector along with implementation of various policies and regulations which played a pivotal role in accelerating the growth in this sector. Restructuring of power distribution companies and commercialization of power generation, transmission and distribution in selected states were a part of this plan (Planning Commission, Government of India, 2017). Plan wise the various targets and achievements of power capacity addition in India is shown in Figure-3 below for the period 1951-56 to 2015-16.

Figure-3: Plan wise the various targets and achievements of power capacity addition in India (1951-56 to 2015-16)



Source: Ministry of Power, Government of India, 1951-56-2015-16

In the 12th plan, the total addition of capacity from the conventional sources is around 101645 megawatt (MW)(CEA, 2016) which has surpassed its target of 88537 MW. In this capacity addition, share of coal is highest - 86250 MW and out of this coal capacity, 33640 MW is in super critical technology which is a more efficient and clean technology for thermal power generation.

Demand Supply Gap

Energy availability of the country has increased by 38 percent since 2009-10 but demand still exceeds supply (Table-1). Demand for electricity in India, between

2010 and 2015 has grown at a Compound Annual Growth Rate (CAGR) of 6.6 percent due to high economic growth rate and modernization. In India, a stupendous population size of about 304 million are still electricity deprived which is about 24 percent of the global population (INDC, 2015).Currently 30 percent of Indian population is urban based which is expected to be 40 percent by 2030 and this economic growth causes change in life style which in turn affects energy demand.

Table-1: The Demand-Supply Scenario of Power in India During 2009-10 to 2014-15

Year	Energy requirement (MU)	Energy Availability (MU)	Deficit (MU)
2009-10	8,30,594	7,46,644	83,950
2010-11	8,61,591	7,88,355	73,236
2011-12	9,37,199	8,57,886	79,313
2012-13	9,95,557	9,08,652	86,905
2013-14	10,02,257	10,30,785	42,428
2014-15	10,68,923	10,30,785	38,138
2015-16	11,14,408	10,90,850	23,558

Source: Ministry of Power, GoI, 2017

The Power Ministry reports that upto July 2017, the power supply in the country falls short of the total demand by 2.9 percent in the northern region, 0.1 percent and 0.5 percent in western and southern regions respectively and 3.1 percent in the north eastern region. At the all India level, supply is less than the demand by 0.9 percent (Ministry of Power, Government of India, 1996-97 to 2017-18). The peak demand calculated upto July 2017 was 1,59,816 MW, whereas 1,58,393 MW of power has been supplied registering a deficit of 1423 MW(Ministry of Power, Government of India, 1996-97 to 2017-18). Some key factors responsible for this widening demand supply gap in the power sector are as follows:

Table-2: Demand Supply Gap in the Power Sector

Key Factors	Reasons
Forest Clearance Regulations	• Stringent forest clearance regulations thereby preventing optimum usage of coal present in the forest areas for power generation
Quality of Coal	• low quality coal often not considered best for power generation
Gas production in Krishna-Godavari belt	• Reduction in the production of gas in the Krishna-Godavari belt has led to either no or low generation of power from gas based power plants.
Droughts and or low rainfall	• Lowering of water levels in dams resulting from droughts and or low rainfall has led to less power generation from hydropower plants
Mismatch in power purchase agreement	• Rising price of imported coal, creating a mismatch in the per unit cost structure as per power purchase agreement

Source: Shailesh, 2013

To meet this demand – supply gap, Government of India has planned a capacity addition of 54,964 MW in the 11th Plan and out of that 30,000 MW was from renewable sources and addition of 88,537 MW from during 12th plan (Planning Commission of India, 2012). Against the backdrop of these targets, conventional sources account for capacity addition of 61014 MW and renewable sources

account for 15828 MW which has been accomplished as of now by 2015 (Ministry of Power, Government of India, 2016).The government has taken a number of steps to meet the rising demand supply gap in the power sector in India. Indian government has decided to put a tab on the capacity addition to the electricity generation. Installation of each Ultra Mega Power Projects (UMPP) of capacity 4000 MW will help in increase in the electricity generation at a least cost with advanced generation capacity to attain the capacity addition targets of the 12th Plan. These initiatives will help in increasing indigenous production of power equipment. Along with existing capacity of coal, oil, natural gas, hydro and nuclear based power generation will be optimised with proper operation and maintenance.

To cater to the supply inconsistency in raw materials to thermal power plants from domestic sources, import of coal by the power utilities has been increased. "Renovation, modernization and life extension" of redundant thermal plants has been taken up. Strengthening of transmission capacity, sub-transmission and distribution network is another agenda to minimize loss. Furthermore, the government is also taking steps to promote conservation of energy along with its efficient usage accompanied by various other demand side management measures (Ministry of Power, Government Of India, 2017).

However, despite these efforts, power cuts are too rampant and as per estimates, a whopping of around 244 million of Indian population lives without electricity (IEA, World Energy Outlook, 2016). Government of India has launched the scheme "Deendayal Upadhyaya Gram Jyoti Yojana" for rural electrification (DDUGJY-RE). Under DDUGJY-RE, Ministry of Power has sanctioned 921 projects to electrify rural areas. These projects aim to provide electricity to 7,14,204 villages out of that 1,21,225 were without any access to electricity and 5,92,979 were partially electrified. This scheme also aims to provide electricity connections to 39.745 million BPL households at free of cost. As on 30th June 2015, electrification of 1,10,146 un-electrified villages and 3,20,185 partially electrified villages have been completed and 22.063 million electricity connections have been released to BPL households(Ministry of Power, Government of India, 2017). However it is important to achieve this development goal by creating lesser burden on environment. Reducing share of fossil fuel in electricity production along with increased and uninterrupted electricity service has become imperative for India.

Renewable Energy in India

The problem of ensuring economic growth while maintaining GHG emission standards lies in the heart of India's development question. In INDC, power sector has been prioritized by several policy frameworks and mitigation initiatives, as clean energy is one of the major concerns now. Since a considerable section of Indian population is still living without electricity, there is an urgent need for expansion of power supply. Prudent utilization of energy from renewable sources like biomass energy, solar energy, wind energy, geothermal energy is thus essential to deal with the energy and environmental crisis, emerging globally as well as in India. Since reduction in carbon intensity of growth has become a global imperative, the Government of India has targeted to increase energy access in an environmentally sustainable way by increasing the installed capacity of renewable energy sources (Table-3).

There has been a steady rise in capacity of electricity generation from renewable energy in the country over the last ten years. Renewable grid capacity has shown an increase in its share by over 6 times from 2 percent to around 13 percent between 2002 and 2015. (INDC, 2015). This capacity expansion of renewable energy is done mainly through solar which is expected to be 100 GW by the end of 2022. The potential of renewable energy in India is greater than 200 GW and that reflects a significant prospect of these non-conventional energy in India (Table-3). This growth rate is particularly significant for solar.

Table-3: Promotion of Clean Energy

Alternative energy sources	Installed capacity as on 2015	Target (2022)
Wind	23.76 GW	60 GW by 2022
Solar	4.06 GW	100 GW by 2022
Biomass	4.4 GW	10 GW by 2022
Hydro	46.1 GW (4.1 GW small hydro; 41.99 GW large hydro)	
Nuclear	5.78 GW	63 GW (2032)

Source: Adopted from (Das & Roy, 2017)

Out of the total potential for power generation from renewable energy in this country which is estimated to be 896603 MW as on 31.03.15 (Table-4), wind accounts for 102772 MW (11.46 percent), SHP 19749 MW (2.20 percent), biomass based power 17,538 MW (1.96 percent), bagasse-based cogeneration in sugar mills 5000 MW (0.56 percent) and solar power 748990 MW (83.54 percent) (Ministry of Statistics and Programme Implementation, 2016).

Table-4: State / Source-Wise Estimated Potential of Renewable Power in India (As on 31.03.2015)

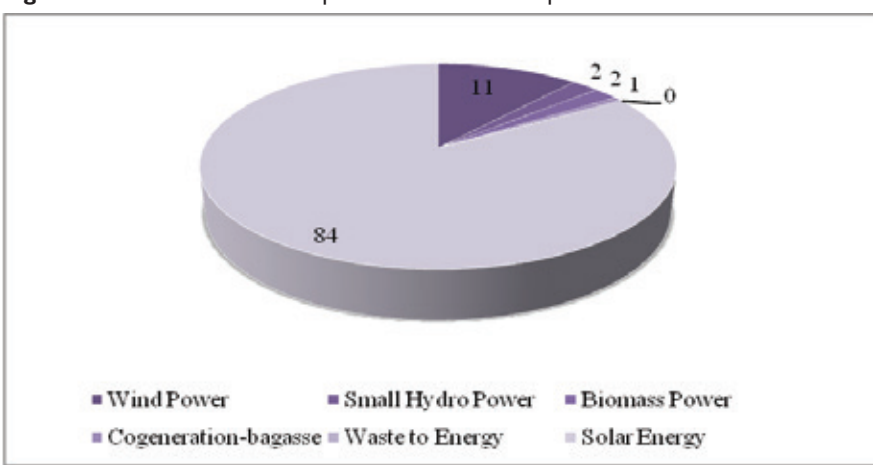
States / UTs	Wind Power	Small Hydro Power	Biomass Power	Cogen-eration-bagasse	Waste to Energy	Solar Energy	Total
Andaman and Nicobar Islands	365	8		-	-	-	373
Andhra Pradesh	14497	978	578	300	123	38440	54916
Arunachal Pradesh	236	1341	8	-	-	8650	10236
Assam	112	239	212	-	8	13760	14330
Bihar	144	223	619	300	73	11200	12559
Chandigarh	-	-		-	6	-	6
Chhattisgarh	314	1107	236	-	24	18270	19951
Dadar and Nagar Haveli	-	-		-	-	-	-
Daman and Diu	4	-		-	-	-	4
Delhi	-	-		-	131	2050	2181
Goa	-	7	26	-	-	880	912
Gujarat	35071	202	1221	350	112	35770	72726
Haryana	93	110	1333	350	24	4560	6470
Himachal Pradesh	64	2398	142	-	2	33840	36446
Jammu and Kashmir	5685	1431	43	-	-	111050	118208
Jharkhand	91	209	90	-	10	18180	18580
Karnataka	13593	4141	1131	450	-	24700	44015
Kerala	837	704	1044	-	36	6110	8732

States / UTs	Wind Power	Small Hydro Power	Biomass Power	Cogen-eration-bagasse	Waste to Energy	Solar Energy	Total
Lakshadweep	-	-		-	-	-	-
Madhya Pradesh	2931	820	1364	-	78	61660	66853
Maharashtra	5961	794	1887	1250	287	64320	74500
Manipur	56	109	13	-	2	10630	10811
Meghalaya	82	230	11	-	2	5860	6185
Mizoram	-	169	1	-	2	9090	9261
Nagaland	16	197	10	-	-	7290	7513
Odisha	1384	295	246	-	22	25780	27728
Puducherry	120	-		-	3	-	123
Punjab	-	441	3172	300	45	2810	6768
Rajasthan	5050	57	1039	-	62	142310	148518
Sikkim	98	267	2	-	-	4940	5307
Tamil Nadu	-	-	3	-	-	20410	20410
Telengana	14152	660	1070	450	151	17670	34152
Tripura	-	47	1617	-	2	2080	2131
Uttar Pradesh	1260	461	24	1250	176	22830	27593
Uttarakhand	534	1708	396	-	5	16800	19071
West Bengal	22	396		-	148	6260	7222
Others*	-	-		-	1022	790	1812
India	**102772**	**19749**	**17538**	**5000**	**2556**	**748990**	**896603**

Source:(Ministry of Statistics and Programme Implementation, 2016)

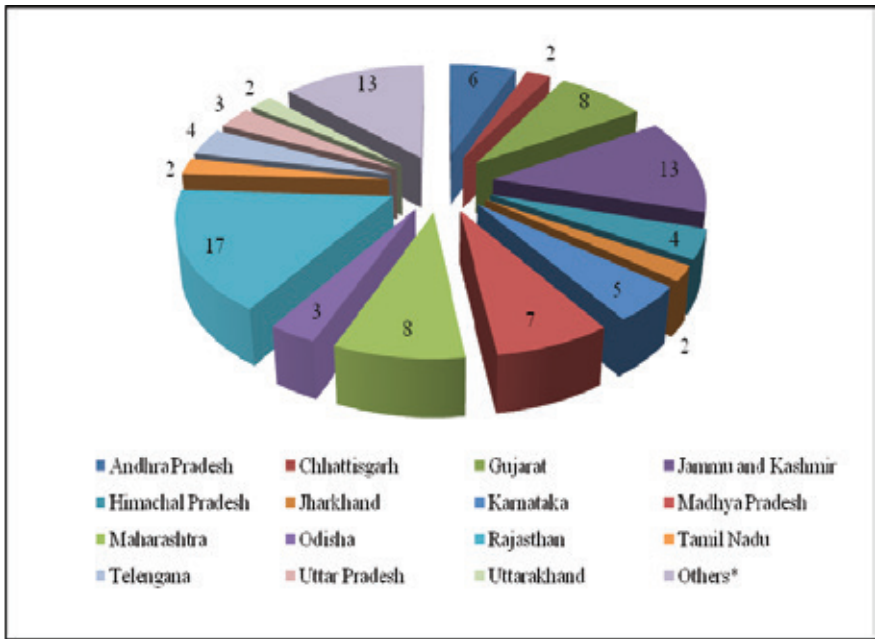
It is evident from Table-4 that the potential for renewable energy is varied across the states. Rajasthan tops the list of the highest potential of renewable power with respect to their geographical specificity-the highest share being around 17 percent (148518 MW) as on 31.03.2015. This is followed by Jammu and Kashmir with 13 percent share (118208 MW) and then Gujarat with 8 percent share (72726 MW), primarily with respect to high solar power potential(Ministry of Statistics and Programme Implementation, 2016).

Figure 4: Sourcewise estimated potential of renewable power in India as on 31.03.15



Source: Ministry of Statistics and Programme Implementation, 2016

Figure-5: Statewise Estimated Potential of Renewable Power in India as on 31.03.15



Source**:** Ministry of Statistics and Programme Implementation, 2016

In the expansion of renewable energy capacity, India ranks foremost in the world (IRENA, 2016). The renewable grid capacity has shown an increase in its share over 13 percent (36 GW) between 2002 and 2015 (INDC, 2015). In its commitment to UNFCC, India aims to reach a goal of attaining 175 GW renewable energy capacities in the coming years (INDC, 2015). Renewable energy in India contributes almost 12.3 percent,out of the total installed capacity (CEA, 2014). As compared to last year, share of grid connected renewable energy has increased by 18 percent and has currently become 46,326 MW of capacity and off-grid captive power capacity has crossed the benchmark of 1400 MW (MNRE, GOI, 2016). In this growth scenario, wind is the main driver. However, in recent times, installed capacity of solar power has increased significantly. The exponential prospects of renewable energy in India are evident when we note that the unrealized market potential for the same is 216.91GW (Novonous, 2014). This growth rate is going to be significant particularly for solar energy as India in its submission to UNFCCC has posed a high aim of 100 GW solar capacity by 2022.

India's Policy Response Towards Alternative Energy

India's energy policy is mainly designed to provide better energy access, improved energy security and thereby create a less impact on environment. As a measure against the adverse consequences of climate change, India a non-annex I country, by 2020, has made a commitment to bring down its emission rate by 20-25 percent of what it had been in 2005. What is interesting is that this commitment has been declared by the country totally voluntarily (INDC, 2015). It is already recognised

that India has the potential to fulfil its climate commitment and The Emission Gap Report (2014) (UNEP, 2014)of United Nations Environment Programme (UNEP) has supported this. It is also evident from the fact that budgetary support from Ministry of New and Renewable Energy (MoNRE) and Ministry of Environment Forest and Climate Change (MoEFCC) is gradually showing an uptrend over time (Table-5).

Table-5: Budget Allocation from MoNRE and MoEFCC

Year	Estimated central plan outlay for energy sector (billion INR)	Estimated budget support for MoNRE (billion INR)	Estimated budget support for MoEFCC (billion INR)
2006-07	695.93	9.70	13.39
2007-08	791.58	10.12	13.51
2008-09	938.15	12.67	15.00
2009-10	1155.74	13.47	18.80
2010-11	1465.79	19.50	22.00
2011-12	1554.95	21.50	21.81
2012-13	1548.42	33.55	24.30
2013-14	1582.87	39.15	24.30

Source: Compiled from Union budget of India; http://indiabudget.nic.in/

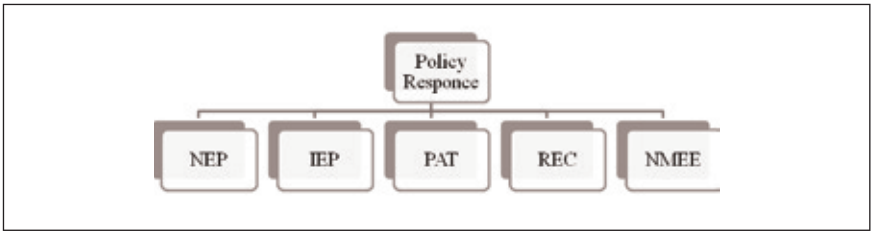
India's National Action Plan on Climate Change (NAPCC) provides an overall framework to address the environmental issues with its eight National Missions. Out of them, National Missions for Enhanced Energy Efficiency (NMEEE) and Jawaharlal Nehru National Solar Mission (JNNSM) defines the importance for a more systematized power sector. These two missions aspire to reduce the demand and supply gap in power sector. To improve supply efficiency, JNNSM has been adopted to increase the share of solar in total energy mix. Similarly on the demand side, under NMEEE various market mechanisms were designed along with promotion of energy efficient appliances. India's approach towards transition to a low carbon trajectory for power sector has policy support both from institutional and financial end. As a part of policy support, National Electricity Policy, Integrated Energy Policy, Perform Achieve and Trade, Renewable Energy Certificates were designed for efficient performance of thermal power sector. But at the same time there were multiple financial support schemes which have also been announced.

Policy Support

As a part of policy support, National Electricity Policy (NEP), Integrated Energy Policy (IEP), Perform Achieve and Trade (PAT), Renewable Energy Certificates (REC), National Mission for Enhanced Energy Efficiency (NMEEE) were envisaged to improve the efficiency of thermal power sector (Figure-6). Both NEP and IEP were designed for increased access to electricity and promoting

renewable sources of energy. Furthermore, the programme seeks to attain total capacity addition of 19,598 MW and also save fuel of approximately 23 million tonnes per year at its full scale operation (INDC, 2015). PAT and REC are market mechanisms particularly designed to improve efficiency of coal based power plants and to increase share of renewables in total power supply.

Figure-6: Policy response of Government of India towards renewable energy and enhanced energy efficiency



National Electricity Policy (NEP): National Electricity Policy was initiated in 2005 in compliance with the Electricity Act 2003. National Electricity Policy aims to improve electricity access with increased supply of power in line with its demand (Planning Commission of India, 2012). To meet these objectives, it is estimated that an investment of INR 9000 billion at 2002-03 price level would be required to finance generation, transmission, sub-transmission, distribution and rural electrification projects (Ministry of Power, 2005). In this policy, it is mentioned that being the most crucial infrastructure sector, state should step in and a sizeable part of investment should come from private sector.

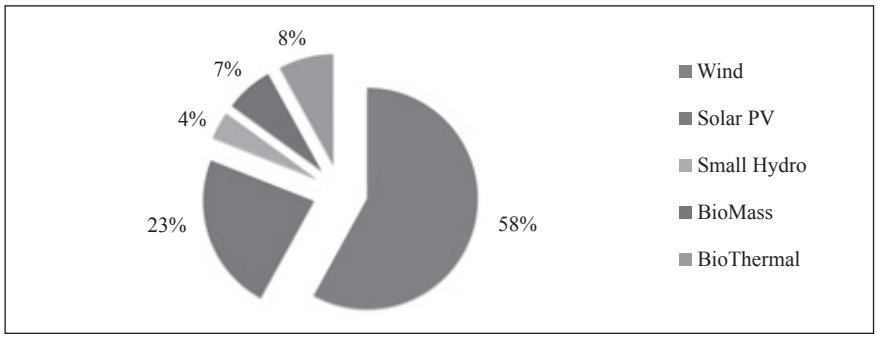
Integrated Energy Policy (IEP): Integrated energy policy was designed to improve the generation of renewable energy sources in India along with efficiency improvement, demand side management and more emphasis on R&D of alternative energy sources. A 100 GW solar capacity by 2022 - a benchmark of India's INDC (INDC, 2015), is also an important part of this policy. Solar parks and Ultra Mega Solar Power Projects, solar PV power plants on canal banks or canal tops are some of the important highlights of this policy (Ministry of New and Renewable Energy, 2016).

Perform Achieve and Trade (PAT): Perform Achieve and Trade (PAT) is a market mechanism under the National Mission of Enhanced Energy Efficiency (Ministry of Power, 2012). The first cycle of PAT covered total eight industries and thermal power was one of them with the number of designated consumers of 144 (97 lignite, 7 diesel, 40 gas) (Ranjan, 2015). Total energy savings achieved from thermal power sector was 3.1 Mtoe out of 6.6 Mtoe target under first cycle of PAT (Gupta P., 2015).

Renewable Energy Certificate (REC): Renewable Energy Certificate (REC), a market based instrument under Renewable Purchase Obligation (RPO), is designed to generate 15 percent of power from renewable sources by 2020 (Ministry of New and Renewable Energy, 2009). Under this scheme power distribution companies are obligated to buy a specified amount of electricity which is generated from renewable sources (figure 7). RECs are issued to renewable energy generators. If power distribution companies fail to meet RPO then this REC can be traded in the market to maintain the target. The India Energy Exchange (IEX) and Power

Exchange India Ltd (PXIL) provide the auction platforms. As of August 2014, 1001 projects have been registered under REC registry in India with total capacity of 4490 MW and 1061 projects are accredited with capacity of 4842 MW. In last one year, total 16069960 REC were issued - out of that 6697318 were traded on exchange (POSOCO, 2016).

Figure-7: Breakdown across Sector for REC

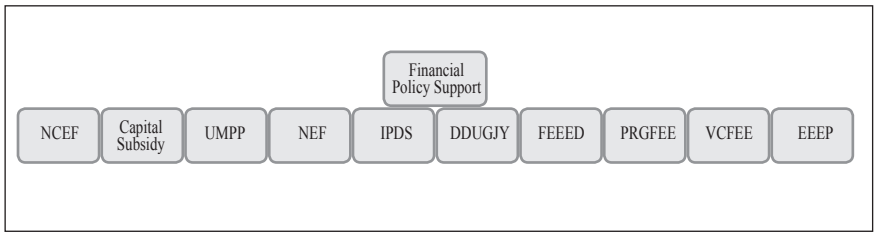


Source: compiled from (POSOCO, 2016)

Financial Policy Support

Power sector is a highly capital intensive sector. Hence to develop a low carbon power sector one needs to be supported by appropriate financial policy framework (Figure-8).

Figure-8: Financial policy support of Government of India towards renewable energy and enhanced energy efficiency



National Clean Energy Fund (NCEF): In order to promote research for clean energy, National Clean Energy Fund (NCEF) was established. The fund is set up by imposing a cess of INR 50 (thereafter raised to INR 200 in 2015 and INR 400 in 2016) per tonne of coal generated domestically or imported(Ministry of Power, Government of India, 2016). It is estimated that it would contribute to about INR 13, 0000 million NCEF every year (Sinha, 2016).

Capital subsidy on solar rooftop: Rooftop solar is perceived to be an important means of achieving 100 GW solar capacity by 2020. It is expected to have a roof top solar capacity 40 GW (Ministry of New and Renewable Energy, 2016). A capital subsidy has been announced for non-commercial setups like residential buildings, government buildings, hospitals, educational institutions and this would be funded from Central Financial Assistance (CFA). Initial budgetary allocation for this scheme was INR 50000 million(Ministry of New and Renewable Energy, 2017) and this subsidy will be provided only until the budget is exhausted (Central Electricity Regulatory Commission, 2016).

The order passed by The Central Electricity Regulatory Commission (CERC) for ascertaining the standard capital cost for solar PV projects (including cost of equipment, construction, land, transmission and pre-operative expenses of the same), appraises at INR 50.1 million/MW for the financial year 2016-17. For fiscal year 2015-16, CERC had fixed the standard capital cost at INR 58.7 million/MW which was later changed to INR 60.6 million after evaluating the responses from the industry.

Investment in Ultra Mega Power Project (UMPP): Ultra Mega Power Projects (UMPP),as a part and parcel of clean coal policies are given priorities in coal based power generation. These UMPPs will be enabled with a highly efficient super critical technology which will help in less use of coal and reduced GHG emission in generation of same amount of electricity. Till date five UMPPs have been approved with potential of about 4000 MW eachin Mundra (Gujarat), Sasan (Madhya Pradesh), Cheyyur (Tamil Nadu), Tadri (Karnataka) and in Krishnapatnam (Andhra Pradesh). This would require an investment of about INR 160000 million (Dubey, 2015). Power Finance Corporation (PFC) is responsible for the finance and administration of specific functions for UMPPs in India.

National Electricity Fund (NEF): National electricity fund was initiated to bridge the gap in the reform process of the power distribution company. This is basically a subsidy for interest scheme for power distribution companies, both public and private to promote capital investment in distribution sector. NEF Scheme has the provision of providing interest subsidy and other charges aggregating to INR 84660 million for a period of 14 years. Under the 12th plan, proposed reform of power sector would get INR 220000 million as a budgetary support from NEF (Ministry of Power, 2012), (REC, 2012).

Integrated Power Development Scheme (IPDS): The Ministry of Power, Government of India launched Integrated Power Development Scheme. The main objective of this scheme is strengthening of transmission system and distribution network. Total outlay of this scheme was estimated as INR 326120 million which includes a budgetary support of INR 253540 million(Integrated Power Development Scheme, 2014), (Ministry of Power, 2015).

Deendayal Upadhyaya Gram Jyoti Yojana (DDUGJY): Deendayal Upadhyaya Gram Jyoti Yojana (DDUGJY) was formulated with the specific objective of providing uninterrupted power supply to rural areas of India. The total outlay of INR 440330 million which includes a budgetary support of INR 334530 million from Govt. of India(Ministry of Power, 2017). The main focus of this scheme is segregation of agricultural and non-agricultural feeders coupled with augmenting the strength and capacity of sub-transmission along with the distribution networks in the suburban and the rural areas. Some other important thrust areas of the scheme are metering of distribution transformers/feeders/ consumers in the villages as well as rural electrification.

Framework for Energy Efficient Economic Development (FEEED): Framework for Energy Efficient Economic Development (FEEED),one of the initiatives under NMEE, is aimed to promote energy efficiency in the country. One of the key objectives of FEEED has been formulation of various fiscal instruments and policies for promoting energy efficiency in the country (Gupta & Sengupta, 2012).This initiative has facilitated the creation of two funds viz. Partial Risk

Guarantee Fund for Energy Efficiency (PRGFEE) and Venture Capital Fund for Energy Efficiency (VCFEE).

Partial Risk Guarantee Fund for Energy Efficiency (PRGFEE): The Partial Risk Guarantee Fund for Energy Efficiency (PRGFEE) provides commercial banks a partial coverage of risk that is often involved while they give loans for various energy efficiency projects. Maximum tenure of the guarantee is five years from the date of issue of the guarantee. Total budgetary allocation for PRGFEE was INR 3120 million(Bureau of Energy Efficiency, 2017).The maximum bail out is INR 30 million per project or 50 percent of loan amount, whichever is less. Previously only government buildings and municipalities were covered under this scheme. However, it was only in the twelfth plan that it has been expanded and efforts have been initiated to bring SMEs and industries under this scheme (Ministry of Power, 2017).

Venture Capital Fund for Energy Efficiency (VCFEE): BEE has initiated a financial instrument under NMEEE called Venture Capital Fund for Energy Efficiency (VCFEE)(Gupta & Sengupta, 2012). This fund provides capital support to improve energy efficiency with the help of new technologies, as well as goods and services. The financial allocation meant for this scheme was about INR 2100 million which is supported through public spending(Bureau of Energy Efficiency, 2017).

Energy Efficiency Financing Platform (EEFP): Another scheme which was initiated under NMEEE was Energy Efficiency Financing Platform (EEFP). As it is now evident that financing is a key challenge to improve energy efficiency, this scheme aims to create a mechanism to channelize more funding towards energy efficiency improvement. Such energy savings will recover costs on one hand and at the same time will also slash the subsidy bill of the state government. The primary goal of this scheme is to augment the comfort level for lenders towards energy efficiency projects.

The government of India in its endeavour to endorse clean energy projects has decided to pardon transmission fee for electricity produced from renewable sources. For this, the government has enabled a legal framework whereby all inter-state transmission of renewable energy will be made at zero cost. Accordingly, no transmission charges will be issued on renewable energy throughout the country. The process is already underway with INR 380 billion of green energy corridors (Ministry of New and Renewable Energy, 2016) along with urgent campaigning to find more areas to expand renewable energy by facilitating the construction of more transmission grids.

Conclusion

Following the analysis we have found that India is already at the desired path of achieving a low carbon emitting power sector with both introduction of new, up to date and efficient technology and escalating fuel usage with absolutely little or almost no carbon content along with proper policy framework to accelerate this journey. However, deployment of new technology at commercial level faces challenges by existing technology in terms of investment and pricing. The growth of Indian renewable sector has been impressive, yet there are certain issues which need to be addressed for the better performance of this sector. The main challenge faced for the renewable energy development in India is high initial

cost of installation. Price is definitely another major impediment for expansion of renewable energy sources. Wind and solar power based plants involve gigantic investments as compared to development of a coal based power plant where investment revolves only around INR 40-50 million per MW of capacity. While India in its endeavour to become one of the emerging and largest producers of green energy globally, by scaling up the target of renewable energy to 175 GW by the year 2022 (including 100 GW from solar, 60 GW from wind, 10 GW from bio-power, 5 GW from small hydro power), the total investment in setting up 100 GW plant will be around INR 6000 billion(Ministry of New and Renewable Energy, 2015-16). On the other hand a wind based plant requires an investment of more than INR 60 million per MW of capacity in India.

India has favourable geographical conditions to transform to a renewable resources based power sector. For all the stakeholders to come together, starting from policy makers, investors, industries, financial and administrative institution and public participation is also needed for a sustainable energy transition. To find a cost competitive and financially viable alternative power sector, more research is needed for cost reduction of these renewable energy technologies. International cooperation can facilitate smooth technology transfer and hence can ensure more advanced energy technology solutions for India. Land acquisition is also a major challenge in India and the land issue faced by project developers can be resolved by creating a better policy and regulatory framework regarding land across whole of India. Introduction of more tax rebates and subsidies in the field of efficient thermal power sector and renewable energy is needed to facilitate the transition. Lastly, there is a huge need for an efficient financing infrastructure as well as a focused, collaborative and goal driven R&D required to help India attain a sustainable low carbon energy future.

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Tertiary Sector's Performance in India

V. Nirmal Rajkumar*

Abstract

The tertiary sector has been the main and vibrant force steadily driving growth in Indian economy for more than two and half decades. Traditional wisdom suggests that during the early stage of development of a country, growth of output in secondary sector paves the way to growth in the tertiary sector. As a country progresses further manufacturing often takes the back seat and give way to the tertiary sector in terms of both output and employment, and secondary sector's firms themselves become increasingly service centric in order to keep on competitive spirit. It is argued that the decline in secondary sector and corresponding shift to tertiary sector is unsupportable in the long run as services depend critically on manufacturing for their demand. The development of Indian economy after the introduction of new economic reform is led to tertiary sector. But many economists have raised doubt that whether this progress can be sustained for a longer period. The main issue is whether the tertiary sector has the capacity to pay off the sluggish growth of agricultural and industrial sector. The tertiary sector contributes more towards GDP, but its contribution towards employment is low. So, an analytical study of Indian tertiary sector is necessary today to depict the actual picture of the tertiary sector

Keywords: Agriculture Industry, Engine of Economic Growth FDI, Exports and Privatization, GDP, Services-Led Growth

Introduction

Tertiary sector also known as service sector is necessary for economic growth of a country including India. The tertiary sector has been the main and vibrant force steadily driving growth in the Indian economy for more than two and a half decades. It has emerged as the largest and fastest-growing sector in the global economy in the last two decades. The economist like Fisher (1935), Clark (1940) and Kuznets (1971) reveals that after countries get industrialized and reach the advanced stage of economic development, the share of secondary sector in national income and employment may be sluggish, while that of tertiary sector increases.

The tertiary sector across the globe has been playing a leading role in the growth of economies, especially in high income economies which have transited to services-led economies. India with a "tertiary sector's share of around 55 per cent in national GDP in the post reform period compares well even with the developed countries in the top 12 countries with the highest overall GDP, growing by 10 per

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cent annually, contributing to about 25 percent of total work force, accounting for a high share in foreign direct investment (FDI) inflows and over one-third of total exports, and recording very fast export growth".

Traditional wisdom suggests that during the early development stage of a country, growth of output in secondary sector may pave the way to the growth in the tertiary sector. As a country progresses further manufacturing often takes a back seat and giving way to the tertiary sector in terms of both output and employment, and secondary sector's firms themselves becomes increasingly service centric in order to keep on the competitive spirit. It is argued that the decline in secondary sector and corresponding shift to tertiary sector is unsupportable in the long run, as services depend critically on manufacturing for their demand. The development of Indian economy after introduction of new economic is led by tertiary sector.

Importance of the Study

Today India is travelling a novel path in economic growth by making services as the engine of growth, by bypassing industry. The tertiary sector covers a wide range of sub sectors from the information technology (IT) to the unorganized sector, such as the services of the drivers, vegetable venders and masen. National Accounts classification of the tertiary sector includes trade, hotels, and restaurants; transport, warehouses and communication; financing, insurance and share trading; community, social, and personal services. The importance of the services sector can be gauged by looking at its contributions to different aspects of the economy.

Statement of the Problem

The growth of Indian economy during the liberalised era is services-led growth. But many economists raised doubt that whether this growth can be sustained for a longer period. The major issue is whether the services sector has the capacity to compensate the slow growth of agricultural and industrial sector. The services sector contributes more towards GDP, but its contribution towards employment is low. A service-led growth is sustainable because the globalization of service at present is just the tip of the iceberg. The services revolution has altered the characteristics of services. Services can now be produced and exported at low cost. The old idea of services being non-transportable, non-tradable, and non-scalable no longer holds for a host of modern impersonal services. Developing countries can sustain a service-led growth as there is a huge room for catch-up and convergence. So, an analytical study of Indian Tertiary sector is essential to know the real picture of the services sector.

Objectives of the Study

To analyse the contribution of a tertiary sector towards GDP and Export.

Methodology

The methodology is a systematic method, which depends on the researcher telling the truth about what is happening in the research, and not what the researcher wishes to happen. The economic events relate to the human behaviour, which might vary in time and space.

Data Source

The study is based on the secondary data to arrive a logical conclusion. Time series data for the year 1980-81 to 2016-2017 has been collected from various sources i.e., Economic Surveys of India, Handbook of Statistics on Indian Economy, the National Sample Survey Organisation's Reports.

Period of Study

The researcher has chosen thirty seven years for the study from 1980-81 to 2016-2017. The period of study has divided into two periods (viz) the pre-reform period which covers the period from 1980-81 to 1990-91 and the post reform period from 1991-92 to 2016-2017. The classification of the period has been done because of the introduction of new economic policy during the year 1991. This is a landmark policy change initiated by the government of India. Another reason for choosing this period is that, the crisis present during the period of 1990-91, particularly in the area of balance of payment, foreign exchange and inflation.

Tools of Analysis

Appropriate tools are required to find the rate of growth and to compare the growth rate of the agricultural sector before and after the introduction of the new economic policy. The following tools are used in the present study

(i) The Time Series Analysis, (ii) The Semi-Log Model; (iii) The Chow test and (iv) 't' test

Regression Analysis

Tertiary Sector to GDP

Table-1: Regression Results of the Contribution of the Tertiary Sector to GDP During 1880-81 To 2016-2017

Model	Period	Year	Regressions Co-efficient			R^2	Compound Growth Rate
			a	b	t		
Linear	Pre-reform period	1980-81 to 1990-91	1105917.06	83007.56	18.57	0.97	--
	Post-reform period	1991-92 to 2011-12	481093.41	366022.59	19.32	0.94	--
	Whole period	1980-81 to 2011-12	-686150.45	263243.40	16.20	0.88	--
Log -linear	Pre-reform period	1980-81 to 1990-91	13.6	0.05	25.08	0.99	5.35
	Post-reform period	1991-92 to 2011-12	14.45	0.06	88.60	0.99	7.03
	Whole period	1980-81 to 2016-2017	13.86	0.06	72.98	0.99	6.42

Source: Computed by Researcher

The Table-1 indicates the rate of change in the growth of tertiary sector's contribution towards GDP in India. In the pre-reform period, the value of the slope co-efficient was found to be Rs.83007.56 crores. This exposed that the

contribution of tertiary sector towards GDP in India has increased annually by Rs.83007.56 crores on an average over the ten years period. The corresponding value for the post reform period and the whole period are Rs. 366022.59 crores and Rs. 263243.40 crores respectively. The value of R^2 for the whole period is found to be 0.88, which meant that about 88 per cent of the variations in the contribution of tertiary sector towards GDP are explained by time. The estimate of 'b' is found to be statistically significant at 5 percent level.

In the semi-log growth model, the value of the slope coefficient is estimated to be 0.06 which shows that the annual average growth rate of the contribution of secondary sector towards GDP is 6 percent and the corresponding value for the post- reform period is 0.06, which shows that the annual average growth rate of the contribution of tertiary sector towards GDP is 6 percent. The growth rate during the whole period is 6 percent. The compound growth rate also shows the same result.

Tertiary Sector to Export

Table-2: Regression Results of the Contribution of the Tertiary Sector to Export During 1880-81 To 2016-2017

(In billion cores)

Model	Period	Year	Regressions Co-efficient			R^2	Compound Growth Rate
			a	b	t		
	Pre-reform Period	1980-81 to 1990-91	-11.802	5.403	9.264	0.91	--
linear	Post-reform period	1991-92 to 2011-12	-2571.99	440.52	12.22	0.86	--
	Whole period	1980-81 to 2011-12	-2665.44	265.80	9.434	0.72	--
	Pre-reform period	1980-81 to 1990-91	2.98	0.12	16.55	0.97	13.1
Log -linear	Post-reform period	1991-92 to 2011-12	4.617	0.21	38.99	0.98	21.8
	Whole period	1980-81 to 2011-12	2.56	0.19	60.01	0.99	21.2

Source: Computed by Researcher

From the Table-2 we could infer that in the pre-reform period, the value of the slope co-efficient was found to be Rs. 5.4 crores. This showed that the contribution of tertiary sector towards export in India increased annually by 5.40 crores on an average over the ten years period, immediately preceding the adoption of new economic policy. The value of R^2 is found to be 0.91, which meant that about 91 per cent of the variations in the contribution of tertiary sector towards export are explained by time. The estimate of 'b' is found to be statistically significant at 5

percent significant level. In the growth model, the value of the slope coefficient is estimated to be 0.12 crores which shows that the annual average growth rate of the contribution of tertiary sector towards export is 12 percent and the value of R^2 is estimated to be 0.96. The compound growth rate is 13.1.

In the post-reform period, the value of 'b' is 440.52. This shows that the annual average growth of the contribution of tertiary sector to export is Rs. 440.52 crores. The value of the coefficient of variation is 0.86. This shows that 86 percent of the variation in dependent variable is explained by time. The 't' value is statistically significant at 5 percent level. The semi-log model shows that the annual average growth rate is 0.21 which means the annual average growth rate is 21 percent. While analysis during the whole period, we could found that the contribution of service sector towards export grows by Rs. 265.80 crores on an average annually. The corresponding value from the log-lin model is 0.21, which shows that the services sector export grows by 21 percent. The compound growth rate shows that the annual average growth rate of the contribution of services sector toward the export is 21.80 percent.

't' Analysis

To examine as to whether the growth rates of the contribution of tertiary sector towards macroeconomic variables has differed between the two sub periods the following 't' test for comparing mean is applied.

Table 3: Analysis on the availability of significance variation between the growth rates of the tertiary sector's contribution to GDP and Export between pre and post reform period

Sl. No.	Macroeconomic Variable	Calculated 't'	Table 't'	Inference
1	GDP	12.11	2.04	H_0 Rejected, Availability of significance change
2	Export	11.6	2.04	H_0 Rejected, Non-availability of significance change

Source: Computed by Researcher

Table 3 shows that calculated 't' value of variables GDP and Export are found to be greater than the 'table' 't' value thus, there is a significant difference between the growth rates of the contribution of services sector towards GDP and export during the two sub periods.

Chow Test Analysis

The 'Chow test' helps us to find out as to whether there is difference in the structural changes that has taken place during the two assumed time periods namely., 'before' and 'after' the introduction of the economic.

H_0= There are no structural changes in the growth rate of the contribution of the tertiary sector towards GDP and Export

H_1= There are structural changes in the growth rate of the contribution of the tertiary sector towards GDP and Export

Table 4: Analysis on the availability of Structural change between the growth rates of the contribution of macroeconomic variables between pre and post reform period

Sl. No.	Macroeconomic Variable	Calculated 'F'	Table 'F' (5 percent significance level) (2, 28)	Inference
1	GDP	37.2	3.42	H_0 Rejected, Availability of Structural change
2	Export	18.7	3.42	H_0 Rejected, Availability of Structural change

Source: Computed by Research

The Table 4 shows that calculated 'F' value of variables since the calculated 'F' value of variables GDP and export are found to be greater than the 'table' 'F' value hence, the null hypothesis is rejected. The 'Chow test' seemed to support the view of that there has been structural changes in the growth rate of the contribution of the tertiary sector to GDP and Export in Indian economy.

Conclusion

The above analysis discloses that the progress of the tertiary sector is alarming. In terms of its contribution towards GDP and export after the introduction of new economic policy is high. Today economist judges the performance of an economy by its contribution in eradication of poverty and unemployment. If we take this criteria into consideration the tertiary sectors growth is not an inclusive one. If tertiary sector becomes labour intensive then its growth will go a long way in developing the Indian Economy. While taking into the distribution aspect of an economy, the contribution of labour should be high than the contribution of capital. Hence we can conclude that the tertiary sector has made a significant impact in Indian economy after the introduction of new economic policy.

Suggestion

The growth of service sector must be driven more by productive services such as trade, tourism, hotel, transport and financial services. This will increase employment opportunity. Government should protect and invest more on real services.

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A Review on the Farmer Suicides in India – An Unsolved Problem

N. Rajendra Prasad*

Abstract

There has been an upward trend in cases of farmer suicides in Maharashtra, Telangana, Karnataka and Punjab recently, besides reporting of instances in Gujarat, Uttar Pradesh and Tamil Nadu. The number of suicide cases by farmers due to agrarian reasons have increased by 26 percent to 1,109 in 2014, with majority of deaths reported from Maharashtra. Out of 1,109 cases, 986 were reported from Maharashtra, 84 from Telangana and 29 from Jharkhand. In 2013, 879 farmers had committed suicide, and in 2012 the cases of farmer suicides were 1,046.

The main reason of farmers' suicides can be attributed to both natural and manmade factors. While natural factors like uneven rains, hailstorm, drought and floods adversely affect crop yield, the manmade factors, i.e. pricing policies and inadequate marketing facilities result in post-yield losses. The increasing costs of production and the falling farm prices that go hand in hand with globalisation, combined with the decline in farm credit is putting an unbearable debt burden on farmers. This is the burden that is pushing farmers to suicide. Government agencies have deliberately delinked the economic crisis farmers are facing from the psychological stresses that this results in. An attempt has been made to reduce the biggest crisis the Indian peasantry has faced in its long and ancient history to the problem of alcoholism and adultery, in order to protect the unworkable and non-sustainable trade liberalization policies as the basis of agriculture. Government and the implementing agencies, along with putting in place ways to rehabilitate the affected farmers. An attempt has been made to address the issue of farmer's plight leading to suicide and measures to address the issue have been suggested.

Keywords: Crops, Farmers, Government, Production, Rehabilitate Policies, Suicide

Introduction

Agriculture is the means of livelihood for over 60% of India's population. Despite a steady decline in its share to the gross Domestic Product (GDP) agriculture remains the largest economic sector in the country. In 2014, the National Crime Records Bureau of India reported 5,650 farmer suicides .The highest number of farmer suicides was recorded in 2004 when 18,241 farmers committed suicide. The farmers suicide rate in India has ranged between 1.4 to 1.8 per 100,000 of the total population in over a 10-year period through 2005. The reasons of suicide by farmers as reported by state governments, are manifold which inter-alia, include crop failure, indebtedness, drought, socio-economic and personal reasons.

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Literature Review

Despite all efforts to paint a rosy picture, the latest compilation of farmer suicide statistics for 2014 by the National Crime Record Bureau clearly brings out the dark underbelly of Indian agriculture. With 12,360 farmer suicides recorded in 2014, it only shows that one farmer commits suicide somewhere in the country every 42 minutes.

Although the NCRB has made a valiant effort to segregate the farm suicides figures into two categories – farmer, and agricultural workers – to show that farm suicides rate has fallen by 67 per cent, the fact remains that historically farm labourers have been counted as part of the farming category. Adding both the figures – 5,650 farmers and 6,710 agricultural workers – the death toll in agriculture for the year 2014 comes to 12,360, which is higher by 5 per cent over the 2013 farm suicide figures.

The serial death dance on the farm is a grave reflection of the terrible agrarian crisis that continues in farming for several decades now. While every successive government – both at the centre and in the States – have made tall promises to resurrect agriculture, the swing in farm suicide figures shows the callous and deliberate neglect of a sector that employs 60-crore people. Farmers have been very conveniently used for only reasons – as a vote bank and as a land bank.

Not showing any signs of petering off, a renewed spurt in suicides is now been witnessed in Uttar Pradesh, Karnataka, Maharashtra, Punjab and Haryana for the past few months.

In 2014, the NCRB data tells us that a third of the total suicides – 4,004 – took place in Maharashtra, followed by Telangana with 1,347 suicides. There is an attempt to downplay the suicide figures by almost all states, including Punjab, the food bowl of the country. This follows a trend that Chhattisgarh started in 2011 when it started showing zero farm suicides. After record zero suicides for 2011, 4 in 2012 and again zero in 2013, Chhattisgarh now shows a sudden jump in farm suicides to 755 in 2014.

In Punjab, as per NCRB data, only 22 farmers committed suicide in 2014. Add agricultural workers, and the final suicide toll comes to 64. This is a gross under-reporting of the real situation that exists. Panchayat records in just four villages of Sangrur and Mansa districts in Punjab show 607 suicides in past five years, with 29 deaths recorded between November 2014 and April 2015. Similarly, in Maharashtra, the Vidharbha Jan AndolanSamiti has contested the NCRB data. Several gaps in the counting methodology, including difficulty in putting women deaths in the farmer category since in most cases the land is not in their names has time and again been brought out.

Indebtedness and bankruptcy (22.8 per cent) tops the reasons behind these suicides; followed by family problems (22.3 per cent) and 19 per cent because of farming related issues. Growing indebtedness of course has been considered to be the major cause for the continuous death being witnessed on the farm.

According to a study conducted by Chandigarh-based Centre for Research in Rural and Industrial Development (CRRID) – the average farm debt has multiplied 22 times in the past decade in Punjab. From 0.25 lakh per household in 2004 it has gone upto Rs 5.6 lakh in 2014. Chhattisgarh tops the chart with an average debt of Rs 7.54 lakh, followed by Kerala with Rs 6.48 lakh household debt.

The total debt that farmers carry in Punjab is almost 50 per cent higher than the State's GDP from agriculture. At the same time, another study by CRRID shows that 98 per cent of rural families in Punjab are indebted, and the average debt is 96 per cent of the total income a household receives. If this is the situation in Punjab, imagine the plight of farmers elsewhere in the country.

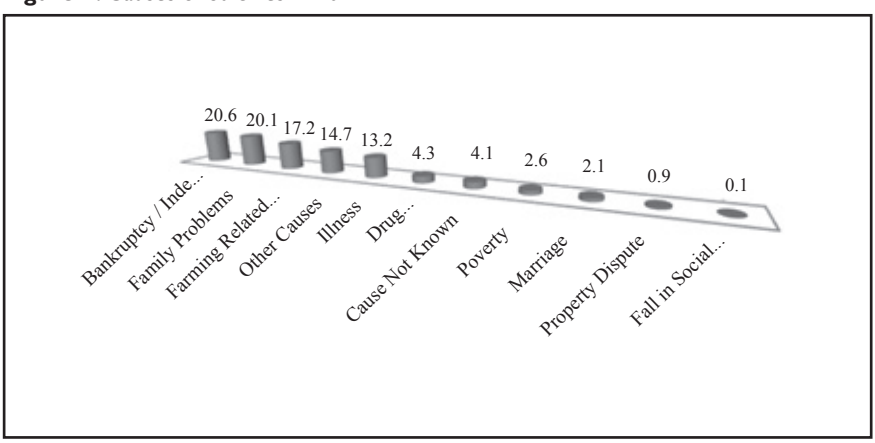
A study conducted in 2014 found that there are three specific characteristics associated with high risk farmers: "those that grow cash crops such as coffee and cotton; those with 'marginal' farms of less than one hectare; and those with debts of 300 Rupees or more." The study also found that the Indian states in which these three characteristics are most common had the highest suicide rates and also accounted for "almost 75% of the variability in state-level suicides."

A 2012 study did a regional survey on farmer's suicide in rural Vidarbha (Maharashtra) and applied a Smith's Saliency method to qualitatively rank the expressed causes among farming families who had lost someone to suicide. The expressed reasons in order of importance behind farmer suicides were – debt, alcohol addiction, environment, low produce prices, stress and family responsibilities, apathy, poor irrigation, increased cost of cultivation, private money lenders, use of chemical fertilizers and failure. In other words, debt to stress and family responsibilities were rated as significantly higher than fertilizers and crop failure. In a different study in the same region in 2006, indebtedness (87%) and deterioration in the economic status (74%) were found to be major risk factors for suicide.

Studies dated 2004 through 2006 identified several causes for farmers suicide, such as insufficient or risky credit systems, the difficulty of farming semi-arid regions, poor agricultural income, absence of alternative income opportunities forced non-farmers into farming, and the absence of suitable counseling service.

Data Findings

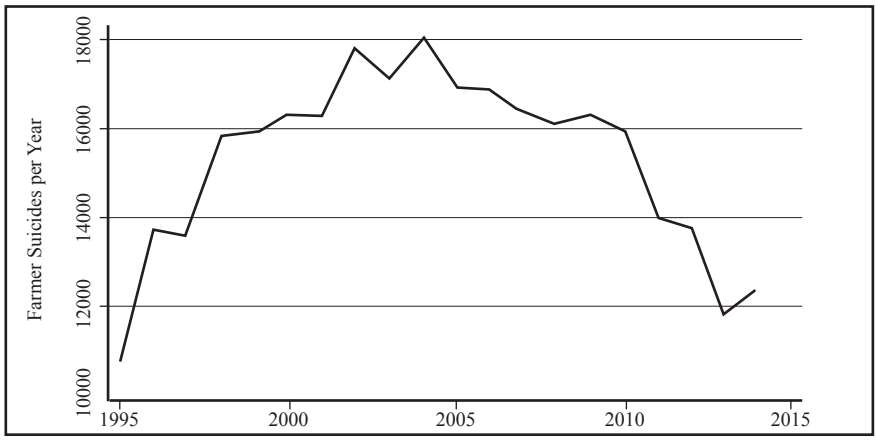
Figure-1: Causes of Suicides in 2014



Source: NCRB 2014

Bankruptcy or indebtedness (20.6%), family problems (20.1%) and crop failure (16.8%) were the main reasons for the farmer suicides in 2014, according to the NCRB.

Figure-2: Number of Farmer Suicides In India, 1995-2014.



In short, one needs a relative measurement to gauge the severity of the problem. That is why researchers estimate number of suicides per 1,00,000 population. This number is called suicide mortality rate (SMR). In Table-1 we have reported suicide mortality rate of farmers in India over the last 20 years (column 2).

Table-1: Farmer SMR and the Ratio of Farmer SMR and Non-farmer SMR in India, 1995-2014

Year	Farmer SMR	Non-Farmer SMR	Farmer SMR / Non-Farmer SMR
1995	5.42	10.87	0.50
1996	6.75	10.14	0.67
1997	6.52	11.00	0.59
1998	7.45	11.67	0.64
1999	7.32	12.22	0.60
2000	7.34	11.71	0.63
2001	7.17	11.50	0.62
2002	7.76	11.33	0.68
2003	7.37	11.25	0.65
2004	7.70	11.27	0.68
2005	7.15	11.22	0.64
2006	7.04	11.51	0.61
2007	6.77	11.86	0.57
2008	6.60	11.95	0.55
2009	6.60	11.96	0.55
2010	6.39	12.59	0.51
2011	5.57	12.69	0.44
2012	5.41	12.50	0.43
2013	4.58	12.43	0.37
2014	4.76	11.87	0.40

Note: Farmer SMR is the suicides of farmers per 1,00,000 farmers; non-farmer SMR is the suicides of non-farmers per 1,00,000 non-farmers.

It is clear from Table-1, column 2 that, like the total number of suicides, SMR also rose during the first ten years, and declined thereafter. The no of suicides have increased. It rose significantly for a decade after 1995 is borne out by the numbers we have reported in Table-1.

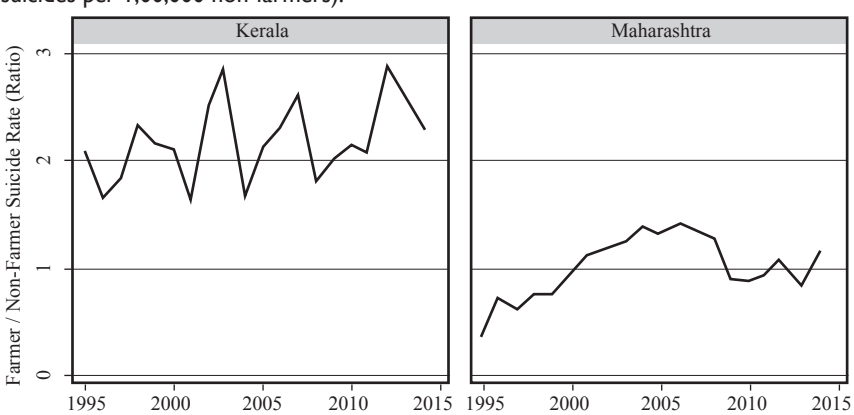
But from these numbers can we infer that farmers in particular have been at the receiving end? It can very well happen that during the same time, that is, from 1995 to 2004, suicide mortality rate rose for the entire population. This rising tendency to commit suicide in the whole population could be finding expression in terms of rising SMR among farmers as well. If such is the case then it would be incorrect to say that the root of rising farmer SMR lies in any trouble in the agricultural sector particularly. In that case, it would be wrong to infer that the agrarian economy is in distress, as some of us have been saying.

After calculating this ratio the numbers are reported in the column 3 of Table-1. The number confirms that this ratio of SMRs underwent a gradual rise from 1995 till about 2004, after which it fell. Thus, it appears that all the three indicators we have examined – total number of suicides, SMR of farmers, and the ratio of farmers' SMR to non-farmers' SMR – have undergone the same pattern of change over the last two decades: a rise in the first ten years (1995 to 2004) and fall in the last ten years (2004 to 2014).

To interpret the SMR ratio, it is useful to distinguish between levels and trends. If we consider the level of the SMR ratio, we see from column 3 of Table-1 and from (the blue line in) Figure-3, that it was always below unity. At its maximum in 2002 and 2004, the SMR ratio was 0.68. The fact that the SMR ratio has always been below unity at the all-India level suggests that the level of distress (that is a cause for suicides) has been relatively lower among farmers than among non-farmers if we consider the country as a whole. Even in the worst years (2002, 2004), the relative distress among farmers was lower than among non-farmers.

When we consider the trend, we see the following pattern: the SMR ratio displayed an increasing trend between 1995 and 2004; thereafter, the SMR ratio declined. Thus, for the decade long period between 1995 and 2004, things were going terribly wrong in the agricultural sector at the all-India level so that the relative rate of suicides among farmers was increasing in comparison to non-farmers. The fact that the SMR ratio fell since 2004 is perhaps an indication that those drivers of distress that led to the spurt of farmer suicides between 1995 and 2004 have mitigated to an extent in the subsequent period.

Figure-3: Ratio of farmer SMR and non-farmer SMR in Kerala and Maharashtra, 1995-2014. SMR of farmers = suicide mortality rate for farmers (farmer suicides per 1,00,000 farmers) ; SMR of non-farmers = suicide mortality rate for non-farmers (non-farmer suicides per 1,00,000 non-farmers).



Second, although the ratio of farmers' SMR to non-farmers' SMR was less than 1 this is true at the all-India level only. If we focus on individual states, we see that two states have defied that trend: Maharashtra and Kerala. In Figure-2 we have plotted the SMR ratio for Maharashtra and Kerala. In Figure-3, we have plotted the all-India SMR ratio with and without these two states, to show the importance of these two states in driving up the all-India SMR ratio.

Figure-4: Ratio of farmer SMR and non-farmer SMR in India with and without Kerala and Maharashtra, 1995-2014. SMR of farmers = suicide mortality rate for farmers (farmer suicides per 1,00,000 farmers); SMR of non-farmers = suicide mortality rate for non-farmers (non-farmer suicides per 1,00,000 non-farmers).

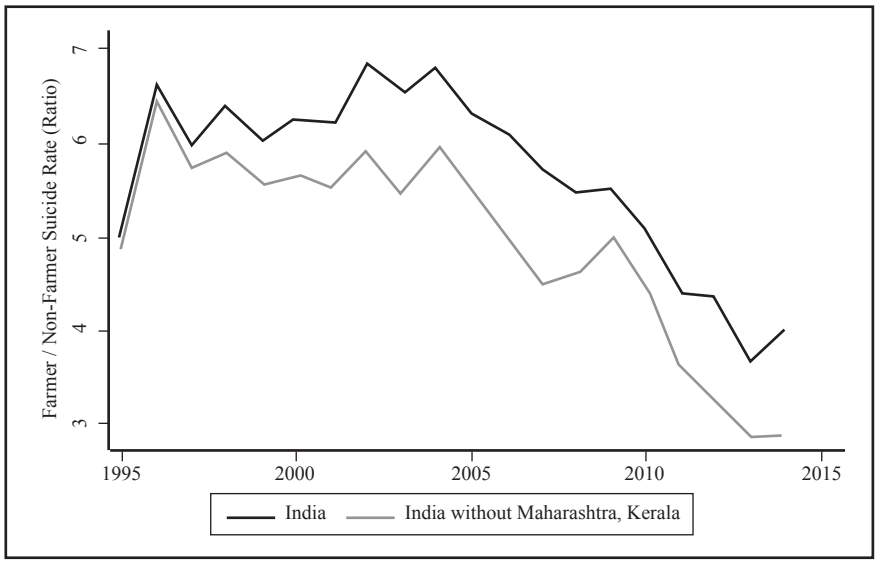


Figure-2 shows that in these two states the SMR ratio has been more than 1 for a number of years. In Kerala the ratio has fluctuated around a value that is greater than 2; in Maharashtra, it has stayed above 1 for most years after 2000. It implies that although Maharashtra occupies more media space on the subject of farmers' plight – as more suicides are committed in Maharashtra than anywhere else – the condition of farmers is grimmer in Kerala in a relative sense. Moreover, one observes a gradual rise in the ratio over the years in both these states. Thus, unlike the all-India picture, the suicide indicators have not come down at all in these two states after 2004.

Figure-3 shows that if Maharashtra and Kerala are taken out, the all-India SMR ratio improves a great deal. The red line (all-India data without these two states) is consistently and appreciably below the blue line (all-India data including these two states). Moreover, once Kerala and Maharashtra are removed, the SMR ratio declines continuously from 1996 onwards. This has important policy implications that we discuss below.

Low profitability directly affected the farmer, i.e., the person who cultivates and owns the land, for he is the person who earns profit and suffers losses. But it indirectly affects the agricultural labourers as well. Low profitability implies low investments and therefore low job generation, which adversely impacts the employment prospects of agricultural labourers. It is found that while between 1983

to 1993-94 employment in the primary sector grew at an annual rate of 1.35%, the rate subsequently fell to 0.67% (1993-94 to 2004-05) and then became negative, -0.13% (1999-2000 to 2009-10) [agricultural sector is the largest component of the primary sector]. Between 2001 and 2011 the total number of farmers (i.e., owner farmers and laboures taken together) went down from 234.1 million to 225.1 million. It is true that indebtedness is often found to be a reason for farmer suicides. These loans are often production loans which the owner-farmer took, and which could not be paid due to crop failure. Such suicides would not impact labourers as much as the owner-farmers. But it must be kept in mind that labourers are the poorest section of agrarian economy. Economic desperation which drives people to take their lives would be far more important to agricultural labourers than to owner-farmers.

We have the data of suicides by agricultural labourers categorised separately from owner-farmers for the year 2014. Thus it is possible to gauge the relative severity of suicide deaths among agricultural labourers, as compared to owner-farmers. In Table-2 we have reported the SMR of these two categories in different states. It can be seen that at the all India level, SMR of cultivators (owner farmers) is not much different from that of agricultural labourers: it is marginally higher. But there is lot of variation across states.

In Maharashtra, SMR of cultivators is quite high – it is twice the value of the SMR of labourers. In the land deficient Kerala, the opposite is true. SMR of labourers is more than three times as high as the SMR of cultivators. For other high farmer suicide states, we see the following pattern: In Andhra Pradesh and Karnataka they are almost similar. In Chhattisgarh, like in Maharashtra, cultivators have a higher SMR. In Tamil Nadu labourers have a higher SMR. In Madhya Pradesh cultivators have the higher figure. West Bengal reports zero suicides for cultivators; this makes the data suspect. In general it appears that land deficient states have higher SMR for labourers compared to cultivators. The fact that labourers are also getting killed in large number, in fact more in absolute number than the cultivators, is an important observation.

Table-2: Suicide Mortality Rate (suicides per 1,00,000 population) for Agricultural Labourers and Cultivators across Indian States, 2014

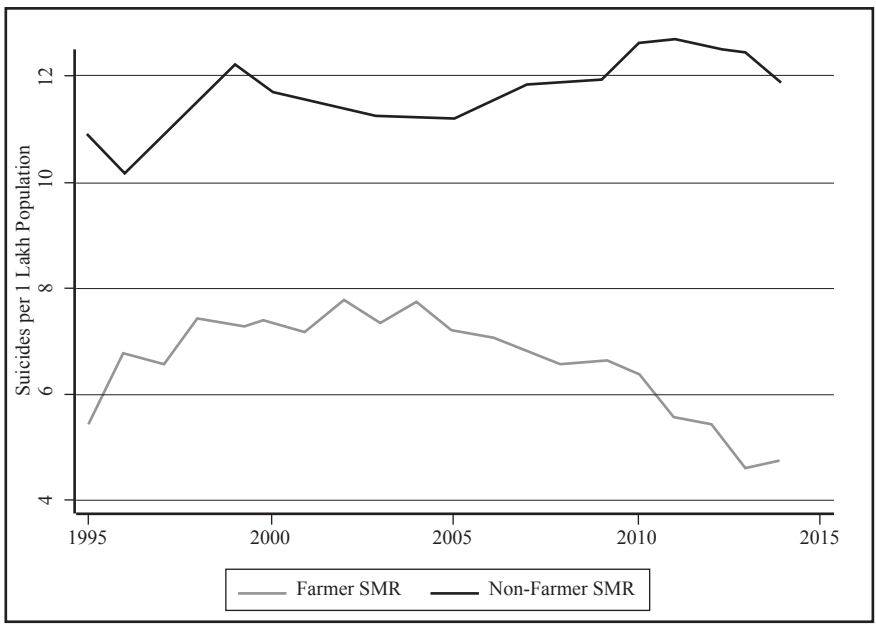
	Agricultural Labourers	Cultivators
Andhra Pradesh	2.79	2.75
Arunachal Pradesh	7.83	0.00
Assam	1.92	0.51
Bihar	0.05	0.00
Chhattisgarh	5.72	11.68
Goa Daman and Diu	0.00	0.00
Gujarat	8.01	0.88
Haryana	7.19	0.63
Himachal Pradesh	16.01	1.54
Jammu and Kashmir	4.31	1.13
Jharkhand	0.08	0.00
Karnataka	6.40	5.15
Kerala	73.24	19.28

	Agricultural Labourers	Cultivators
Madhya Pradesh	2.85	9.08
Maharashtra	10.68	20.69
Manipur	0.00	0.00
Meghalaya	1.00	0.00
Mizoram	22.82	0.00
Nagaland	0.00	0.00
Orissa	1.36	0.13
Punjab	2.67	1.34
Rajasthan	6.88	0.00
Sikkim	0.00	31.21
Tamil Nadu	9.54	1.88
Tripura	8.92	0.00
Uttar Pradesh	0.62	0.36
Uttarakhand	0.00	0.00
West Bengal	2.16	0.00
India	**4.54**	**5.04**

Decline in Suicides

The points discussed above give us a clue regarding the possible reasons for the decline in the farmer suicide rate after 2004. Although the overall direction of government policies did not change since 2004, some important welfare initiatives were put in place in last 10 years.

Figure 5: Farmer SMR (farmer suicides per 100000 farmers), and non-farmer SMR (non-farmer suicides per 100000 non-farmers) in India, 1995-2014.



Source: Data: Sources and Definitions

We capture the severity of farmer suicides by the ratio of the farmer suicide mortality rate (SMR) and the non-farmer suicide mortality rate. By "farmer" we mean a person who is either a cultivator (someone who works on owned or hired land) or an agricultural labourer (someone who works on others' land). The SMR for farmers is defined as the number of farmer suicides per 1 lakh farmer population; the SMR for non-farmers is defined in an analogous manner as the number of non-farmer suicides per 1 lakh non-farmer population. We calculate SMRs for farmers and non-farmers at the all-India level and for all major states.

The data on the number of farmer suicides and total suicides have been extracted from various years of *Accidental Deaths and Suicides in India*, an annual publication of the National Crime Records Bureau. The difference between total and the farmer suicides gives us the number of non-farmer suicides.

The data on the population of cultivators and agricultural labourers have been taken from reports of the Censuses for 1991, 2001 and 2011. The number of farmers is the sum of the number of cultivators and agricultural labourers in rural India.

Responses to Farmers' Suicides

The government appointed a number of inquiries to look into the causes of farmer's suicide; The following are the relief measures:

In 2006, the Government of India identified 31 districts in the four states of Andhra Pradesh, Maharashtra, Karnataka, and Kerala with high relative incidence of farmer's suicides. The Government of India next implemented the Agricultural debt Waiver and Debt Relief Scheme in 2008 to benefit over 36 million farmers at a cost of ₹653 billion (US$9.6 billion).

Various state governments in India have launched their own initiatives to help prevent farmer suicides. The government of Maharashtra set up a dedicated group to deal with farm distress in 2006 known as the Vasantrao Naik Sheti Swavlamban Mission, based in Amravati. The State Government also announced that it will form Village Farmer Self Help Groups, that will disburse government financed loans,a low rate Crop Insurance program whose premium will be paid 50% by farmer and 50% by government, launch of alternate income opportunities such as poultry, dairy and sericulture for farmers in high suicide prone districts.

Kerala, in 2012, amended the Kerala Farmers' Debt Relief Commission Act, 2006, to extend benefits to all distressed farmers with loans through 2011. It cited continuing farmer suicides as a motivation.

Special Rehabilitation Package for Rehabilitation of Distress Farmers and their Family Members

Central as well as State Government has announced the special packages in the State of Maharashtra. i) Package of Central Government Prime Minister visited the Vidarbha region in July 2006 and announced a package of Rs.3750 crores to the families of the farmers in Maharashtra. Under the package, an 8 additional credit of Rs.1275 was earmarked for disbursement in the identified region. Entire interest on overdue loan was waived and principal rescheduled for 3 to 5 years. The other important components of the package are as under: PM's Package – goal & means

- Establishment of sustainable and viable farming, livelihood support system through:
  - Complete credit cover through institutional credit sources
  - Debt relief by restructuring overdue loans and interest waiver
  - Assured irrigation facilities
  - Effective watershed management
  - Seed replacement program
  - Subsidiary income opportunities through horticulture, livestock, dairying, fisheries, etc
  - Better extension and farming support services and improved marketing facilities
- Components & targets
  - Ex-gratia assistance from PMNRF – Rs. 50 lakh per district
  - Debt relief to farmers – Re-scheduling of OD loan as on June 30, 2006
  - Fresh credit to farmers
  - Interest waiver – Entire OD interest as on July 1, 2006, to be shared equally by Center and State
  - Assured irrigation facilities – Completion of all major, medium and minor irrigation projects sanctioned under AIBP and RIDF in 3 year time.
- Seed replacement program
- 50% subsidy for quality seed over 3 years (entitlement 1 ha / farmer)
- Watershed Development
  - construction of check dams – 500 per district per year for 3 years
  - area treatment under watershed development - 15000 ha per district per year for 3 years
  - construction of rain water harvesting structures by SC/ST/SF/MF beneficiaries with 50% bank loan and 50% back ended subsidy - 1000 beneficiaries per district per year for 3 years
- Horticulture Development
  - All districts to be covered under National Horticulture Mission
  - Launching of a Technology Mission on Citrus
- Micro Irrigation – All districts to be covered under Scheme of Micro Irrigation for propagation of Drip and Sprinkler Irrigation
- Extension Services – All districts to be covered under ATMA (Agriculture Technology Management Agencies) to ensure extension support and convergence at district level.

Conclusion

For last few years every other day we read the news of farmers committing suicides. Innovative remedies have to be thought of which can be implemented with sincerity by the Government and the implementing agencies, along with

putting in place ways to rehabilitate the affected farmers. Several studies have been conducted by the Government and social science organizations to analyse the agrarian crisis and farmers suicides.

The present study focused on the phenomenon of farmer suicides in India specifically Maharashtra. This paper discussed the various factors leading to farmer suicides. International, national, and local level factors all contribute. Globalization, inadequate government policies, along with ecological distress and social issues are more specific reasons. Based on these facts, this paper recommended policy suggestions to pursue as preventative strategies. The advocacy of organic farming techniques, an increase in insurance schemes, and the creation of community groups for farmers all would have a positive impact on a farmer's livelihood. The study has identified various reasons, that range from poverty to marriage-related reasons, drug and alcohol addiction, and property disputes, of which Maharashtra tops in almost all the counts.

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The Relationship Between Public Expenditure and Economic Growth in South India: An Econometric Analysis

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Abstract

Public expenditure is the effective measures whereby different economic and social objectives. The increasing expenditure are leads to the acceleration of the improving the living standards, stabilization of economic activity, balanced regional development in addition to the orthodox classical objectives of defence, maintenance of law. It is to explain the compositional changes in the public expenditure of Southern States and to test the validity of "Wagner's Law" and "Peacock and Wiseman law" to the growth of Public expenditure in Southern States. The growth trend and compositions of Public expenditure of southern states are namely Andhra Pradesh, Karnataka, Kerala and Tamil Nadu during 1990-91 to 2013-14. It is divided into six sections. The first section is introductory in nature and discusses the various nuances public expenditure. The second section deals with various theoretical developments of Public expenditure; the third section deals with the objectives. Fourth section is focus on research methodology. The fifth deals about the results and discussion and lastly summary and conclusion.

Keywords: Public Expenditure, Economic Growth, India, Southern States

Introduction

Public expenditure is the effective measures whereby different economic and social objectives. The objectives consists of the acceleration of the rate of economic growth, equitable distribution of income, improving the living standards, stabilization of economic activity, balanced regional development in addition to the orthodox classical objectives of defence, maintenance of law and order. It tries to bring regional balance in the economy as well. In every State, there are some underdeveloped regions. Government expenditure can be effective in bringing prosperity to such depressed areas through the allocation of greater proportion of Public expenditure on different socio-economic upliftment programmes and thereby may ensure balanced regional development. Further more progressive expenditure leads to reduction in inequalities. It is uses for a long time have been the minimization of Inequalities in the distribution of income and wealth.

State has been widening and depending as a result maximizing welfare and developmental expenditure along with increasing population. State finance occupies a predominant role in economic and social developments of the people

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as states are nearer to the people than the centre. Though, Public expenditure is a means to achieve social well-being of the people and also promote agriculture, industry, transport, health and development sectors intended to the welfare of the society. In the Indian federal setup, the centre and state government decide the composition of Public expenditure in India. The success of these efforts to Public expenditure with appropriate composition, but the major states in India failed to pay adequate attention to Public expenditure composition and its effectiveness. It is emerged in Public expenditure of state governments either concentrated on expenditure or expenditure items in individual states.

Theories of Public Expenditure

Adolf Wagner (1835-1917), a German political economist, stated that "increasing state activities" known as Wagner's law or Wagner Hypothesis of public expenditure. According to, there is a positive relationship between economic growth and public expenditure or the causality runs from economic growth to government spending. On the contrary, Keynesian (1936) emphasized the economic depression, to supplement effective demand in the crisis or resolve the crisis emerging out of under-consumption or over production. The government has the political, social and economic responsibility of balancing the economy.

Robert Solow argued that economic growth and public spending were not significantly related to each other in the long-run. According to him, technological change and rate of growth in population determined the performance of the economy. Romar (1986), Lucas (1988), Barro (1990) and Rebelo (1991) supported the growth model proposed by Solow. Barro (1990) upheld the view that the government expenditure focus on productive sector, which would stimulate economic growth through expenditure on the productive sector. In short, growth in expenditure in the non-productive sector or on welfare measure would leave adverse consequences on its growth performance of any economy. In the parlance of government in the present era, such standpoints tantamount to the view that capital expenditure is preferred to current expenditure by the state. In developing countries, governments do increasingly resort to stimulate economic growth and it has resulted in an enormous increase in public expenditure.

Wagner's Theory of Public Expenditure

He evolved a 'law of increasing expansion of public, and particularly state, activities'. He anticipated that the development of modern industrial society would give rise to increasing political pressure for social progress and increasing importance to social considerations in industry. Consequently, the public sector would need to expand as well. According to him, the main cause of the growth in public expenditure was the growth of the economy. As the economy grows, the public sector also expands. Wagner's hypothesis of increasing state activity holds that, as per capita income and output increase, the public sector or total economic activity. The relative share in the increase in government expenditure would result in increase the output more than proportionately.

Wiseman-Peacock Hypothesis

The growth of public expenditure was put forward by Wiseman and Peacock in their study of public expenditure in the United Kingdom during the period

1890-1955. The observation was that public expenditure does not increase in a smooth and continuous manner, but in jerks or step-like fashion. Peacock and Wiseman have described the process of growth in public expenditure. They start with a normal situation, in which tax rates are low and stable and public expenditure is in keeping with taxes, the only growth in public expenditure is coming from growth of real output, the community being averse to the idea of higher levels of taxation. A 'social disturbance' such as a war causes increase in public expenditure and public revenue becomes inadequate. Such disturbances are called 'displacement effect' that is, both public expenditure and public revenue are shifted to a new, higher level. Even after the disturbance is over, government spending remains at a high level as a result of the need to fulfill certain obligations connected with the disturbance (such as war pensions) but also the government take on added functions that were not thought 'desirable' before the great depression during 1930's. This higher level of public expenditure is possible because revenue also remains high due to a willingness of the tax payers who accept the higher level of taxation as they become more conscious of the responsibilities of the government.

Market Failure Theory

Another justification for the public expenditure comes from the functions of the public sector. Market failure theory was first put forward by Francis Bator. He contends that there are some areas where the private sector would not produce at all if left to itself. More importantly, there are some goods that the private sector can produce, but they may not always be of the desired quality, quantity and price.

Another significant role of the public sector is in providing merit goods, that is, goods that are private in nature (i.e., rival and excludable) but that have large positive externalities. The prices charged for such goods by a private producer would not be able to capture the wider social benefits and hence may not be supplied in adequate quantities, thus reducing total welfare of the society. Another instance of market failure is when more of the society's resources get allocated to the production of luxury goods in response to the demand expressed by a few rich individuals and inadequate resources remain for the production of necessities. Goods like transport and power are subject to decreasing costs as their output increases. Private producers may find it profitable to produce less and charge a higher price. The output of such goods, which are essential goods, will be less than optimum and social welfare will be reduced. Since the marginal cost of producing public goods is nearly zero, additional users can be added at no extra cost (e.g., bridge and defense). Provision of such goods should be undertaken on a large scale to minimize costs.

Public Choice Theory

Public choice theory applies to theories and methods of Economics analysis of political behaviour. Duncan Black, Kenneth Arrow, James Buchanan, Gordon Tullock, Anthony Downs, William Niskanen, Mancur Olson, William Riker and others. Public choice literature continues to grow, with recent contributions from several Economists, including William Shughart and Amartya Sen (Shughart 2008).

Public Choice theory focuses on how collective decisions are made about which goods are to be provided through the public budget and what taxes should be levied in order to finance such expenditure. In a democracy, there are three major groups that decide the allocation of resources in the public budget – the voters, politicians and bureaucrats. Public choice theory examines the behaviour of these three groups. Each of these groups is taken to be acting rationally and trying to maximize its own self-interest in their interactions with each other.

Objectives of the Paper

The objectives is to explain the compositional changes in the public expenditure of Southern States and to test the validity of "Wagner's Law" and "Peacock and Wiseman law" to the growth of Public expenditure in Southern States. The growth trend and compositions of Public expenditure of southern states namely Andhra Pradesh, Karnataka, Kerala and Tamil Nadu during 1990-91 to 2013-14.

It is divided into six sections. First chapter is discusses the various nuances public expenditure and second deals with various theoretical developments of Public expenditure; the third section deals with the objectives. The fourth section is focus on research methodology. The fifth deals about the results and discussion and lastly summary and conclusion.

Research Methodology and Data Sources

The research paper depends on secondary data from different published Government Reports like Economic Survey published by the Planning Department, Government of India for various years. Reviews on State Finances, published by the Reserve Bank of India, for various years. Five Year Plans, published by Planning Commission, Government of India. In addition to the above sources, many Studies, Reports, Status papers, working papers prepared by different Government Departments and Non-Governmental Organizations have also been consulted. The growth trend and compositions of Public expenditure of southern states namely Andhra Pradesh, Karnataka, Kerala and Tamil Nadu during1990-1991 to 2013- 2014.

Statistical Tools

In order to test trends in the revenue expenditure the tools namely Unit root tests, Co integration tests, Granger Causality test and Auto Regressive Move Average (ARIMA) have been applied for estimating the responsiveness of government expenditure to State Gross State Domestic Product (GSDP).

The paper is divided into six sections. First section discusses the various nuances of public expenditure and second section deals with various theoretical developments of Public expenditure. The third section deals with the objectives. The fourth section focuses on research methodology. The fifth section deals with the results and discussion and the last section deals with summary and conclusion.

Results and Discussion

In order to test trends in the revenue expenditure the tools namely Unit root tests, Co integration tests, Granger Causality test and ARIMA have been applied for

estimating the responsiveness of government expenditure to State Gross State Domestic Product (GSDP).

Unit Root Test

The logic behind the Auto Regressive Move Average is based on stationary time series. A series is said to be stationary if the mean and auto-covariance of the series do not depend on time. A series do not follow the conditions is said to be non-stationary, is otherwise called as Random walk.

$$y_t = y_{t-1} + \epsilon_t$$

$$y_t - y_{t-1} = (1 - L)y_t = \epsilon_t$$

Where ε is a stationary random disturbance term. The series 'y' has constant forecast value, conditional on 't', and variance is increasing over time. The random walk is a difference stationary series since the first difference of y is stationary.

A difference stationary series is said to be integrated and is denoted as I (d) where d is the order of integration. The order of integration is number of unit roots contained in the series, or the number of differencing operations it takes to make the series stationary.

Augmented Dickey Fuller Test (ADF)

The Simple AR (1) process is:

$$y_t = \rho y_{t-1} + x_t'\delta + \epsilon_t \quad \text{..... (1)}$$

Where

Xt = Exogenous regressors consists of Constant or Constant and Trend

ρ and δ = Parameters to be estimated

ϵ_t = White noise (Error term)

The equation (1) becomes after subtracting y_{t-1} from the both sides of the equation:

$$\Delta y_t = \alpha y_{t-1} + x_t'\delta + \epsilon_t \quad \text{..... (2)}$$

Where $\alpha = \rho - 1$.

The ADF test constructs a parametric correction for higher order correlation by assuming that the y series follow an AR (p) process by adding p lagged difference terms of the dependent variable y to the right-hand side of the test regression

$$\Delta y_t = \alpha y_{t-1} + x_t'\delta + \beta_1 \Delta y_{t-1} + \beta_2 \Delta y_{t-2} + \cdots \ldots \ldots + \beta_p \Delta y_{t-p} + \epsilon_t$$

…….(3)

Based on the above methodology, the study tested the core variables (GSDP, TRE) contain unit roots (Stationary) or not (non-Stationary).

Table-1: Unit Root Test for South India

	Andhra Pradesh					
For TPE	ADF (0)	'p'	ADF(1)	'p'	ADF (2)	'p'
Constant	1.496	0.998	-3.851	0.0084	-7.396	0.000
Constant and trend	-0.068	0.992	-4.641	0.0066	-7.200	0.000
	For GSDP					

Constant	13.104	1.00	-0.311	0.908	-7.982	0.000
Constant and trend	4.539	1.00	-2.617	0.276	-8.387	0.000
			Karnataka			
For TPE	ADF (0)	'p'	ADF(1)	'p'	ADF (2)	'p'
Constant	1.225	0.997	-3.877	0.007	-7.435	0.000
Constant and trend	-0.138	0.990	-4.584	0.007	-7.237	0.000
			For GSDP			
Constant	9.371	1.00	-1.152	0.675	-9.241	0.000
Constant and trend	2.758	1.00	-3.855	0.032	-9.373	0.000
			Kerala			
For TPE	ADF (0)	'p'	ADF(1)	'p'	ADF (2)	'p'
Constant	0.9537	0.994	-3.681	0.012	-6.450	0.000
Constant and trend	-0.310	0.985	-4.198	0.016	-6.272	0.003
			For GSDP			
Constant	13.943	1.00	-0.141	0.932	-7.940	0.000
Constant and trend	4.827	1.00	-2.486	0.330	-8.302	0.000
			Tamil Nadu			
For TPE	ADF (0)	'p'	ADF(1)	'p'	ADF (2)	'p'
Constant	1.373	0.998	-3.337	0.025	-6.188	0.000
Constant and trend	0.068	0.994	-3.920	0.028	-6.014	0.000
			For GSDP			
Constant	11.706	1.00	0.164	0.963	-4.261	0.003
Constant and trend	4.098	1.00	-1.786	0.676	-4.421	0.011

Table-1 provides unit root test of the variable Total Public Expenditure and Gross Domestic Product of Southern States. Augment Dickey Fuller Test is applied to check whether the series contain unit roots or not. It is clearly visualized in the table that the series has unit root with zero differencing. The variable total public expenditure for all the states show significant p value both with constant and trend at first order differencing. The GSDP has not shown any significance at the order (1). It is understood that both Total Public Expenditure and Gross State Domestic Product of Southern States are stationary in second order difference.

Cointegration Test

Time series can be cointegrated in various ways, with details such as trends assuming some importance because asymptotic distributions depend on the presence or lack of such terms. If cointegration is detected, Vector Error Correction (VEC) or nonstationary regression methods

May be equation.

Johansen Cointegration Test

Consider a VAR of order p:

$$y_t = A_1 y_{t-1} + \cdots \ldots \ldots \ldots + A_p y_{t-p} + B x_t + \epsilon_t$$

Where

y_t is a k-vector of non-stationary I (1) variables, xt is a d-vector of deterministic variables and ϵ_t is a vector of innovation. Rewriting the VAR equation is as follows:

$$\Delta y_t = \Pi y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta y_{t-1} + B x_t + \epsilon_t$$

Granger's representation theorem asserts that if the coefficient matrix Π has reduced rank r<k, then there exist k x r matrices α and β each with rank r such that $\Pi = \alpha\beta'$ and $\beta' y_t$ is I(0). r is the number of cointegrating relations (the cointegrating rank) and each column of α is the cointegrating vector. As explained below, the elements of are known as the adjustment parameters in the VEC model. Johansen's the $\prod$ matrix from an unrestricted VAR and to test whether we can reject the restrictions implied by the reduced rank of $\prod$. Based on the above methodology, the study has applied Johansen Cointegration test for the variables and the test result is produced in the Table-2 for four southern states of India.

Table-2: Cointegration Test Result for South India

Trace Test: Andhra Pradesh					Maximum Eigen value Test			
Hypothesized No. of CE(s)	Eigen Value	Trace Statistic	Critical Value (5%)	Prob	Eigen Value	Max.Eigen Statistic	Critical Value (5%)	Prob
None*	0.629	24.59	15.49	0.001	0.629	21.852	14.264	0.002
At most 1*	0.116	2.73	3.84	0.098	0.116	2.737	3.841	0.098
Trace Test: Karnataka					Maximum Eigen value Test			
Hypothesized No. of CE(s)	Eigen Value	Trace Statistic	Critical Value (5%)	Prob	Eigen Value	Max.Eigen Statistic	Critical Value (5%)	Prob
None*	0.505	18.434	15.494	0.017	0.505	15.473	14.264	0.032
At most 1*	0.125	2.960	3.841	0.085	0.125	2.960	3.841	0.085
Trace Test: Kerala					Maximum Eigen value Test			
Hypothesized No. of CE(s)	Eigen Value	Trace Statistic	Critical Value (5%)	Prob	Eigen Value	Max.Eigen Statistic	Critical Value (5%)	Prob
None*	0.627	25.20	15.494	0.001	0.627	21.727	14.264	0.002
At most 1*	0.146	3.47	3.841	0.006	0.146	3.477	3.841	0.006
Trace Test: Tamil Nadu					Maximum Eigen value Test			
Hypothesized No. of CE(s)	Eigen Value	Trace Statistic	Critical Value (5%)	Prob	Eigen Value	Max.Eigen Statistic	Critical Value (5%)	Prob
None*	0.440	13.137	15.494	0.109	0.4403	12.768	14.264	0.085
At most 1*	0.016	0.368	3.841	0.543	0.0166	0.368	3.841	0.543

Source: Computed

The first block reports the so-called trace statistics and the second block reports the maximum eigenvalue statistics. For each block, the first column is the number of cointegrating relations under the null hypothesis, the second column is the ordered eigenvalues of the $\prod$ matrix, the third column is the test statistic, and the last two columns are the 5 percent and 1 percent critical values.

It is computed as:

$$LR_{tr}(r|k) = -T \sum_{i=r+1}^{k} log(1-\lambda_i)$$

Where $\lambda_i$is the *i*-th largest $\prod$ matrix which is reported in the second column of the output. The output reports the maximum eigenvalue statistic.

It is to be less than 0.05 and the trace statistic value (24.59 and 2.73) is greater than the table value (15.49 and 3.84). There exists a cointegration between Revenue expenditure and GSDP of Andhra Pradesh.

The p value is found to be less than 0.05 and the trace statistic value (18.43 and 2.96) is greater than the table value (15.49 and 3.84). It is inferred that there exists a cointegration between Revenue expenditure and GSDP of Karnataka.

The p value is found to be less than 0.05 and the trace statistic value (25.20 and 3.47) is greater than the table value (15.49 and 3.84). It is inferred that there exists a cointegration between Revenue expenditure and GSDP of Kerala.

The p value is found to be greater than 0.05 and the trace statistic value (13.13 and 0.368) is greater than the table value (15.49 and 3.84). It is inferred that there exists nocointegration between Revenue expenditure and GSDP of Tamil Nadu.

Granger Causality Test

Granger established the direction of relationship between two variables. y is said to be Granger-caused by x if x helps in the prediction of y, or equivalently if the coefficients on the lagged x's are statistically significant. The bivariate relationship is as:

$$y_t = \alpha_0 + \alpha_1 y_{t-1} + \cdots \ldots + \alpha_l y_{t-l} + \beta_1 x_{t-1} + \cdots \ldots + \beta_l x_{-l} + \epsilon_t$$

$$x_t = \alpha_0 + \alpha_1 x_{t-1} + \cdots \ldots + \alpha_l x_{t-l} + \beta_1 y_{t-1} + \cdots \ldots + \beta_l y_{-l} + u_t$$

Based on the above methodology, granger causality test is applied and the result is produced in the table.

Table-3: Granger Causality Test for South India

Null Hypothesis:	Andhra Pradesh	F-Statistic	Prob.
GSDP does not Granger Cause	Total Public Expenditure	11.7648	0.0006
TPE does not Granger Cause	Gross State Domestic Product	2.8457	0.0859
	Karnataka		
GSDP does not Granger Cause	Total Public Expenditure	9.27953	0.0019
TPE does not Granger Cause	Gross State Domestic Product	0.52533	0.6007
	Kerala		
GSDP does not Granger Cause	Total Public Expenditure	3.953	0.038
TPE does not Granger Cause	Gross State Domestic Product	2.2378	0.122
	Tamil Nadu		
GSDP does not Granger Cause	Total Public Expenditure	8.17733	0.0033
TPE does not Granger Cause	Gross State Domestic Product	2.29490	0.1311

Source: Computed

Granger causality test is applied to ascertain the unidirectional or bidirectional relationship between the two variables, and the results are tabulated. It is revealed

from the test that the F-value is 11.768 and probability value is 0.0006, which shows that the GSDP do not granger causes TPE at 5 percent level of significance. It is also observed that the F -Statistic value is 2.8457 and probability value is 0.0859 (8 percent), which indicates that the GSDP do not granger because TPE at 10 percent level of significance. Hence, the null hypothesis is accepted. The results demonstrate that there is no lead-lag relationship between GSDP and TPE.

For the State Karnataka, it is revealed from the test that the F-value is 9.27 and probability value is 0.0019, which shows that the GSDP do not granger causes TPE at 5 percent level of significance. It is also observed that the F -Statistic value is 0.523 and probability value is 0.600 (60 percent), which indicates that the GSDP do granger cause TPE. Hence, the Alternative hypothesis is accepted. The results demonstrate that there is a relationship between TPE and GSDP.

For the State Kerala, it is revealed from the test that the F-value is 3.953 and probability value is 0.038, which shows that the GSDP do not granger causes TPE at 5 percent level of significance. It is also observed that the F -Statistic value is 2.237 and probability value is 0.122 (12 percent), which indicates that the GSDP do granger cause TPE. Hence, the Alternative hypothesis is accepted. The results demonstrate that there is a relationship between TPE and GSDP.

For the State Tamil Nadu, it is revealed from the test that the F-value is 8.177 and probability value is 0.003, which shows that the GSDP do not granger causes TPE at 5 percent level of significance. It is also observed that the F -Statistic value is 2.294 and probability value is 0.131 (13 percent), which indicates that the GSDP do granger cause TPE. Hence, the Alternative hypothesis is accepted. The results demonstrate that there is a relationship between TPE and GSDP.

Conclusion

The causal nexus between public expenditure and state domestic product of southern states for the year 1990-91 to 2013-14. Granger, Johansen Cointegration and ADF tests are employed to examine the objective. The analysis reveals that there is an independent relationship between public expenditure and state domestic product in southern states. The possible reasons behind an independent relationship between the two are:-Economic growth is not having an impact on public expenditure due to the vested interest of elected representatives. Expansion of public expenditure is on the basis of populistic measures and enhancement of vote bank of elected representatives.

The positive and negative impact of public expenditure on economic growth will nullify the actual influence of public expenditure on economic growth. The impact of government expenditure is positive due to (a) government will play a role of harmonizing the complex between private and social interest, (b) there is a prevention of exploitation of the country by foreigners, and (c) securing an increasing productive investment and providing a socially optimum direction of growth and development.

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