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# Asset Creation through MGNREGA – A Study of Yellur Gram Panchayat in Udupi District of Karnataka

**Pesala Peter***
**I. Maruthi****

## Abstract

The government is helping rural india in creating assets, one such way is asset creation at community level and second is asset creation at individual level. Under MGNREGA Scheme, individual asset creation is taking place in the entire State of Karnataka. Out of the MGNEREGA covered 30 districts spread across the state, the present study is carried in gram panchayat of yellur of Udupi district. The study selected 30 beneficiary households through transit walk during field visits. Findings of the study are that the land size is higher with OBC category than that of SC, OC and ST. OBC category stands higher economically as compared to other social groups in sample households. Construction of a house was taken as a major asset creation at individual level in Yellur GP. The study suggests that the policy should be altered to release 20 percent of the amount at the initial stage so that other social groups will also get benefited from the scheme.

**Keywords:** Case Study, Individual Asset Creation through MGNREGA, and Satisfaction of Beneficiary Households

## Introduction

In places of Karnataka new farm ponds, dug wells, other water harvesting structure, livestock shelter construction, fish drying yards, and other assets are crated under individual asset creation. In addition to that community

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level asset creations are also taking places in Karnataka. These asset creations will provide water facilities, infrastructure facilities and other suitable facilities that will help to enhancing the agricultural production and productivity. This leads to increase the farmer's income in long run. The study focuses on individual asset creation and households' welfare through MGNRGEGA. The study conducted empirical study to know the welfare of the rural and selected sample households. The individual asset creation, in total increased from 3,20,808 in 2014-15 to 4,50,155 in 20-16-17 in Karnataka. In the same way, the asset created against total works completed is significantly increased from 95 per cent in 2014-15 to 99 per cent in 2016-17. Similar results were found in Udupi district. In 2014-15, total works completed were 4,629 and in 2016-17 it was 4,720. The percentage of assets created against total works completed has also significantly increased from 96 to 99 in the above mentioned years. In case of Yellur GP there were total 24 assets created in 2014-15 but declined to 15 in 2015-16. During the study period a meagre 61 assets were created in entire Gram Panchyat (GP). However assets created against total works completed is hundred per cent (Table-1) in selected GP.

**Table-1:** Total Individual Asset Created During Mentioned Years in GP, District and State

| State / Udupi District / Yellur GP | Years | Total Works Completed | Assets Created Against Total Works Completed |
|---|---|---|---|
| Karnataka State | 2014-15 | 320808 | 305901(95.35)* |
| | 2015-16 | 404366 | 396108(97.96) |
| | 2016-17 | 450155 | 447232 (99.35) |
| Udupi District | 2014-15 | 4629 | 4443 (95.98) |
| | 2015-16 | 3795 | 3760 (99.08) |
| | 2016-17 | 4720 | 4686 (99.28) |
| Yellur GP | 2014-15 | 24 | 24(100) |
| | 2015-16 | 16 | 16(100) |
| | 2016-17 | 21 | 21(100) |

Source: http://nrega.nic.in/netnrega/home.aspx;

* indicates that percentage to asset created against total works completed.

For assets creation, many people are involved in labour work, were benefited more employment days and improved their purchasing power parity (PPP) during above said period.

## Statement of the Problem

MGNREGA is one of the major poverty alleviation programs in the world (Benni - 2017). Through this program government provides 100 man days for rural unskilled workers. Any one interested in this program can participate with prior registration of their names in the Gram Panchayat. For providing 100 day employment purpose, government is creating two

assets, one is community assets and second, individual asset. School compound wall, Anganwadi centers / compound wall, water conservation, water harvesting structure, rural connectivity, drought proofing, land development, flood control and protection are covered under community level assets. In a similar way, livestock shelters, house construction, farm ponds, plantation, farm forestry, horticulture, water harvesting structures, development of fallow or waste lands, dug well and toilet / sanitation are under individual assets. So far, majority of the literature and studies focused on employment and labour prospects in MGNREGA work and secondly, MGNREGA improving purchasing power parity (PPP) in rural people. To the best knowledge of the author studies asset creation at individual level are not available hence the study focuses on this. Udupi district comes under low performance district as well Yellur GP. Based on the number of man days generated by the district, the study confirmed the district as low performance district.

## Methodology

In Karnataka, out of 30 selected districts, the study purposively selected Udupi district in the first stage. In second stage, again the study selected one GP namely Yellur from the same district. In final stage, 30 beneficiary households were selected and all selected households are from Yellur village. There are no hamlets in this GP. In a total of 30 beneficiary households who participated in manual labour work under the MGNREGA programme during the three-year period identified for the study i.e. 2016-17, 2015-16 and 2014-15, were drawn as the primary sample of the study. The 30 beneficiary household selected through transit walk during our filed visit. The study primary data collected during the month of March-May, 2018. The secondary data collected from MGNREGA website. In this paper, the study exclusively focused on asset creation through MGNREGA. The objective of the study is to investigate individual asset creation through MGNREGA and whether it is a helpful to the farmers' welfare in the village of Yellur. The study used structured questionnaire for collection of primary data. The hypothesis of the study is that there is a positive impact on MGNREGA in individual asset creation at village level. Present study is also moved with above said assumption.

## Profile of Yellur

Yellur village, a Gram Panchayat as for 2011 census. In the village there are 2543 male and 2910 female population and 1265 households were living (Census 2011) together. The study observed that female population is higher than the male population in the village. In case of SCs, the male population is 170 and female population is 194 and the total SCs population is 364. In a similar way, the male ST population is

28 and the female population is 27. There are 254 total job cards issued and 533 registered workers available in the GP. Out of 533 workers, SC-57 (10.7%), ST-8 (1.5%) and Other communities are 468 (87.8%) registered their names in the GP. Among the workers, the share of women is 305 (57.2%). The active workers in SC-17(29.8%), ST-0 (0.0%), Other-186 (39.7%) and the total active workers are 203 (38.1%). The active women workers are 114 (37.4%). Based on the above information, the study stated that majority of them are in-active.

## Results and Discussion

The study selected 30 beneficiary households. Out of 30 sample households, half (50%) of the sample households belong to OBC category (50%), followed by OC (40%), SC (7%) and ST (3%) (Table-2). The data indicates that almost all social group households are living together in their located own houses in Yellur GP. In rural areas, caste played a pivotal role in their day to day life. The participation of manual labour work is also increasing in all communities in the village.

**Table-2:** Name of the Social Group and Selected Sample Households in Yellur GP in Udupi District

| S. No. | Name of the Social Group | Sample Households |
|---|---|---|
| 1 | SC | 2 (7.0) |
| 2 | ST | 1(3.0) |
| 3 | OBC | 15(50.0) |
| 4 | OC | 12(40.0) |
| 5 | Total | 30 (100) |

Source: Primary data collected, 2018

## Type of House and Selected Sample Households in Yellur GP

In the study, more than half (57%) of the sample households were having pucca houses, followed by semi-pucca (40%) and thatched houses (8%). Those living in pucca houses are protected from heat in the summer, rain and winds in the rainy season and the cold in winter season and enjoy a high level of dignity in the society/village (Maruthi I, Pesala Busenna - 2015, 2016). The total two SC households are having pucca houses, and one household constructed house through MGNREGA scheme. In case of one ST household and has having semi pucca-house. In a similar way, majority (73%) of the OBC households is having pucca houses and 27 per cent of them are having semi-pucca houses. But in case of OCs households, houses type is semi-pucca (58%), pucca (33%) and thatched/kachcha houses (8%). Here one OC community house type is kachcha house and seems he is economically weaker. In case of OBC category households',

houses are little bit better than other community, in terms of their type of houses.

**Table-3:** Type of House and Social Group in Yellur GP in Udupi District in Karnataka

| S. No. | Type of House | Social group | | | | |
|---|---|---|---|---|---|---|
| | | SC | ST | OBC | OC | Total |
| 1 | Thatched / Kachcha | 0(0.00) | 0(0.00) | 0 (0.00) | 1(8.33) | 1(3.33) |
| 2 | Semi-pucca | 0(0.00) | 1(100.0) | 4(26.67) | 7(58.33) | 12(40.00) |
| 3 | Pucca | 2(100.0) | 0 (0.00) | 11(73.33) | 4(33.33) | 17(56.67) |
| 4 | Total | 2(100) | 1(100) | 15(100) | 12(100) | 30(100) |

Source: Primary data collected, 2018

## Farmer Classification

Different categories of farmers are seen in Karnataka. Based on availability of farmers, the study divided into three types of farmers in sample households. Whoever is not having agricultural land, study treated as a landless labour. Whoever is having agricultural land 0.1 acre to 2.5 acres, study concerned as a marginal farmer and from 2.6 acres to 5 acres, study treated as small farmers. In this study, out of 30 households, most of them are marginal farmers (87%), followed by landless labours (7%) and small farmers (7%). The data indicates that, only two farmers are belongs to small farmers and they belong to OBC category; and remaining of them are marginal and landless labour. The study observed that the large farmers did not participate in MGNREGA labour work. In other words marginal and small farmers participated in manual labour work under MGNREGA.

**Table-4:** Type of Farmers and Social Group in Yellur GP

| S. No. | Type of Farmers | Social group | | | | |
|---|---|---|---|---|---|---|
| | | SC | ST | OBC | OC | Total |
| 1 | Landless labour | 0 (0.00) | 0 (0.00) | 1(6.67) | 1(8.33) | 2(6.67) |
| 2 | Marginal farmers | 2(100.0) | 1(100.0) | 12(80.00) | 11(91.67) | 26(86.67) |
| 3 | Small farmers | 0(0.00) | 0 (0.00) | 2(13.33) | 0 (0.00) | 2(6.67) |
| 4 | Total | 2(100) | 1(100) | 15(100) | 12 (100) | 30 (100) |

Source: Primary data collected, 2018

## Particulars of Land Holding and Selected Sample Households in Yellur GP

Out of 30 sample study households, majority of the (28 households) (93%) households are having own land. The average land size is higher

in OBC category (1.9 acres), followed by SC (1.1 acres), OC (0.6 acres) and ST (0.5 acres) (Table-5). Among the social groups in the study, OBCs are bit higher economically as compared to other social group in selected sample households. An average, SC households are having one acre of land. According to Reddy *et al.,* (2016) stated that majority of the Dalits households' status is landless. But this study sample, one ST household land is less than one acre (Table-5).

**Table-5:** Total and Average Land Size and Selected Sample Households in Yellur GP

| S. No. | Social Group | Number of Sample Households | Land Particulars | |
|---|---|---|---|---|
| | | | Total Owned Land | Average Owned Land |
| 1 | SC | 2(7.1) | 2.1 | 1.1 |
| 2 | ST | 1(3.6) | 0.5 | 0.5 |
| 3 | OBC | 14(50.0) | 26.3 | 1.9 |
| 4 | OC | 11(39.3) | 6.5 | 0.6 |
| 5 | Total | 28(100) | 35.4 | 1.3 |

Source: Primary data collected, 2018.

## Asset Creation through MGNREGA in Yellur GP

The study observed that, during the study period (2014-15, 2015-16 and 2016-17) farmers benefitted asset creation in their land. Out of total samples, 93 per cent of the sample households asset created mentioned study period and remaining seven per cent of them did not get asset since they did not have own land at the time of our investigation. Mishra (2011) mentioned that, 58 per cent of the workers were accepted that, to create assets individual land is required. A majority of the households responded that MGNREGA has helped in creating assets, if MGNREGA was not there; it was very difficult to create assets. All selected SC and ST households benefited asset creation, but in case of OBC (93%) and OC (92%) households benefited asset creation low through MGNREGA during the study period. Only one OBC and one OC household did not get asset creation.

**Table-6:** Did You Get Individual Asset Creation During Study Period?

| S. No. | Asset Benefited | Social Group | | | | |
|---|---|---|---|---|---|---|
| | Yes / No | SC | ST | OBC | OC | Total |
| 1 | Yes | 2(100) | 1(100) | 14(93.33) | 11(91.67) | 28(93.33) |
| 2 | No | 0(0.00) | 0(0.00) | 1(6.67) | 1(8.33) | 2(6.67) |
| 3 | Total | 2(100) | 1(100) | 15(100) | 12(100) | 30(100) |

Source: Primary data collected, 2018

## Type of Asset Creation in Yeluru GP

Construction of asset is important, but what type of asset is constructed as well is important. And how the asset helped the farmer is more important. Abraham (2016) study identified that the durability of assets created under MGNREGA varied from place to place in sample states. In present study, majority (61%) of the sample households' constructed houses (61%), followed by dug well (25%), water harvesting structure (7%) and livestock shelter (7%). Chauhan and Rajdeep (2016) mentioned that 80 per cent of the sample households were benefited livestock shelters. In the study data indicates that, house construction was considered more important. Construction of house is very important, social and economic asset for rural people in India. House gives security, dignity and economic power to the owner. House is very important economic asset among the rural people, because it is an indicator of social status and economic power. According to Rani Suvarna (1996) 'Homelessness is a wretched feeling.' Suvarna (1996) mentioned that homeless person cannot be happy in his life and he feels rootless, address-less and insecure. Whoever constructed houses, they were very happy due to this they are more comfortable with their own house rather than earlier. The house is more security, privacy and dignity in the society. In a similar way, our sample household majority of them constructed houses and it indicates that, sample households gave first priority on house construction. Kumar (2016) observed that the MGNREGA provided good employment and improved the rural livelihoods of poor people in Mysuru district in Karnataka. The MGNREGA helped to poor people to improve their housing condition in sample households.

In caste wise, among the social groups, 100 per cent first priority given to house construction by ST households, followed by OBCs (79%), SC (50%) and OC (36%). Here, the study observed data, and the data reveals that, STs, OBCs and SCs main basic amenity is house construction, where as in case of OCs, their house construction priority is very less, as compared to other social groups. The water harvesting structure constructed by two OC (18%) households; and remaining other social groups did not construct the water harvesting structure in during the study period. The livestock shelters are also priority given by OCs (9%) and OBC (7%) communities and remaining of them did not. Some (36%) of the OC households constructed dug wells, followed by SC (50%) and OBC (14%) (Table-7). Based on construction of asset, the study is able to know that their needy of particular asset. The study identified that the year of construction of asset and year of started in sample households. Among the three years in the study, majority (75%) of the asset created in 2016-17, but the asset creation is completed in year/different. Nearly 21 per cent of the asset created in 2015-16 and followed by 2014-15 (Table-8).

**Table-7:** Type of Asset and Social Group in Sample Households

| S. No. | Name of the Asset | Social Group | | | | |
|---|---|---|---|---|---|---|
| | | SC | ST | OBC | OC | Total |
| 1 | Dug well | 1(50.00) | 0(0.00) | 2(14.29) | 4(36.36) | 7(25.00) |
| 2 | Water harvesting structure | 0(0.00) | 0(0.00) | 0(0.00) | 2(18.18) | 2(7.14) |
| 3 | House construction | 1(50.00) | 1(100) | 11(78.57) | 4(36.36) | 17(60.71) |
| 4 | Livestock shelter | 0(0.00) | 0(0.00) | 1(7.14) | 1(9.09) | 2(7.14) |
| 5 | Total | 2(100) | 1(100) | 14(100) | 11(100) | 28(100) |

Source: Primary data collected, 2018

**Table-8:** When Did You Get Asset?

| S. No. | Year of Sanction | Social group | | | | |
|---|---|---|---|---|---|---|
| | | SC | ST | OBC | OC | Total |
| 1 | 2014-15 | 1(50.0) | 0(0.00) | 0 (0.00) | 0(0.00) | 1(3.57) |
| 2 | 2015-16 | 0(0.00) | 0(0.00) | 6(42.86) | 0 (0.00) | 6(21.43) |
| 3 | 2016-17 | 1(50.0) | 1(100) | 8(57.14) | 11(100) | 21(75.00) |
| 4 | Total | 2(100) | 1(100) | 14 (100) | 11(100) | 28(100) |

Source: Primary data collected, 2018

## Purpose of Asset Creation

Singh and Jain (2017) stated that the study, MGNREGA helped to create assets in selected districts in Punjab State. In the study identified that the purpose of households' asset created. Majority (61%) of them are created asset for shelter of family, followed by drinking water harvesting (18%), drinking water (14%) and animal shelter (7%). Among the purposes, shelter of family is higher and this information is informed by majority of the ST (100%) households and followed by OBC (79%), SC (50%) and OC (36%) (Table-9).

**Table-9:** Purpose of Asset Created, Social Group And Selected Sample Households In Yellur GP

| S. No. | Purpose of Asset Created | Social Group | | | | |
|---|---|---|---|---|---|---|
| | | SC | ST | OBC | OC | Total |
| 1 | Animal shelter | 0 (0.00) | 0(0.00) | 1(7.14) | 1(9.09) | 2(7.14) |
| 2 | Drinking water | 1(50.00) | 0(0.00) | 2(14.29) | 1(9.09) | 4(14.29) |
| 3 | Drinking water harvesting | 0(0.00) | 0(0.00) | 0(0.00) | 5(45.45) | 5(17.86) |
| 4 | Shelter for family | 1(50.00) | 1(100) | 11(78.57) | 4(36.36) | 17(60.71) |
| 5 | Total | 2(100) | 1(100) | 14(100) | 11(100) | 28(100) |

Source: Primary data collected, 2018

The study observed that after completion of their asset creation, beneficiary were very happy and expressed by all study sample households. The beneficiary households expressed that they were very happy to construct

individual asset creation and this assets would be helpful to in their long run life. The drinking water, harvesting structure would help to the beneficiary to get water in summer season. The constructions of houses help them to stay a comfortable life in their day-to-day life. Hence the study observed that, the assets are more helpful to study beneficiary households in Yellur village. Through construction of assets, the village got more man days and MGNREGA helped labour in the village.

## Asset Creation and Amount Sanctioned

The government sanctioned amount varies from asset to asset under MGNREGA scheme. Average sanctioned amount is ₹ 39,251. However, the component wise, average sanctioned amount is higher in Other water harvesting structures (₹ 87,500), followed by dug well (₹ 75,413), livestock shelter (₹ 30,000) and house construction (₹ 20,873). Among the asset benefited households, the average sanctioned amount is higher in other water harvesting structures and household belong to OC (₹ 87,500) community, followed by dug well (₹ 81,000) and household belongs to OBC community. In a similar way, the lowest amount sanctioned for house construction (₹ 20,000) which belongs to SC category (Table-10). Based on the above information, the study observed that, under MGNREGA scheme, all participated households are benefited, but most of them economically benefited by OC households, followed by OBCs, STs and SC. In other words, the suppressed / disadvantaged group i.e., SC/ST are economically less benefited as compared to other social groups in terms of sanctioned amount. The sanction of amount depends upon construction of asset. Majority of the beneficiary households suggest that at least 20 per cent of amount should be sanctioned at initial stage of the work, so that even poor person can get benefit of individual asset creation through MGNREGA.

**Table-10:** Total and Average Sanctioned Amount through MGNREGA for Asset Creation

| S. No. | Name of the Asset | Social Group | | | | |
|---|---|---|---|---|---|---|
| | | SC | ST | OBC | OC | Total |
| 1 | Dug well | 82000 (82000) | NA | 162000 (81000) | 282000 (70500) | 526000 (75143) |
| 2 | Other water harvesting structures | NA | NA | NA | 175000 (87500) | 175000 (87500) |
| 3 | House construction | 20000 (20000) | 21240 (21240) | 224400 (20400) | 89200 (22300) | 354840 (20873) |
| 4 | Livestock shelter | NA | NA | 30000 (30000) | 30000 (30000) | 60000 (30000) |
| 5 | Total | 102000 (51000) | 21240 (21240) | 416400 (29743) | 576200 (52382) | 1115840 (39851) |

Source: Primary data collected, 2018. NA data not available.

## Conclusion

Based on our secondary and primary data, the study concluded that there are large variations among the social groups. Out of 30 sample households, half (50%) of the sample households belong to OBC category (50%). Majority (57%) of the sample household was having pucca houses, followed by semi-pucca (40%) and thatched houses (8%). Other backward castes households' houses are little bit better than rest of the community in terms of their type of house construction. In the study, majority of them are marginal farmers (87%), followed by landless labours (7%) and small farmers (7%). Large farmers did not participate in MGNREGA labour work, and 28 (93%) sample households were having land. The average land size is higher in OBC category (1.9 acres), followed by SC (1.1 acres), OC (0.6 acres) and ST (0.5 acres). Among the social groups in the study, OBCs are little bit higher in economically as compared to other castes in selected sample households.

The study observed, during 2014-15, 2015-16 and 2016-17 farmers were able to benefit from asset creation in their land. Out of total samples, 93 per cent of the household constructed assets mentioned study period and remaining seven per cent of the households did not get asset. Majority (61%) of the households' asset is house construction, followed by dug well (25%), water harvesting structure (7%) and livestock shelter (7%). It indicates that the house construction was taken more in selected study GP. The study observed that the data, STs, OBCs and SCs main basic amenity is house, where as in case of OCs their house construction priority was very less as compared to other social groups. Based on the construction of the asset, the study is able to know that their needy of the particular asset. Greater part (61%) of the households created asset for shelter of family, followed by drinking water harvesting (18%), drinking water (14%) and animal shelter (7%). The study finds that some of the OCs an average sanctioned amount is higher and followed by SCs, OBC and ST. In contrary that the suppressed / disadvantaged group (ST) people average sanctioned amount is low as compared to other social groups. The MGNREGA helped to Yellur GP farmers, to construct individual asset creation. The assets helped to welfare of the households/ farmers in Yellur. The main policy suggestions of the study is at least 20 per cent of amount should be sanctioned at initial stage of work, so that even poor person can get benefitted under individual asset creation of MGNREGA.

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# Determination and Stabilization Issues of India's Exchange Rate – A Game Theoretic Approach

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## Abstract

Exchange Rate is a key macroeconomic and a financial variable, which reflects the position of the economy to the rest of the world and is subject to high volatility. It affects the decisions of various economic agents, who operate in international market, in the fields of trade, banking, investments, etc. The foreign exchange market is a worldwide-decentralized financial market for currency trading. In 1990s, the Indian forex market experienced a new phase of developments beginning with the Balance of Payments crisis in 1991, after which the Indian currency experienced heightened volatility due to the growing integration with the rest of the world. Hence, it becomes a necessary task to understand the sources of the uncertainties in the exchange rate. The study revolves around the identification of various macroeconomic, financial and fiscal factors with a significant influence on the exchange rate. An attempt has also been made to capture the impact of the market factors like speculation, on the exchange rate and to check for the effectiveness of the monetary and the fiscal policies in containing the speculation, using the Game Theoretic approach. The period of study has been from 1990 to 2015 with an annual frequency. The econometric models namely the ARCH-GARCH methods of estimation, Structural Vector Auto-Regressive (SVAR) and the Impulse Response Function (IRF), have been used for analysis. The conclusions obtained from the study show a significant impact of the macroeconomic variables like the GDP differential, real monetary shock, etc. and also of the fiscal variables like the debt to GDP and the tax revenues, on the exchange rate. The study has also led to the conclusion that, it is necessary for the monetary and the fiscal authorities to operate in a coordinated fashion to achieve a positive sum game with regards to controlling the speculative activities in the forex market and stabilize the exchange rate.

**Keywords:** Econometric Modelling, Exchange Rate, Game Theory

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## Introduction

The foreign exchange market is a worldwide-decentralized financial market for currency trading. The financial centers around the globe, facilitate diverse range of buyers and sellers around the clock. The foreign exchange market establishes relative values of different currencies and supports trade and investment, by enabling the conversion of the currencies. Therefore, the exchange rate is a key macroeconomic and financial variable affecting the decisions of various agents who operate in the international market in the fields of trade, banking, investments, tourism, etc. Thus any disturbance in the exchange rate affects the value of the foreign exchange reserves, international portfolios, competitiveness of the exports, the currency value of the debt payments, etc.

The Indian forex market has experienced developments due to gradual liberalization during the past two decades and more. It has come a long way since its inception in the year 1978, when the banks were allowed to undertake intra-day trade. In the 1990s the forex market experienced a new phase of developments beginning with the Balance of Payments crisis after which the economy decided to shift from a pegged system of exchange rate to a floating system in 1993, following the recommendations of the High Level Committee on the Balance of Payments, which was led by C. Rangarajan, which also brought heightened phases of volatility along with it. Therefore, according to the monetary authority, i.e., the Reserve Bank of India, the exchange rate of the Indian currency is determined by the market and not determined administratively. But India adopted a managed exchange rate system in the year 1994 and thus RBI trades in the forex market actively in order to contain the volatility. Formally the RBI states that, its primary goal in the exchange rate market is to manage the volatility without any prefixed target for the exchange rate.

Therefore, it becomes a necessary task to understand the sources of the fluctuations in the exchange rate. One of the major shocks on the exchange rate is from the disturbances in the market, i.e., various situations of crises or announcements which cause instability in the world economy. As the economy grows on the path of integration with the rest of the world (ROW), it gets exposed to the risks of that the developed countries face. For instance, the Global Financial Crisis had a worldwide impact and is considered as one of the worst since the Great Depression of 1929, had taken off in today's world leader, the United States. Because of its integration, India was no exception to the aftereffects of the crisis, even though the brunt was well managed. Many sectors of the economy experienced large fluctuations because of the crisis. The exchange rate also experienced a significant depreciation owing to the announcement effect of the likely tapering of the quantitative easing by the Federal Reserve, in May 2013,

which was followed by the tightening of the overall financial market conditions. Thus in such situations, the role of the monetary policies and the fiscal policies is very important in containing the volatility.

## Analysis of India's Exchange Rate

India obliged to follow the Bretton Woods system[1], with regards to the determination of the exchange rate, as India is part of the IMF since its inception in 1946. Under this system, the member countries of the IMF were to follow the fixed exchange rate system. The Bretton woods system operated with the aim to re-kindle the international trade and also the economic growth by removing the exchange rate uncertainties after the second world.

However, on 15th August 1971, the United states President, Nixon announced that the economy was going to shut down the gold window and removed the gold backing from the dollar, which meant that the foreign countries could not convert the dollars to gold. This announcement was thereafter named as Nixon Shock, which was made without the prior consultation of the other world leaders of the major capitalist economies. Therefore the Bretton Woods system collapsed in 1971.

Consequently, the INR was pegged to Pound Sterling, for four years, after which in the initial phases, it was linked to a basket of 14 currencies which got reduced to 5 currencies with respect to major trading partners of India. This system continued through 1980s, though the exchange rate was allowed to fluctuate in a wider range and to depreciate modestly with the view to maintain competitiveness. However, the need for adjusting the exchange rate became urgent in the face of the Balance of Payments crisis of 1991.

Indian foreign exchange market has experienced gradual liberalization during the past two decades. The Indian currency, Rupee (INR), has experienced high levels of volatility since the Indian economy adopted market determined exchange rate in 1993. One of the latest episodes for the volatility had been post May 22, 2013 due to the likely tapering of the quantitative easing by the US Fed. Excessive exchange rate volatility puts the cost pressure on the economy by impacting the international trade and investments. The central bank's responses to the volatility in the forex markets has come into the lime light.

The Indian forex market has developed well since its inception in 1978, when the Indian banks were permitted to participate in the intra-day trade in the foreign exchange. But since 1990s, the process of economic reforms began in India. The Indian economy shifted from pegged exchange rate

1 Each member country of the IMF was required to define its currency value, in terms of the US dollar and in terms of gold (because United States controlled about two-thirds of the world's gold), and maintain the market value of its currency within a fixed band of the defined par value.

regime to floating exchange rate regime. The BOP crisis of 1991, marked the beginning of the process of the economic reforms in India. In the year 1992, liberalised exchange rate management system (LERMS)[2] was introduced as a transitional measure and a dual exchange rate system. But this system was abolished in March 1993 and flexible exchange rate regime was adopted. With the adoption of the floating exchange rate regime in the year 1993, adoption of the current account convertibility in the year 1994, and a gradual liberalization of the capital account over a period of time has helped the Indian forex market to grow in the economy.

## Scope of the Study

The present study tries to identify the variables that have a significant impact on the exchange rate. The variables have been classified as the macroeconomic variables, the fiscal variables and the market variables – namely information, speculation – spot rate and the Sensex – representing the stock market. The work applies the approach of the Game Theory to check for the effectiveness of the monetary and the fiscal policies on the speculation, in two situations wherein there is no coordination between the two authorities and in a next case there is coordination. The study aims to identify the determinants of the exchange rate, applying the Game Theory to understand the behavior of the Indian exchange rate since 1990.

To achieve this the study tests the effectiveness of the monetary and the fiscal policies under the situations of the non-coordination and otherwise, in controlling the speculation activity which impacts the exchange rate significantly.

## Review of Literature

Volatility, it is one of the prominent characteristics of a financial market and one of the prominent macroeconomic variables that faces such high fluctuations in the financial market is the exchange rate. Exchange rate is a very dynamic variable and it is very difficult to predict a particular level of exchange rate in the market at any point of time because it is on a continuously changing path. There are many variables that effect the exchange rate of an economy. Especially for a rapidly developing country like India, innumerable factors determine the foreign exchange level. Many studies have been carried out for identifying the significant factors that affect the exchange rate. Literature has shown the factors like interest rate differential, FIIs, FDIs, arbitrage opportunities, information etc. have had a very significant impact on the exchange rate of India.

In various studies carried out by authors namely, Mishra and Yadav (2012), Anita Mirchandani, Somesh K. Mathur, Rituparna Kar and Nityanand

2 Under this system the exporters of the goods and services and the recipients of the remittances from abroad could sell their bulk of forex receipts at the market determined rates.

Sarkar, Takeshi Inoue and Shigeyuki Hamori, and N. R. Bhanumurthhy, they tried to identify the relationship between the exchange rate and some very significant macroeconomic variables like inflation rate, money supply, trade balance of both, the Indian and the foreign economy, forex reserves, etc., where they confirmed that the variables like real inflation rate, money supply, interest rate differential, GDP differential etc., have a very significant impact on the exchange rate.

Exchange rate, when left to the market may fluctuate in such a way that the economy may be in danger. Thus, in such situations the role of the monetary and the fiscal authorities becomes very crucial to prevent the economy from experiencing volatility. Some studies have been undertaken to understand the role of the policies in the determination of the exchange rate. Ashima Goyal, Matthew B. Canzoneri, Robert E. Cumby and Behzad T. Diba, Betty C. Daniel, Renu Kohli, are some of the academicians who have addressed various issues regarding the policies and the exchange rate. They have studied the behaviour of the exchange rate over the reform period with respect to the determinants; some of them studied the effectiveness of the policies depending on whether the economy follows a Ricardian or a Non-Ricardian regime. Renu Kohli undertook the study on the importance of the intervention of the monetary authority and its efforts to control inflation. From almost all the studies it could be seen that in the foreign exchange market, the monetary and the fiscal policies play a very important role. Also it was found that when an economy follows a Non-Ricardian regime, then the disturbances in the forex market can't be checked only by the monetary authority, but also requires the support of the fiscal authority.

In the study, an attempt has been made to apply the concept of the Game Theory in determination of the exchange rate. Game Theory talks of the cooperation or antagonism of the players that operate in the market. Some of the people have studied and applied the concept, in the forex market in order to see how the volatility in the exchange rate can be curbed. Vadivel A. has concluded from his study that, it is very important for the central banks of the developing economies to intervene in the forex markets in a coordinated fashion to contain the volatility in the exchange rate. Considering the volatility in the exchange rate, one of the major sources of the volatility is the information in the market which also gives a scope to the growth of speculation. Frank Heinemann, in his study carried tried to determine the exchange rate by conducting experiments with the help of various students. He found out that the private and the public information yield similar results when the people are bounded rationally rather than being allowed to be fully rational. Also it was found that the

public information improves the efficiency and the cooperation among the subjects and there is no proof of any destabilization effect owing to self-fulfilling beliefs as described by the theory. But it is often seen that there are always some players in the forex market, who maintain a constant vigil for any kind of information that circulates in the economy, who try to earn riskless profits. They are called the arbitragers. Q. Farooq Akram, Dagfinn Rime, and Lucio Sarno, tried to enquire the characteristics and the presence of the arbitrage opportunities in the forex market and their study revealed that there are many economically significant short-lived arbitrage opportunities across exchange rates and that are comparable crosswise different maturities of the instruments that are indulged in arbitrage. On an average the arbitrage opportunities are enough long existed to comprehend the scatter from the purchasing power parity but also they are short lived to tell why some such opportunities have been in incognito.

## Empirical Analysis

One of the objectives of the study has been to identify the macroeconomic and the fiscal determinants of the exchange rate (EXR) in the Indian scenario. Exchange rate is a very dynamic macroeconomic variable and also a financial variable, which reflects the fundamentals of an economy. There are various factors that determine the exchange rate. Thus for the study we have segregated the variables as macroeconomic variables and the fiscal variables.

There are four models, where, in the first model we identified the macroeconomic variables and tried to look at their impact on the exchange rate. The second model establishes the relationship between the fiscal variables and determines their impact on the exchange rate. The third model analyses the impact of the macroeconomic and the fiscal variables together on the exchange rate and finally the fourth model is the policy model, analyses the combined impact of the monetary policy and the fiscal policy on the exchange rate. But before initialising the analysis, we tested for the unit root problem in the variables using the Augmented Dickey-Fuller test and it was found that most of the variables are stationary at levels except for three variables namely the inflation differential, fiscal shock and spot rate.

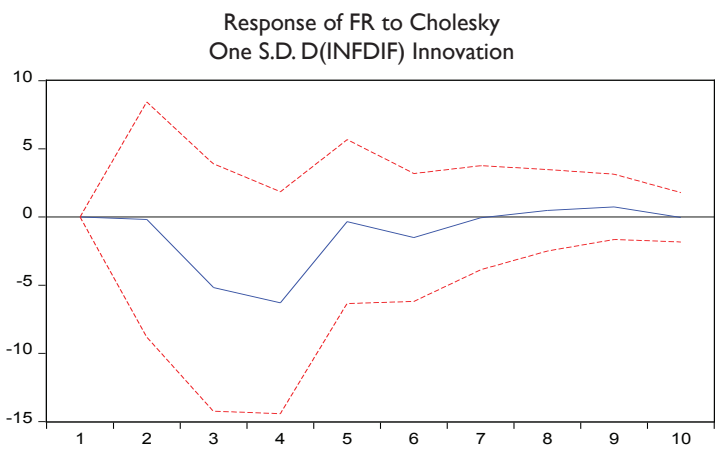
$$EXR = 4.40 - 0.12*ZMS(-1) - 0.85*GDIF - 0.04*FR - 0.03*BOT + 0.66*D(INFDIF(-1))$$
$$[5.47]\ [-19.18]\quad [-15.10]\ [-1.67]\ [-2.19]\quad [2.51]$$
$$\text{Adj } R^2 = 0.91 \qquad \text{D-W Stat} = 2.01 \qquad \textit{...(1)}$$

Looking at the model we observe that the t-values of all the explanatory variables are significant at 5% level of significance except for foreign exchange reserves, which is significant at 10% level. Of all the variables,

monetary shock (ZMS)[3] is the most significant variable and it has a negative relationship with the exchange rate as was also found in the study carried out by Anita Mirchandani and others, where they found a significant relationship between the interest rate and the exchange rate. Therefore, when the economy experiences a monetary shock, it would attract the foreign capital, implying that the INR is demanded internationally. Therefore, INR is valued greatly, resulting in the appreciation of the INR.

GDP differential (GDPDIF)[4] is a measure that helps in comparing the domestic economic activity with that of the US' economic activity. An increase in the value of this variable implies strong fundamentals and better performance of the domestic economy or a relatively passive growth of the US economy. So, when the domestic economy performs well then it gains confidence of the ROW leading to an increase in the inflow of the foreign capital, which is reflected by an increase in the forex reserves. This variable, as can be seen from the model above, is very significant which was also proved significant in the study undertaken by Sunil Kumar who employed the ARDL method for identifying the determinants of the exchange rate. There are other macroeconomic variables that would help in understanding the behavior of the exchange rate. One of the very important variables is the inflation differential (INFDIF; difference between India's inflation and the US' inflation). For an economy like India, inflation is a detrimental factor especially because India is a net importer. Thus if the economy is inflationary in nature, then the economy may experience a hike in the import bill. This would lead to depletion of the foreign exchange reserves. This may be seen from the impulse response function (IRF 1) of the INFDIF on the FR from the following figure:

**IRF-1:** Response of Foreign Exchange Reserves (FR) to Inflation Differential (INFDIF)

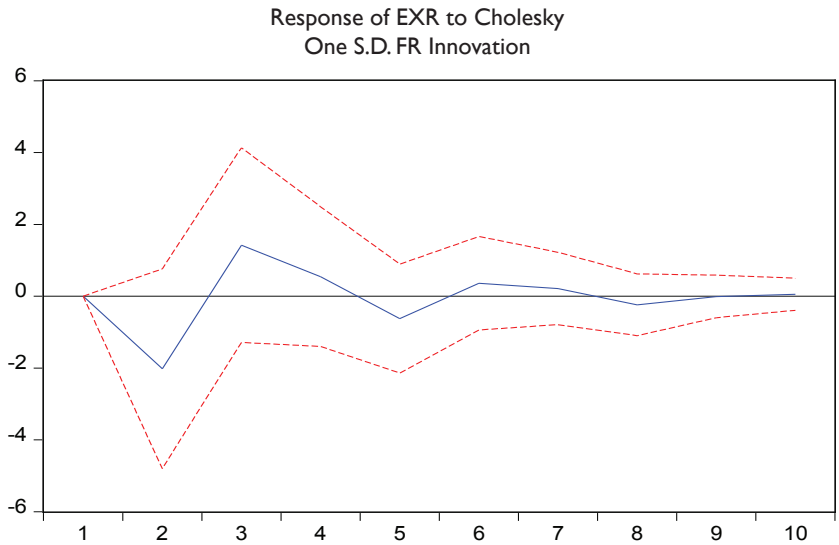



3 The monetary shock has been calculated by increasing the real interest rates by 100 basis points.
4 This variable is calculated by taking the difference between the GDP of India and the US.

Also from the figure below we can see that the FR has a negative relationship with the exchange rate (IRF 2). Thus when the Indian economy is inflationary in nature or if the inflation in the US is relatively low, then the INR will depreciate. Thus we can see that the exchange rate has a positive relationship with the inflation differential.

For a country like India, which is an emerging market and not yet efficient in the production of all the goods, trade plays a very vital role for the economy. Though GDP covers the overall activity of the economy, the variable - balance of trade (BOT), specifically gives the impact of the trade on the exchange rate. So, when the growth rate of exports is relatively greater than that of the imports, then there would be an increase in the inflow of the foreign currency. Thus the domestic currency experiences an appreciating trend. Thus we have a negative relationship between the exchange rate the balance of trade.

**IRF-2:** Response of Exchange Rate (EXR) to Foreign Exchange Reserves (FR)




The adjusted R-squared[5] value was found lower than that of the R-squared value. Thus we consider the adjusted R-squared value, which is about 91%, i.e., 91% of the changes in the dependent variable are explained by the changes in the independent variables.

$$EXR = 1.08 + 0.30*D(FS) - 0.61*TR + 2.35*DTOGDP(-1) + 16.65*DUM$$
$$[0.64]\ [2.08]\quad [-4.34]\quad [5.24]$$
$$\text{Adj } R^2 = 0.58 \qquad \text{D-W Stat} = 1.65 \qquad \ldots(2)$$

The effect of a change in the fiscal policy is not accommodated by the monetary policy and is also indeterminate in the theory. Therefore, in

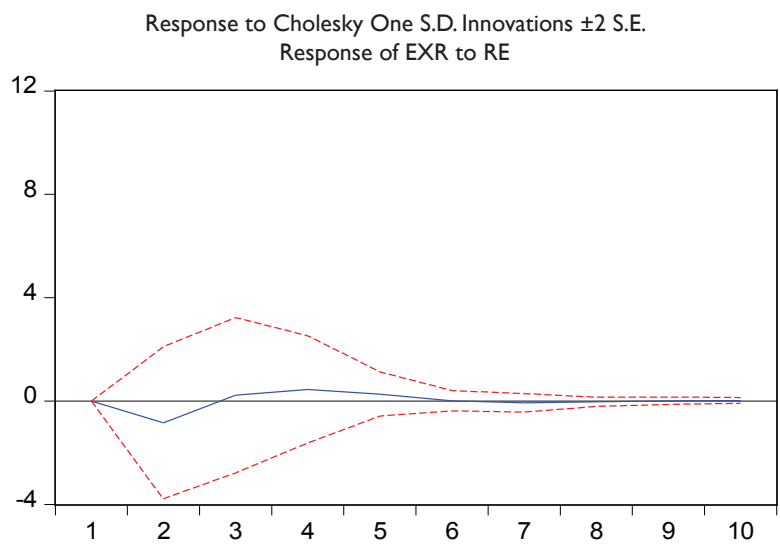
5 Adjusted-R squared gives the percentage of variation explained by only those explanatory variables which in reality affect the dependent variable.

this model we have tried to capture the impact of the fiscal policy on the exchange rate, empirically. Here we have considered the variables like fiscal shock, tax revenue and the debt to GDP, which represent the fiscal policy.

The efficiency of the economy may be measured with the help of the variable debt to GDP (DTOGDP). An increase in the debt would imply that the government is relying on the external sources for financing its expenditure and consequentially the confidence in the economy may be lost. As a result, this may lead to capital flight as it would be an irrational idea to invest in a debt led economy. Therefore, from the model it can be observed that this variable has the most positive significant influence on the exchange rate. Hence it is very important that, the government should make its policies strong and tend towards self-sufficiency with regards to managing the expenditure.

Here we have used a new variable namely, the Fiscal Shock (FS)[6]. An increase in the fiscal shock, i.e., when a negative shock is given to the public expenditure, this would result in the decline of the deficit and thereby the economy would become stronger and more reliable. As a result of this, there would be boost in the ROW's confidence and therefore inflow of capital. Consequentially, the value of the INR goes up and it experiences an appreciating trend. Hence the exchange rate follows the path of fiscal shock. (IRF 3 shows the response of the exchange rate to the public expenditure).

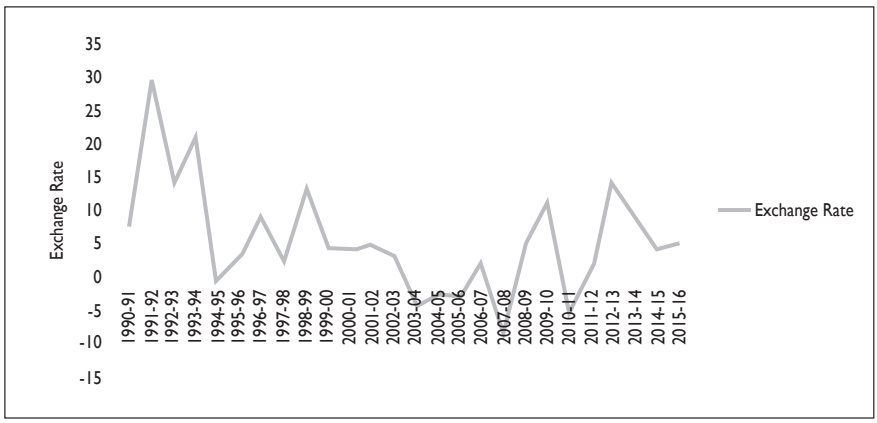
**IRF 3:** Response of Exchange Rate (EXR) to Public Expenditure (PE)




6 Fiscal shock has been calculated by cutting the public expenditure equivalent to the magnitude of 0.5% of the real GDP.

A dummy variable for the years 1991 and 1993 has been included in the model to capture the impact of the BOP crisis and the shift in the exchange rate regime to a floating system respectively. During these two years the currency experienced high depreciation (Figure-1).

**Figure-1:** Growth Rate of Exchange Rate since 1990




Source: Reserve Bank of India

EXR = 2.23 - 0.78*GDIF + 0.60*D(INFDIF(-1)) - 0.03*D(FR(-1)) 0.02*ZINT
[5.91] [-61.03] [6.16] [-8.40] [13.07]

0.46*D(D2GDP(-1)) + 0.07*D(FS) + 1.73*DUM + AR(1)=0.73
[2.22] [3.28] [4.17]

Adj $R^2$ = 0.95 D-W Stat = 1.72 *...(3)*

From the above two models we have seen how the macroeconomic variables and the fiscal variables are able to explain the behaviour of the exchange rate. In this model we have tried to see the combined impact of the macroeconomic and the fiscal variables on the exchange rate.

This model is formulated by combining the determinants of the exchange rate from the previous two models. Similar to the prior models, it is observed that the macroeconomic variables like GDPDIF, real interest rates (ZINT = CMR – Inflation), DTOGDP, etc. are all significant and also prove the theory. Here a dummy variable for the year 1997 has been considered to capture the impact of the East-Asian crisis, which has a significant impact on the exchange rate of India.

EXR = -13.15 - 0.10*ZINT + 3.50*D2GDP + 0.41*D(PE)
[-2.21] [-2.59] [2.84] [4.11]
Adj $R^2$ = 0.43 D-W = 1.24 *...(4)*

In a general scenario when the economy faces any disturbance like inflation or fluctuations in the currency, the monetary authority can control these disturbances on its own. But if the economy is under the Non-

Ricardian regime[7], then the monetary authority alone cannot control these situations. The fiscal authorities have to complement them and intervene in the market to stabilise the economy.

Therefore, in this model we have tried to examine whether there is any significant effect of the monetary and the fiscal policies together on the exchange rate. The variable, real interest (ZINT) represents the monetary policy and the variables debt-to-GDP (DTOGDP) and the public expenditure (PE) represent the fiscal policy and from the result it can be seen that all the variables are statistically significant at 5% level of significance and also their relationship with the exchange rate satisfies the theory.

## Information and Speculation

Yet another objective of the study is to apply the idea of the Game theory where the players in the market take decisions based on the information available to them or their decisions are based on the decisions of the other players. In the study the main players in the exchange rate market are the monetary authority, the government and the speculators in the market. The decisions of the monetary authority are reflected by the monetary policy and similarly the fiscal policies reflect the decisions of the government. From equation 4 we have seen that the real interest rates, debt to GDP and the public expenditure play a significant role in the determination of the exchange rate where the first variable is controlled by the monetary authority and the latter two are controlled by the government. Further down, we have tried to study whether these variables can be used to control the shock of the speculation activity on the exchange rate or not with the help of the SVAR models. But prior to that it is important to see whether the information (INFO), and the speculation activity, reflected by the spot rate (SR) is significant in affecting the exchange rate or not. Therefore, on analysing this, the following result has been obtained:

$$EXR = 0.14 + 0.98*INFO + 0.24*D(SR) - 0.04*SS(-1)$$
$$[1.67]\ [8.76]\quad [13.33]\quad [-3.77]$$
$$\text{Adj } R^2 = 0.28 \qquad \text{D-W} = 1.89 \qquad \textit{...(5)}$$

The variable information reflects all those times when the monetary authority had to intervene in the exchange rate market to stabilise the economy through various policies, due to the disturbances caused by the external environment like various crises, the attack on the WTC, the announcement made by the Fed chairman, etc. Information seems to be

7 An economy is said to follow the Non-Ricardian regime when, the demand in the economy is affected by the government's attempt to stimulate the economy through debt-financed spending. The demand in the economy like India is likely to change because majority of the people don't have excess money with them to save for paying off the debts they owe; in case the future taxes are expected to rise.

a very significant factor in giving a shock to the exchange rate but it is not as influential as the spot rate. When the speculators in the exchange rate market speculate that the exchange rate would depreciate in the recent future, various players in the forex market jump into action and buy the dollars as soon as possible. This actually leads to early depreciation of the currency. Thus we see that the speculation is the most significant of all the variables in the above model even though its impact is less than the information or the exchange rate.

## SVAR Models

From the above model we could see that information and speculation significantly affect the exchange rate. Therefore, we have used SVAR models to study the inter-dynamics among the variables by imposing restrictions on the variables to be estimated through the desired channel. The first model studies the impact of the information on the exchange rate through the effect on speculation followed by its effect on the Sensex.

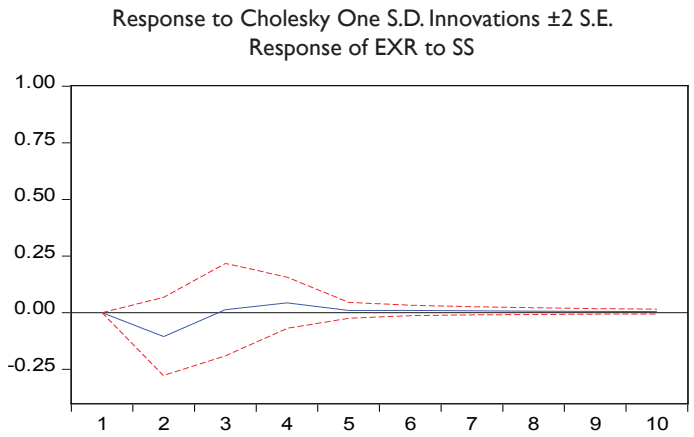
**Table-1:** Impact of Information on Speculation

| **[MAT(A)]** | **EXR** | **INFO** | **D(SR)** | **SS** | |
|---|---|---|---|---|---|
| EXR | 1 | 0 | 0 | 0 | |
| INFO | 0 | 1 | C(3) | 0 | |
| D(SR) | C(1) | 0 | 1 | C(4) | |
| SS | C(2) | 0 | 0 | 1 | |
| | | | | | |
| [MAT(B)] | EXR | INFO | D(SR) | SS | |
| EXR | 1 | 0 | 0 | 0 | |
| INFO | 0 | 1 | 0 | 0 | |
| D(SR) | 0 | 0 | 1 | 0 | |
| SS | 0 | 0 | 0 | 1 | |
| | | | | | |
| | | Coefficient | Std. Error | z-Statistic | Prob. |
| | C(1) | -1.040433 | 0.111834 | -9.303387 | 0 |
| | C(2) | 1.545749 | 0.060746 | 25.44625 | 0 |
| | C(3) | -0.003671 | 0.038846 | -0.094512 | 0.9247 |
| | C(4) | 0.101875 | 0.060746 | 1.677068 | 0.0935 |
| | | | | | |
| | Log likelihood | -8576.247 | | | |
| | LR test for over-identification: | | | | |
| | Chi-square(6) | 13172.32 | | Probability | 0 |

From Table-1 we can see how the restrictions have been imposed (as in the matrix A) to determine the exchange rate. Looking at the z-statistic, we can clearly see that, the information in the market is not significantly leading to the speculation activity (reflected by the spot rate, SR). However, we can see that the speculation in the market results in a significant variation in

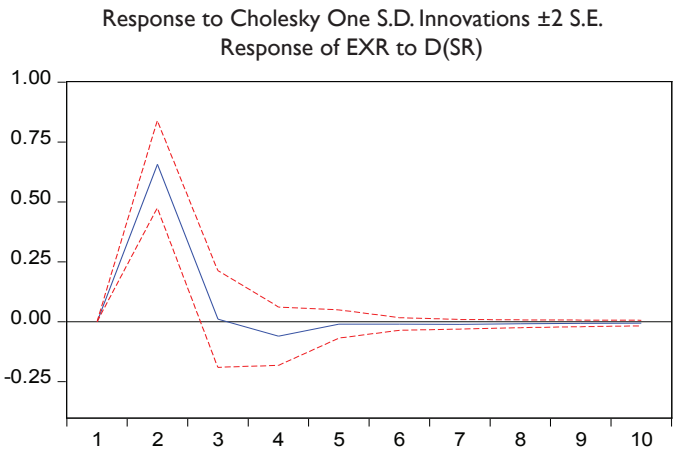
the stock market and in turn the stock market is significantly affecting the exchange rate. Therefore, from the impulse response function (IRF 4) we can see that, when a positive shock is given to the Sensex, the exchange rate appreciates, i.e., a negative relationship exists between the exchange rate and the Sensex. This can also be seen from the equation 5, above.

**IRF-4:** Response of Exchange Rate (EXR) to Sensex (SS)




Also from the table it can be inferred that the spot rate also has a very significant impact on the exchange rate (as can also be seen from the equation 5, above).

**IRF-5:** Response of Exchange Rate (EXR) to Spot Rate (SR)




From the above figure (IRF 5) it can be inferred that, when the speculation activity is given a positive shock, i.e., when the speculators in the market operate with the motive of making risk free profits, they speculate that the exchange rate would depreciate in the near future. As a result of which the players in the market buy the foreign currency a soon as possible leading

to an increase in the demand for the dollars. This sudden increase in the demand for the dollars will actually depreciate the domestic currency sooner. Thus we can see that the speculation in the market has a very significant positive impact on the exchange rate.

Such speculation activities make the economy vulnerable to fluctuations. Therefore, it is important that the authorities intervene in the market and keep a check on such activities. One of the questions that needs to be addressed is, whether the monetary authority alone can minimise such activities or does it need the support of the government too? As already stated earlier, a low per-capita income country like India, follows a Non-Ricardian fiscal regime. Thus, there has to be a coordination between the monetary authority and the fiscal authority to control the speculative activities.

Here we tried to apply the concept of the Game Theory where the monetary authority, the fiscal authority and the speculators are the three main players in the exchange rate market. From the above regression equations and the above SVAR table we have seen how influential the monetary policy variable, the fiscal policy variables and speculation are. Therefore, with the help of the following models, we try to prove that the monetary policy alone cannot control the activities of the speculators in the exchange rate market.

**Table-2:** Monetary Policy Impact on the Speculation

| **[MAT(A)]** | **EXR** | **ZINT** | **D(SR)** | **SS** | |
|---|---|---|---|---|---|
| EXR | 1 | 0 | 0 | 0 | |
| ZINT | 0 | 1 | C(2) | 0 | |
| D(SR) | 0 | 0 | 1 | 0 | |
| SS | C(1) | 0 | 0 | 1 | |
| | | | | | |
| [MAT(B)] | EXR | ZINT | D(SR) | SS | |
| EXR | 1 | 0 | 0 | 0 | |
| ZINT | 0 | 1 | 0 | 0 | |
| D(SR) | 0 | 0 | 1 | 0 | |
| SS | 0 | 0 | 0 | 1 | |
| | | Coefficient | Std. Error | z-Statistic | Prob. |
| | C(1) | 1.24812 | 0.208514 | 5.985773 | 0 |
| | C(2) | -0.269073 | 0.208514 | -1.29043 | 0.1969 |
| | Log likelihood | -15622.96 | | | |
| | LR test for over-identification: | | | | |
| | Chi-square(8) | 30575.12 | | Probability | 0 |

From the above model (Table-2), we can see that the z-statistic of the coefficient C(2) is not significant at all, i.e., the real interest rates are not affecting the spot rate significantly. Thus it is a zero sum game for the monetary authority to operate alone in the exchange rate market in order to keep the speculation activities in check.

The following table (Table-3) would show the significance of the fiscal policy variables on the speculation activity. The fiscal policy can manage the speculation activity partly by imposing strict restrictions on the policies with respect to gross fiscal deficit but the public expenditure is not significantly influencing the spot. Hence it is not a completely positive sum game, but only partially.

**Table-3:** Impact of Fiscal Policy on Speculation

| **[MAT(A)]** | **EXR** | **GFD** | **TR** | **D(SR)** | **SS** |
|---|---|---|---|---|---|
| EXR | 1 | 0 | 0 | 0 | 0 |
| GFD | 0 | 1 | 0 | C(2) | 0 |
| TR | 0 | 0 | 1 | C(3) | 0 |
| D(SR) | 0 | 0 | 0 | 1 | 0 |
| SS | C(1) | 0 | 0 | 0 | 1 |
| | | | | | |
| [MAT(B)] | EXR | GFD | PE | D(SR) | SS |
| EXR | 1 | 0 | 0 | 0 | 0 |
| GFD | 0 | 1 | 0 | 0 | 0 |
| PE | 0 | 0 | 1 | 0 | 0 |
| D(SR) | 0 | 0 | 0 | 1 | 0 |
| SS | 0 | 0 | 0 | 0 | 1 |
| | | Coefficient | Std. Error | z-Statistic | Prob. |
| | C(1) | 1.589181 | 0.208514 | 7.621442 | 0 |
| | C(2) | -1.263763 | 0.208514 | -6.060795 | 0 |
| | C(3) | 0.329533 | 0.208514 | 1.580387 | 0.114 |
| | Log likelihood | -15188.4 | | | |
| | LR test for over-identification: | | | | |
| | Chi-square(12) | 29606.53 | | Probability | 0 |

This leads us to the final model (Table-4) where we show that coordination between the monetary and the fiscal authorities' strategies is a very significant and a completely positive-sum game. The result justifies that when the two authorities of the economy come together and execute their strategies, they would be significantly influencing the speculation activity and thereby the speculative activities can be checked. An important observation to make is that when the monetary authority choses to work alone, it is not successful in preventing the exchange rate from fluctuation due to the speculation. But when they collaborate with the fiscal authority, it can significantly impact the exchange rate market through the channel of inflation followed by FIIs.

From the impulse response functions below, we can see that, when a positive shock is experienced by the real interest rates, the inflation differential would come down leading to a fall in the relative inflation level in the domestic economy. When the US economy experiences a relative growth in its inflation, then Indian economy experiences a surge in the FII inflows, but this increased inflow into the economy is experienced only after the first period, (IRF 6 and IRF 7).

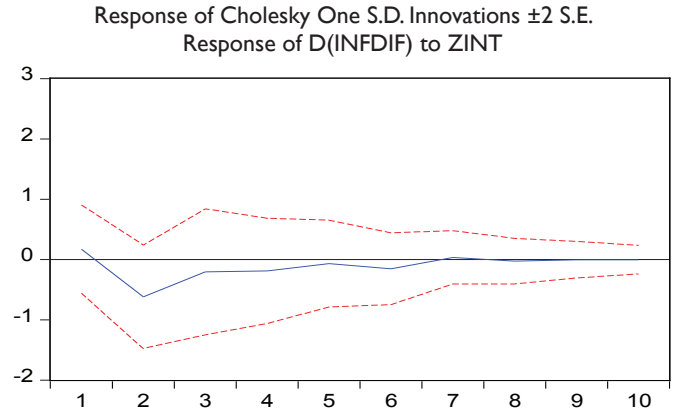
Since the FII inflow would bring in the foreign currency, the INR strengthens and appreciates. Therefore, it is very evident from the figure (IRF 8) that the exchange rate shares a negative relationship with the FII flows.

**Table-4:** Combined Impact of the Monetary and the Fiscal Policies on Speculation

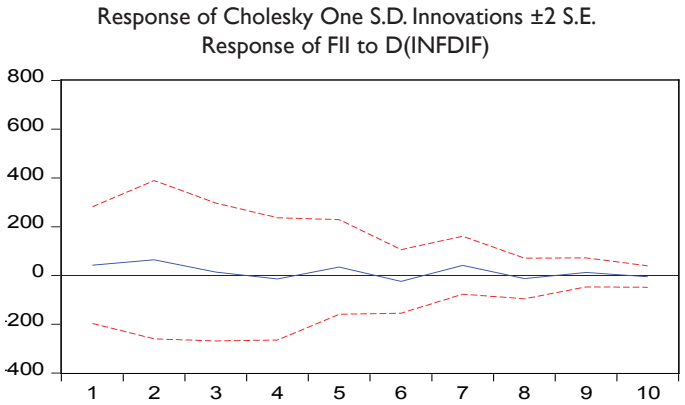
| **[MAT(A)]** | **EXR** | **ZINT** | **GFD** | **TR** | **D(SR)** | **SS** |
|---|---|---|---|---|---|---|
| EXR | 1 | 0 | 0 | 0 | 0 | 0 |
| ZINT | 0 | 1 | 0 | 0 | C(2) | 0 |
| GFD | 0 | 0 | 1 | 0 | C(3) | 0 |
| TR | 0 | 0 | 0 | 1 | C(4) | 0 |
| D(SR) | 0 | 0 | 0 | 0 | 1 | C(5) |
| SS | C(1) | 0 | 0 | 0 | 0 | 1 |

| [MAT(B)] | EXR | ZINT | GFD | D(PE) | D(SR) | SS |
|---|---|---|---|---|---|---|
| EXR | 1 | 0 | 0 | 0 | 0 | 0 |
| ZINT | 0 | 1 | 0 | 0 | 0 | 0 |
| GFD | 0 | 0 | 1 | 0 | 0 | 0 |
| D(PE) | 0 | 0 | 0 | 1 | 0 | 0 |
| D(SR) | 0 | 0 | 0 | 0 | 1 | 0 |
| SS | 0 | 0 | 0 | 0 | 0 | 1 |
| | | Coefficient | Std. Error | z-Statistic | Prob. | |
| | C(1) | 1.732433 | 0.208514 | 8.308457 | 0 | |
| | C(2) | -0.998234 | 0.201808 | -4.946453 | 0 | |
| | C(3) | -3.60986 | 0.201808 | -17.88759 | 0 | |
| | C(4) | 0.580285 | 0.201808 | 2.875428 | 0.004 | |
| | C(5) | 0.129946 | 0.10424 | 1.246606 | 0.2125 | |
| | Log likelihood | -14029.76 | | | | |
| | LR test for over-identification: | | | | | |
| | Chi-square(16) | 27145.3 | | Probability | 0 | |

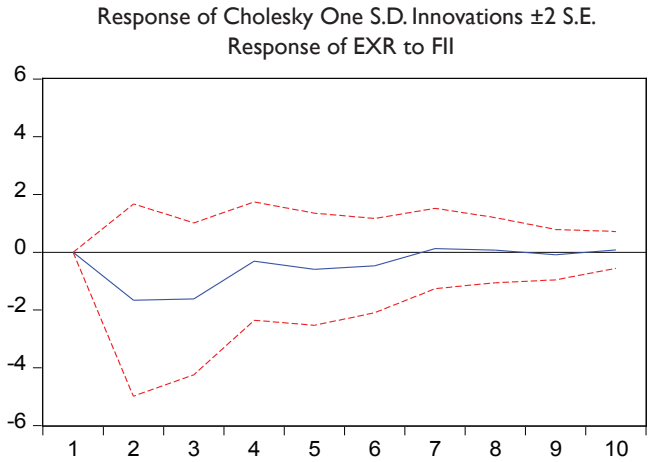
**IRF 6:** Response of Inflation Differential (INFDIF) to Real Interest Rate (ZINT)




**IRF 7:** Response of Foreign Institutional Investments (FII) to Inflation Differential (INFDIF)




**IRF 8:** Response of Exchange Rate (EXR) to Foreign Institutional Investments (FII)



From the above analysis we could see different variables that had significant impact on the exchange rate. With the help of the SVAR analysis we could see how the speculation activity played a very influential role in the behaviour of the stock market which in turn contributes to fluctuations in the exchange rate. Therefore, it is necessary for the concerned authorities to intervene in the market and frame the policies in such a way that the speculative activities are under control. Hence from the above results we can infer that, non-coordinated efforts of the monetary and the fiscal authorities to keep a check on the speculation in the market would only lead to a zero-sum game or a partially positive sum game, because of the reason that the economy follows a Non-Ricardian fiscal regime due to the low levels of the per-capita income. Following this, we could prove the importance of the coordination between the two authorities which results in a complete positive-sum game. From the Table-4, we can see that the z-statistic of the coefficient C(5) is insignificant, i.e., the impact of the speculation on the stock markets is insignificant but that of the stock market is significant. But this doesn't matter anymore because of the combined effectiveness of the policies on the speculation, the root cause for the stock market disturbances.

## Summary and Policy Implications

In the study we have tried to understand the various factors that contribute to the fluctuations in the exchange rate. For this purpose, the variables have been classified as the macroeconomic variables which also include the monetary variables (like the interest rates) and as the fiscal variables.

The ARCH-GARCH method of estimation has been used to analyze the impact of the macroeconomic and the fiscal variables on the exchange rate. From this it was found that the real monetary shock has the most significance in determining the exchange rate, but impact wise, the GDP differential is the most influential. Similarly, the inflation differential also has been found to have a significant brunt on the exchange rate. If the economy is inflationary in nature, this would force the authorities to bring down the interest rates, which is not a good sign for the economy as it would cause the capital flight. Therefore, the concerned authorities should formulate the policies in such a way that, the economy doesn't enter into the phases of inflation. Among the fiscal factors, debt to GDP (which could be a proxy to measure the efficiency), is the most influential with maximum impact on the exchange rate. When an economy is a debt led economy, the investors' confidence is lost which would lead to capital flight and also increasing debt may have to be financed at the cost of reserves and thereby causing in its depletion.

Looking at the history of the exchange rate, it could be seen that the variable has been affected by the market disturbances in the ROW and also in the domestic economy. These disturbances were due to the various crises that occurred in the world economy or announcements made by the US Fed etc. The exchange rate also gets affected due to the speculation activities[8] in the forex market. Therefore, we tried to check for the impact of the information, speculation and the stock market on the exchange rate and found that all the three variables have a very momentous influence on the exchange rate.

Here, with the help of the SVAR models we tested for any significance, of the market disturbances on the domestic speculation, which was found to be missing. But the brunt of the speculation on the stock market was very evident which in turn got reflected on the exchange rate heavily. One way to avoid or minimize such derelictions in the economy is by strengthening the policies. Thus in an attempt to check for the potentiality of the monetary and the fiscal policies on the speculation, we tried to test them with the help of the SVAR technique. But before that, the significance of the policies on the exchange rate was tested and very satisfying results have been obtained.

One of the objectives of the study has been to apply the basic concept of the game theory in the exchange rate market. Hence we tested for effectiveness of the monetary policy and the fiscal policy on the speculation separately. From the results it has been observed that when the monetary (using the real interest rates) and the fiscal authorities try to intervene in the forex market alone to check the speculative activities, then the result is a zero sum game or a partially positive sum game, respectively.

From the theory it is known that if an economy is under a Non-Ricardian fiscal regime, then the monetary authority alone cannot control the disturbances in the economy and it has to be complemented by the fiscal authority.

Taking the lead from the theory, the monetary policy and the fiscal policy variables were combined to test their significance on the speculation. By using the SVAR technique, we put restrictions on the speculation (spot rate) from the policy variables and the result turned out to be a positive-sum game, but partially. Here, the public expenditure proved to be insignificant. Therefore, we replaced this policy variable with tax revenues and this decision was based on the results from the second equation where the tax revenues were more significant than the public expenditure. On the inclusion of this variable, the result turned out to be a complete positive sum game, i.e., when the real interest rate is the strategic variable of the

8 Speculators predict the depreciation of the currency in the near future, abiding to which the players in the market demand for the dollars as soon as possible. This affects the stock market and the currency actually depreciates earlier than the speculated time.

monetary authority and GFD and the taxes are strategic variables of the fiscal authority. An important observation made from this model is that, when these policies are used in a proper manner together, the brunt of the speculation on the stock market is insignificant.

Some important policy implications inferred from the study are:

- It is very important that the overall activity in the economy maintains its pace so that it can contribute more to the world economic activity and become a confidant for the ROW's investment activities, which would in turn help in the growth of the economy;
- It is very crucial that the authorities should frame the policies by imposing strict restrictions on the requirement of borrowings and work towards building up of reserves and become self-sufficient; and
- The authorities in the economy should coordinate among themselves and frame the policies in such a way that there is a very minimal scope for any kind of misbehavior in the forex markets, since the nexus of the government and the monetary authority is the stabilization of the economy.

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# Sub-National Fiscal Rule and Fiscal Discipline – Empirical Evidence from Indian States

**M. Shanmugam***

## Abstract

This paper empirically examines how fiscal rules imposed by sub-national governments influence the deficits of sub-national sectors in India, using a panel data for 14 major states over the period from 1980-81 to 2012-13. We applied the Bias Corrected Least Square Dummy Variable (LSDVC) model. The results show that fiscal rules imposed by sub-national governments have a discipline-enhancing effect on their fiscal discipline. Similarly, the deficits of sub-national sector are influenced negatively by the lagged own tax revenues of the states. The negative and significant result on transfer dependency confirms the widely held view that the national governments resource transfers in the form of tax devolution and grant-in-aid create adverse incentives to sub-national governments to control their deficits. The structural factors namely, growth rate of GSDP, population of states, agriculture sectors' share of GSDP have no significant impact on sub-national fiscal deficits. We also find the existence of election year cycle in the sub-national fiscal deficits.

**Keywords**: Fiscal Rules, LSDVC, Sub-National Fiscal Deficits

## Introduction

The theoretical literature has emphasized that the risk of fiscal indiscipline is one of the challenges of maintaining sound fiscal policies in federal countries. The sub-national policy makers' apparent tendencies to accumulate unsustainable debt level (Hagen and Eichengreen, 1996) and to conduct pro-cyclical policy[1] are the root causes of fiscal indiscipline (Ter-Minassian, 1997; Tanzi, 2000; and Rodden and Webbers, 2010). Empirical evidence on this issue find that sub-national governments'

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1 Rodden and Webbers, 2010 show that Sub-national governments make greater use of borrowings to smooth their expenditures during recession when the central transfers move with business cycle.

reliance on central transfers and easier borrowing access are responsible for the deterioration of aggregate fiscal balances as well as sub-national fiscal balances in federations (Rodden, 2002; Singh and Plekhanov, 2006; and Eyraud and Lusinyan, 2013). To mitigate time inconsistency problem of sub-national governments' soft-budget constraint and to alleviate the patrician manipulation of fiscal policy formulation, national governments in federation imposed fiscal rule on sub-national fiscal policy. Fiscal rule is a long lasting constraint on fiscal policy, expressed in terms of summary indicator of fiscal performance, such as annual limits on the government budget deficits, borrowings and debt level. The sub-national fiscal rule is either imposed by central government or adopted themselves by law. In India, the fiscal imbalance at sub-national level was major concern of the policy makers in the early 2000s. The surge in current expenditure and deceleration in central transfers to states was responsible for the deterioration of sub-national finances in India. For example, the combined fiscal deficits of sub-national governments increased from 3.3 percent of GSDP in 1990-1991 to 4.7 percent in 2001-2002. To address the problem of fiscal consolidation, sub-national governments were enacted Fiscal Responsibility Legislations (FLRs) at different point of time during 2003-2010. The fiscal corrections and adjustments at sub-national level in India are guided by the FRLs. The fiscal correction path as specified in the FRLs of most of States envisaged elimination of revenue deficit by 2008-09 and reduction in gross fiscal deficit at 3 percent of GSDP by 2009-10. This paper provides an empirical assessment of the sub-national governments' fiscal rule on the discipline enhancing effect on the sub-national fiscal discipline in India.

While there is an extensive body of empirical work focused on the effectiveness of national fiscal rule, there are few studies that focus on the context of discipline-enhancing effects of sub-national fiscal rules[2]. We contribute to the literature in two important ways. *First,* we investigate the impact of sub-national fiscal rule on sub-national fiscal deficits using data for a panel of 14 major States of India over the period from 1980-1981 to 2012-2013. *Second,* we estimate dynamic model of fiscal reaction function using Bias-Corrected Least Square Dummy Variable estimator (LSDVC). In our model, incorporating dynamics is essential because the sub-national budget is characterised by intertemporal budget constraint. Further, the LSDVC model is more efficient and robust than other instrumental variable estimators for the small sample study.

Our empirical results support the view that fiscal rules imposed by sub-national governments have discipline-enhancing effects on their

2 Kotia and Lledo (2016) for European Countries and Formney (2014) for OECD countries.

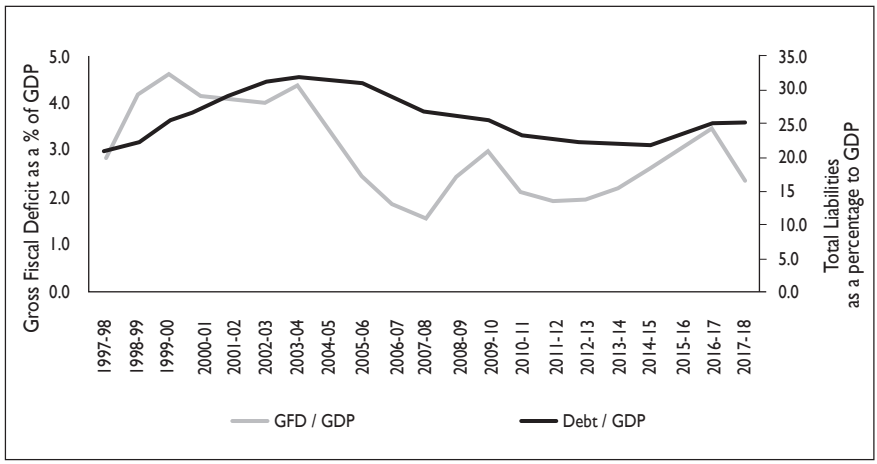
fiscal discipline. The deficits of the sub-national sector have significantly improved by the size of the sub-national sector. The dependency of central resources in the form of tax devolution and grant-in-aid for the expenditure responsibilities worsen the fiscal position of sub-national sectors. Sub-national sectors have made fiscal adjustments considerably in relation to their previous year states' own tax revenue. Further, per capita GSDP and state population have positive and significant impacts. Overall, the study finds that variations in fiscal deficits of states are explained by both institutional factors and state specific structural factors. The fiscal rules imposed by sub-national sectors are effective in controlling sub-national fiscal deficits in India.

The rest of the paper is organized as follows. The below section discusses the fiscal position of Indian States. The section that follows it summarises the literature survey. Its subsequent section provides data and methodology. Results are given in the next section. The section that follows it concludes the paper.

## Fiscal Position of State Governments in India

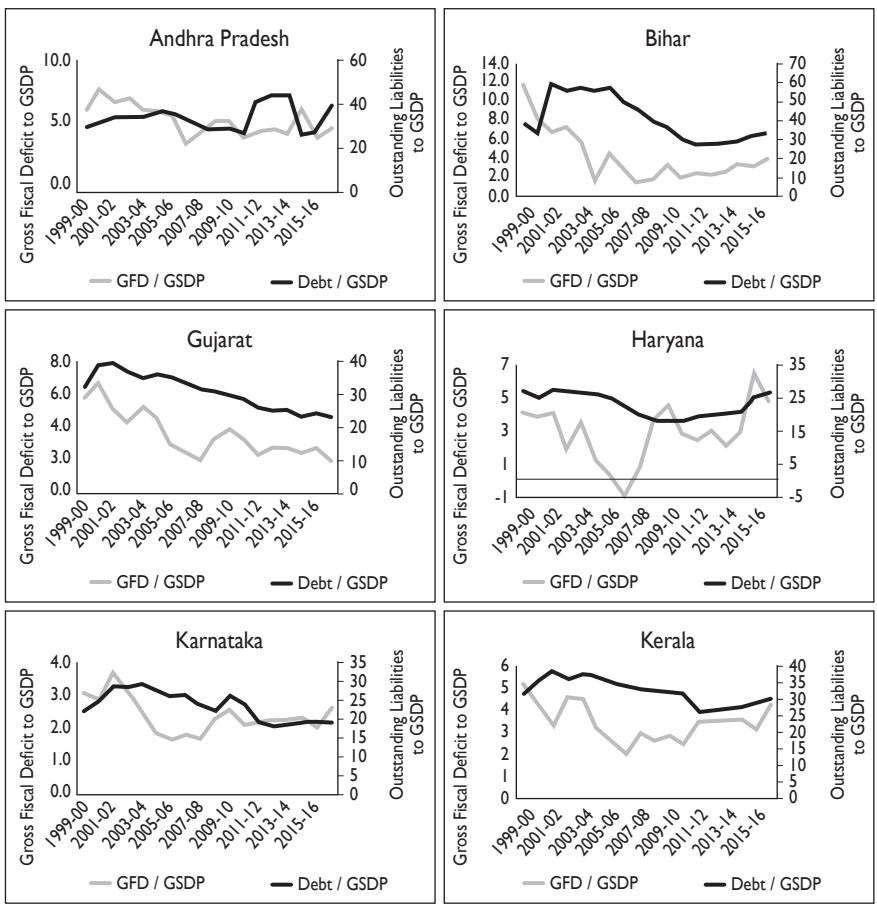
In India, the state governments are frequently face severe resource constraints as their non-debt receipts are often insufficient to fulfil their development obligations. Consequently, States are highly relying on borrowings to bridge the resource gap. Over the time, such a high borrowing reliance of states may result in the accumulation of debt liabilities could pose major challenges for macroeconomic and financial stability. The state government's gross fiscal deficit and debt as a percentage of GDP are depicted in Figure-1. The increasing debt position of state governments has seen in several phases. During the period from 1992-93 to 1996-97 the aggregate debt liabilities of states were stable at 21 percent of GDP. Thereafter it was started to increase from 21 percent of GDP in 1997-98 to 31.8 percent of GDP in 2003-04. The debt liabilities of the states' were declined sharply from 31.3 percent of GDP in 2004-05 to 22.8 percent of GDP in 2011-12. The declining trend of states' debt liabilities was attributed to the implementation of Fiscal Responsibility and Budget Management (FRBM) Act at state level during the last decade. The States' debt liabilities were increased to 25 percent of GDP in 2016-17. Similarly, the Gross fiscal deficit of States' was stood at 2.9 percent of GDP in 1996-97. It was more than 4 percent of GDP during the period from 1997-98 to 2003-04. With the implementation of the FRBM Act at state level, the fiscal deficit declined to a low level of 1.6 % of GDP in 2007-08. However, the implementation of UDAY scheme, states' gross fiscal deficit recorded a sharp increase of 3.5 percent of GDP in 2016-17.

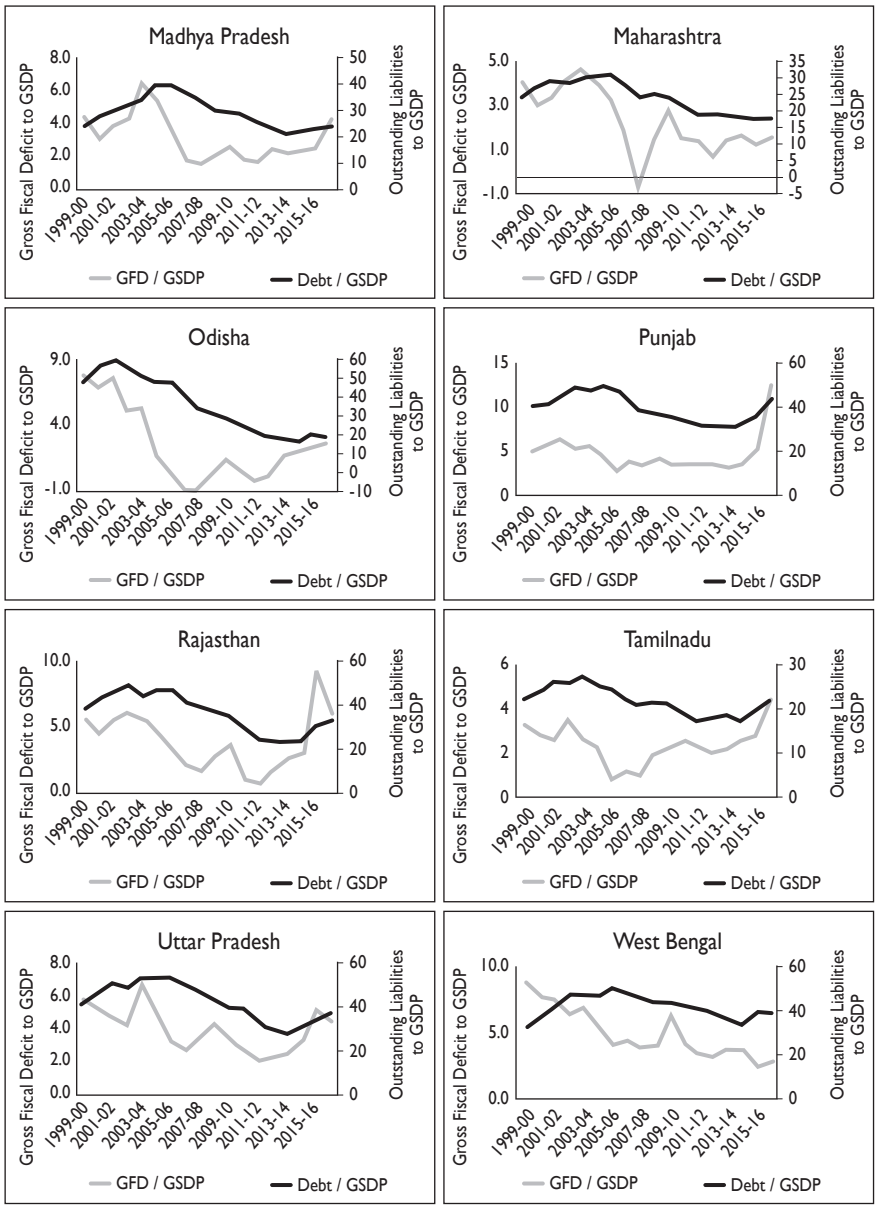
**Figure-1:** Gross Fiscal Deficit and Debt to GDP of Indian States




Source: Hand Book of Statistics on Indian States (RBI).

**Figure-2:** Gross fiscal Deficit and Debt to GSDP Ratio of Major States






Source: Handbook of Statistics on Indian States

Note: Negative sign indicates the fiscal surplus.

At the aggregate level, fiscal deficit of all the states taken together have broadly remain in line with the states' Fiscal Responsibility Legislation (FRL) targets, except during the (UDAY(Ujwal DISCOM Assurance Yojana) scheme implementation (2015-16 and 2016-17). Fiscal deficit of selected states fell dramatically in the mid 2000s, and by 2007-08 almost

all the states had achieved their respective FRL limits (Figure-2). It was also observed that fiscal deficits in many states fell far below these limits. During the period from 2003-04 to 2007-08, eight out of 14 major states reported fiscal deficit of lower than 2 percent of GSDP in at least one year and two states (Haryana and odisha) reported fiscal surplus in at least one year during the period. Since 2008-09, the fiscal deficit of many states increased to more than 3 percent of GSDP. These states are Andhra Pradesh, Haryana, Kerala, Punjab, Rajasthan, Uttar Pradesh, and West Bengal.

After a period of fiscal consolidation, debt to GSDP ratio across Indian states is increased. Recently, the debt to GSDP ratio across individual states varies sharply and many states have breached threshold of debt to GSDP ratio of 25 percent. The outstanding liabilities of many states have increased sharply during 2015-16 and 2016-17. Among the non-special category states, Punjab has highest debt-SGDP ratio of 42.8 percent, followed by West Bengal, the debt to GSDP ratio were higher at 38.7 percent. Andhra Pradesh (37.2 percent), Bihar (33 percent), Haryana (26.6 percent) Kerala (30.2 percent), Rajasthan (33.6 percent) and Uttar Pradesh (36.7 percent) also have debt to GDP ratios far higher than the threshold level of 25 percent in 2016-17. In contrast, Gujarat (20.9 percent), Karnataka (17.05 percent), Madhya Pradesh (24 percent), Maharashtra (18 percent), Odisha (18.3 percent) and Tamilnadu (21.8 percent) have the lowest Debt-SGDP ratio among the non-special category states. The trend line clearly indicates that during the FRBM period the fiscal deficit and debt to GSDP ratio of states were within the FLR limits. Therefore, the present study aims to analyse the relationship between states' fiscal deficit and FLR across major states in India.

## Review of Literature

The theoretical literature on soft budget constraint, in the context of fiscal federalism has triggered empirical contribution in the area of sub-national fiscal discipline. The main focus of the empirical studies is to identify the instance of soft budget constraints and examine how country specific institutional structure gives rise to soft budget constraints within individual countries. A model of soft budget constraint developed by Kornai et al., (2003) show that central governments' inability to commit no bailout is rather weak and this leads to soften the sub-national budget. Using Swedish local government data, Pettersson (2010) find that Swedish local governments' debt increased by 20 percent when they expected future support from the central government.

Alesina et al., (1999), for the first time examined the cross-country variations in fiscal positions using a sample of Latin America and Caribbean countries and find that budgetary procedures that impose

constraint on deficits strongly influence the fiscal outcomes. Several other recent empirical studies have been conducted in different regions and similar findings have been arrived at (Hellerberg et al., 2009; Perotti and Kontopolous, 2002; Fabrizio and Mody, 2006; Prakash and Cebezon, 2008). Recently, Tapsoba (2012) analysed the effects of national numerical fiscal rule on fiscal discipline using a large sample of 74 countries covering the period 1990-2007. He find that the cyclically adjusted primary balance is positively correlated with numerical fiscal rule. Hallerberg and Hagen (2007) examine how the design of fiscal rules and types of governance impact on fiscal discipline in EU15 countries and find that delegating budgetary decision-making to the minister of finance improves fiscal discipline if the government is controlled by single party or if coalition parties are closely aligned. In the opposite case, they find a stringency of fiscal targets which are effective in states with considerable degree of ideological dispersion. Similarly, Hellerberg and Ylaoutineen (2010) find supportive evidence for Central and East European countries. Vlaicu et al. (2014) analyse the impact of different phases of multi-year budgeting framework on aggregate as well as sectoral measure of fiscal performances using a large panel dataset of 181 countries over the period from 1990 to 2008. They find that on average the multi-year budgeting improves budget balances by two percent points and suggest that the adoption of multi-year budgeting as an institutional framework can have tangible benefit for fiscal performance by controlling short-run incentives to manipulate the budget.

A body of theoretical literature on political economy commonly assumes that fiscal deficits are the aggregate outcome of political conflict between different groups of citizens (Alesina and Tabellini, 1990; and Persson and Svensson, 1989). Roubini and Sachs (1989)'s OECD countries study results supported this evidence. This line of empirical research has emphasised that political incentives of national governments and dispersion of political power, ideology of political parties, election year cycle is the determinant of fiscal indiscipline of subnational governments (Dutta, 1994; Khemani, 2007; and Chaudhuri and Dasgupta, 2006). Dutta (1994) examined the effects of unstable coalition governments on policy distraction using panel data of Indian states and find evidence in support of the hypothesis that fiscal deficits are higher when states are controlled by unstable coalition political parties. Similarly, Khemani (2007) has focused on the political incentives of national government to impose fiscal discipline on a sub-national government using a panel data for 14 major states in India. He find that fiscal deficits are higher if the state governments' political party is the same the national political party than the states that are controlled by the local political party or is a coalition member of the national government. He also argued that such political vulnerability of national ruling political

parties, the institutional solution of sub-national borrowings adopted by the national government to reduce the problem of fiscal indiscipline is likely to be ineffective. Another recent study by Chaudhuri and Dasgupta (2006) find the existence of election cycle in the state government expenditure when government raises less commodity tax revenue spends less on current account and incurs a capital expenditure in election year. They also find evidence in support of the hypothesis that the choices of the fiscal policy at state level altered by the dispersion of political power. In a somewhat different context, Noorudhin (2004) demonstrates that multi-party states have higher expenditures on salaries and administration and less expenditure on development in India. Recently Khemani (2007) has focused on whether delegated authority of government makes a difference by contrasting the impact of patrician politics on two different types of central transfers to states in India over the period from 1972 to 1995. He demonstrates that the fiscal transfers that are distributed by the delegating agency have constrained patrician impact although specific transfers that are distributed in favour of politically affiliated states.

While the literature focusing on the context of national fiscal rule is vast, very few studies have investigated the effectiveness of sub-national fiscal rule and even these have come up with inconclusive results. Singh and Plekhanov (2006) focus on the impact of different institutional approaches to control sub-national borrowings on their fiscal deficits and the effectiveness of the institutional arrangements using a panel data of 43 countries over the period 1982 to 2000. They find that rules imposed by central government and cooperative arrangements for sub-national borrowings reduce fiscal deficits when the vertical fiscal imbalance is large. Recently, Aringmon et al. (2012) examined the role of economic, institutional and political determinant on sub-national fiscal discipline in Spain over the period from 1984 to 2004. They show that fiscal rule that has been implemented in the context of regional government in Spain has not significantly improved sub-national fiscal balances. They also suggested that providing greater discretionary capacity to raise revenue would improve fiscal discipline. Similarly, Formney (2014) explores which institutional arrangements help to balance the sub-national fiscal accounts by focusing on two different institutional mechanisms viz., sub-national tax autonomy and centrally imposed fiscal rule using a sample of EU15 countries over period ranging from 1995-2008. He find that centrally imposed fiscal rule is only effective for unitary countries, but not for federal countries. For federal countries, he shows that tax autonomy over own tax instrument is a key to prevent large fiscal deficit at the sub-national level. most of the existing studies focus on the effectiveness of sub-national fiscal rule on general government fiscal performances (Debrun,2008) or national

fiscal rules on sub-national fiscal discipline (Formney, 2014). None of the studies focus on the impact of sub-national fiscal rule on sub-national fiscal discipline. The response of aggregate fiscal indicator varies with respect to the type of fiscal rule (whether it is national or sub-national rules). This study adds to the literature by focusing on the impact of sub-national fiscal rules on sub-national fiscal deficits.

## Data and Methodology

We consider a sample of 14 major states in India and the data is organised annually over the period from 1980-81 to 2012-13. The states covered in this study are Andhra Pradesh, Bihar, Gujarat, Haryana, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal. We choose these major states due to the availability of the data that is needed to undertake the advanced panel data analysis for the variable we want to study. Special category states are more liberally funded by central government and their revenue and expenditure functions differ from non-special category states. In order to avoid the bias in sample selection this study concern with non-special category states only. These 14 states accounted for 75 percent of the India's land area and 87 percent of the country population (Census 2011). The data on state level income and the share of agriculture GSDP were collected from various issues of Handbook of Statistics on Indian Economy, published by RBI. The state level population data were collected from two sources such as, EPW States database and National Account Statistics (NAS), published by the Ministry of Statistics and Programme Implementation (MOSPI). The information on fiscal variables was obtained from the Handbook of Statistics on State Government Finances, 2010 and various issues of State Finances-A Study of State Budgets (RBI). All the nominal variables were converted into real term using State level GDP deflator (2004-05 prices). The information on political variables was collected from the statistical report on general election to the State Legislative Assemble (Vidhan Sabha), published by Election Commission of India. The data on list of chief ministers and their political party and information on coalition were obtained from Election commission of India Website.

## Methodology

To examine the impact of sub-national fiscal rules on sub-national fiscal deficit, we use the fiscal reaction function which has been used in the literature (Foremney 2014)

$$Y_{it} = \beta_1 FRUL_{i,t} + \delta_1 X_{i,t} + \theta_1 S_{it} + \omega_1 P_{it} + \upsilon_t + \eta_i + \varepsilon_{i,t} \qquad ...(1)$$

where states are indexed by *i* and years by *t*. The dependent variable is the ratio of State government fiscal deficits to Gross State Domestic Product (GSDP). The impact of fiscal rule on sub-national fiscal deficit is captured by the parameter $\beta_1$. The parameter $\eta$ and $\nu$ is individual and time fixed effects respectively. In the empirical model, we include institutional, state specific structural and political control variables. The matrix X includes Institutional (Transfer Dependence ratio) and other budgetary variables (share of own tax revenue and size of the state government). The transfer dependence is taken as a proxy for coordination failure. The State government size has been considered as a measure of the extent of the level of fiscal decentralization. The share of own tax revenue to total revenue of states has been considered as a measure of local revenue mobilization. In addition to this, the log of share of agriculture GSDP, log of per capita GSDP and log of state population are included in the matrix S. We also consider whether the election cycle, coalition government and alteration of government have an effect on state government fiscal deficits. The coalition is a dummy variable coded as 1 when the state ruling party controls less than 50 percent of the seats in the state legislative assembly; and 0 otherwise. Election cycle is a dummy variable coded as 1 for the scheduled state assembly election year and 0 for all other years. Alteration is a dummy variable coded as 1 if a state assembly is ruled by a political party that is different from the political party that ruled the state prior to the last assembly election in that state and 0 if the state assembly is ruled by the same political party that ruled prior to the election.

## Identification

To establish the relationship between the fiscal rule and sub-national fiscal deficit, the researcher needs to address the problems of reverse causality and omitted variable bias. Several researchers have discussed the difficulties in dealing with the problem of reverse causality[3], but none has proposed an instrument that influences the probability of fiscal reform while being exogenous to fiscal performance. Second, the omitted variable bias arises due to failure to account for the factor that effects both adoption of fiscal rule and state fiscal performance. This problem can be partially addressed if we use within-country variation in fiscal institution (Fabrizio and Mody, 2006). This approach controls time invariant country-level heterogeneity that may influence budget deficit. However, focusing variation within-country overtime, the problem of omitted variable bias alleviated but not eliminated.

3 Alesina and Perotti (1999), Stein et al. (1999), Knight and Levinson (2000), and Perotti and Kontopoulos (2002)

## Dynamic Estimation

$$GFD_i = \alpha + \beta_1 GFD_{i-1} + \theta_1 FRUL_i + \theta_2 SIZE_i + \theta_3 OTR_i + \theta_4 OTR_{i-1} + \theta_5 TDR_i + \phi_1 LPCI_i + \phi_2 LAGRI_i + \phi_3 POPLN_i + \varpi_1 COALIN_i + \varpi_2 ELECT_i + \varpi_3 ALTRN_i + \eta + \varepsilon_i \quad ...(2)$$

In this dynamic framework, we include one period lag of dependent variable as well as year fixed effects which are likely to play an important role in determining state fiscal performances. For the present case of small $N$ (14) and large $T$ (32), the above mentioned GMM estimator is inappropriate. It is also well established in the literature that the parameter estimates derived from the dynamic Least Square Dummy Variable model(LSDV) would be biased when lagged dependent variable is included in a small sample(Roodman, 2009).

An alternative approach to dynamic LSDV panel estimates would be to use other instrumental variables such as Anderson-Hsiao (AH), Arellano-Bond (AB) and Blundell-Bond (BB). These approaches are bias-corrected Least Square Dummy Variable (LSDVC) dynamic panel-data models has recently been popular in econometric literature. We use this LSDVC estimator, a method recently proposed by Kiviet (1995), Judson and Owen (1999), Bun and Kiviet (2003) and extended by Bruno (2005). This estimator has been used by several empirical applications[4].

## Results

**Table-1:** Descriptive Statistics

| Variable | No. of Observations | Mean | Standard Deviation | Minimum | Maximum |
|---|---|---|---|---|---|
| Ratio of Gross Fiscal Deficits to GSDP (GFD) | 448 | 3.568 | 1.616 | -4.020 | 6.179 |
| Transfer dependency Ratio(TDR) | 448 | 35.394 | 15.05 | 8.857 | 80.314 |
| State government Size (SIZE) | 448 | 18.985 | 4.924 | 11.717 | 36.893 |
| Share of own Tax Revenue to Total Revenue (OTR) | 448 | 49.954 | 13.540 | 17.471 | 74.625 |
| Log of Per capita GSDP(LPCI) | 448 | 9.877 | 0.583 | 8.419 | 11.193 |
| Log of Share of Agricultural GSDP(LAGRI) | 448 | 3.131 | 0.417 | 1.813 | 3.838 |
| Log of State population(POPLIN) | 448 | 17.769 | 0.564 | 16.388 | 19.144 |
| Interest payment/Revenue Expenditure(IPRE) | 448 | 15.009 | 5.487 | 1.153 | 35.757 |
| Coalition Dummy (COALIN) | 448 | 0.328 | 0.470 | 0 | 1 |
| Election Year Dummy (ELECT) | 448 | 0.207 | 0.440 | 0 | 1 |
| Alteration(ALTRN) | 448 | 0.578 | 0.470 | 0 | 1 |
| State Separation Dummy(SDY) | 448 | 0.087 | 0.282 | 0 | 1 |
| Fiscal rule Dummy (FRULE) | 448 | 0.263 | 0.441 | 0 | 1 |

4 For example, Meschi and Vivarelli (2009) applied for trade and inequality relationships; Huank (2010) applied for political and financial development; and Nepal and jamasb (2012) used for power sector reform and growth relationships.

**Table-2:** Correlation Matrix

| | GFD | FRULE | SIZE | OTR | TDR | IPRE | LPCI | LAGRI | LPOPLN | COALIN | ELECT | ALTRN | SDY |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **GFD** | I | | | | | | | | | | | | |
| **FRULE** | -0.333 | I | | | | | | | | | | | |
| **SIZE** | 0.482 | 0.011 | I | | | | | | | | | | |
| **OTR** | -0.167 | 0.165 | -0.453 | I | | | | | | | | | |
| **TDR** | 0.166 | -0.023 | 0.380 | -0.855 | I | | | | | | | | |
| **IPRE** | 0.354 | 0.091 | 0.013 | -0.840 | 0.162 | I | | | | | | | |
| **LPCI** | -0.280 | 0.567 | -0.505 | 0.701 | -0.623 | 0.235 | I | | | | | | |
| **LAGRI** | 0.193 | -0.502 | 0.319 | -0.458 | 0.250 | -0.161 | -0.648 | I | | | | | |
| **LPOPLN** | 0.122 | 0.162 | 0.277 | -0.230 | 0.450 | 0.094 | -0.244 | -0.307 | I | | | | |
| **COALIN** | -0.050 | 0.241 | -0.117 | 0.098 | 0.038 | 0.219 | 0.248 | -0.374 | 0.106 | I | | | |
| **ELECT** | -0.049 | -0.028 | -0.001 | -0.016 | 0.002 | -0.036 | -0.023 | 0.035 | 0.002 | -0.029 | I | | |
| **ALTRN** | 0.059 | -0.054 | -0.029 | 0.160 | -0.224 | 0.001 | 0.132 | 0.117 | -0.375 | 0.154 | 0.017 | I | |
| **SDY** | 0.029 | 0.265 | 0.283 | -0.348 | 0.450 | 0.089 | -0.138 | 0.033 | 0.378 | 0.122 | -0.007 | -0.185 | I |

**Table-3:** Determinants of Sub-national Government's Fiscal Deficits

| **Variables** | **Bias Corrected Least Square Dummy Variable (LSDVC)** | | | |
|---|---|---|---|---|
| | **OLS** | **Anderson-Hsiao (AH)** | **Arellano Bond (AB)** | **Blundell-Bond (BB)** |
| Lagged GFD | 0.390*** | 0.375*** | 0.382*** | 0.392*** |
| | (0.0439) | (0.0439) | (0.0422) | (0.0431) |
| **Budgetary Variables** | | | | |
| SIZE | 0.207*** | 0.331*** | 0.333*** | 0.334*** |
| | (0.020) | (0.034) | (0.031) | (0.0327) |
| OTR | 0.043*** | 0.077*** | 0.078*** | 0.078*** |
| | (0.013) | (0.014) | (0.012) | (0.013) |
| $OTR_{t-1}$ | -0.029** | -0.030** | -0.030** | -0.030** |
| | (0.013) | (0.013) | (0.012) | (0.012) |
| TDR | 0.039*** | 0.059*** | 0.059*** | 0.059*** |
| | (0.009) | (0.016) | (0.015) | (0.015) |
| IPRE | 0.083*** | 0.025 | 0.023 | 0.021 |
| | (0.016) | (0.020) | (0.018) | (0.019) |
| **State Specific Controls** | | | | |
| LPCI | 2.235*** | 3.285*** | 3.357*** | 3.349*** |
| | (0.418) | (0.707) | (0.672) | (0.705) |
| LAGRI | 0.006 | -0.081 | -0.089 | -0.064 |
| | (0.190) | (0.400) | (0.372) | (0.396) |
| POPLN | 0.357*** | 2.769*** | 2.936*** | 2.862*** |
| | (0.134) | (0.994) | (0.925) | (0.990) |
| SDY | 0.118 | 0.026 | 0.043 | 0.032 |
| | (0.197) | (0.349) | (0.321) | (0.339) |

| Variables | Bias Corrected Least Square Dummy Variable (LSDVC) | | | |
|---|---|---|---|---|
| | OLS | Anderson-Hsiao (AH) | Arellano Bond (AB) | Blundell-Bond (BB) |
| **Political Variables** | | | | |
| Election Dummy | 0.126 | 0.137 | 0.138 | 0.138 |
| | (0.107) | (0.110) | (0.102) | (0.107) |
| Coalition Dummy | -0.004 | -0.072 | -0.074 | -0.068 |
| | (0.102) | (0.161) | (0.147) | (0.155) |
| Alteration | 0.051 | 0.061 | 0.059 | 0.062 |
| | (0.101) | (0.123) | (0.113) | (0.119) |
| Year Effect | Yes | Yes | Yes | Yes |
| Observations | 434 | 434 | 434 | 434 |
| Number of ID | 14 | 14 | 14 | 14 |

The time period used for the analysis is from 1980-81 to 2012-13.

Note: Dependent variable is Gross Fiscal Deficits of States (GFD). Bootstrapped standard errors are presented in parenthesis. We performed first order bias corrections while the number of bootstrapping repitations has been confined to 50. SDY is state separation dummy for three States, namely Uttar Pradesh, Madhya Pradesh and Bihar, which is equal to 1 after the year 2001.

*, ** and *** denotes significance at 10 %, 5% and 1% respectively

The LSDVC (AH), LSDVC (AB) and LSDVC (BB) estimates for the determinants of sub-national government deficits are displayed in Columns 3 to 5 of Table-3. The estimation result show that the one period lagged dependent variable is statistically significant at 1 percent level (Column 3). The positive coefficient of lagged dependent variable implies that there exists an inter-temporal budget constraint in the budget process across States. Our result also shows that the sub-national fiscal stance is likely to be effected by size of the sub-national government, transfer dependency ratio and the sub-national revenue autonomy. All of the coefficients of the institutional and budgetary variables have the expected signs and are statistically significant. The sub-national government size negatively affects their fiscal deficits. The estimated co-efficient implies that a 1 percent increase in the share of sub-national expenditure to GSDP increases the share of fiscal deficit to GSDP by about 0.33 percent. This implies that the sub-national fiscal stance is strongly influenced by sub-national government size.

Returning to our core interest i.e, the effect of institutional variables on sub-national fiscal deficits, such as transfer dependency ratio and sub-national tax autonomy indicator, significantly impact sub-national fiscal deficit. The transfer dependency ratio significantly increases the sub-national fiscal deficits. This implies that a 1 percent increase in the share of central transfer to total revenue deteriorate the sub-national fiscal stance by about 0.059 percent point. These findings are corroborated by those

of De-Mello (2000), Rodden (2002) and Purfield (2004). Similarly, the co-efficient of the share of own-tax revenue to total revenue, as a measure of states' local revenue mobilization is positively associated with state government's fiscal deficits. However, the coefficient of lagged share of own-tax revenue is negative and significant, with a coefficient of 0.029. The negative sign of the sub-national tax autonomy indicator denotes that sub-national deficits can be avoided by providing autonomy over their local tax instruments. These results confirm the findings of Argimon et al., (2012) and Foremny (2014).

Finally, as for the state specific control variables, per capita GSDP and sub-national population were found to be positive and statistically significant at 1 percent level. Other political variables do not have an impact on deficits which is statistically different from zero. Overall, the main conclusion from the baseline regression is that the deterioration of state finances is explained by both state specific controls and institutional variables.

**Table-4:** The Impact of Sub-national Fiscal Rule on Fiscal Deficits

| Variables | OLS | Bias Corrected Least Square Dummy Variable (LSDVC) | | |
|---|---|---|---|---|
| | | Anderson-Hsiao (AH) | Arellano Bond (AB) | Blundell-Bond (BB) |
| L.GFD | 0.392*** | 0.377*** | 0.383*** | 0.394*** |
| | (0.044) | (0.044) | (0.042) | (0.043) |
| **Fiscal Rule** | | | | |
| FRUL | -0.316 | -0.509* | -0.496* | -0.487* |
| | (0.246) | (0.293) | (0.266) | (0.281) |
| **Institutional variables** | | | | |
| SIZE | 0.206*** | 0.330*** | 0.331*** | 0.332*** |
| | (0.020) | (0.033) | (0.031) | (0.033) |
| OTR | 0.043*** | 0.077*** | 0.0778*** | 0.079*** |
| | (0.013) | (0.013) | (0.012) | (0.013) |
| $OTR_{t-1}$ | -0.029** | -0.029** | -0.029** | -0.029** |
| | (0.013) | (0.013) | (0.012) | (0.012) |
| TDR | 0.039*** | 0.057*** | 0.0563*** | 0.057*** |
| | (0.009) | (0.016) | (0.015) | (0.016) |
| IPRE | 0.078*** | 0.016 | 0.015 | 0.013 |
| | (0.016) | (0.020) | (0.018) | (0.019) |
| **State Controls** | | | | |
| LPCI | 2.229*** | 3.274*** | 3.339*** | 3.341*** |
| | (0.417) | (0.702) | (0.665) | (0.705) |
| LAGRI | 0.014 | -0.071 | -0.077 | -0.055 |
| | (0.190) | (0.396) | (0.367) | (0.395) |
| POPLN | 0.355*** | 2.746*** | 2.889*** | 2.839*** |

| Variables | OLS | Bias Corrected Least Square Dummy Variable (LSDVC) | | |
|---|---|---|---|---|
| | | Anderson-Hsiao (AH) | Arellano Bond (AB) | Blundell-Bond (BB) |
| | (0.134) | (0.985) | (0.910) | (0.987) |
| SDY | 0.114 | 0.016 | 0.031 | 0.022 |
| | (0.197) | (0.345) | (0.316) | (0.337) |
| **Political Controls** | | | | |
| ELECTION | 0.113 | 0.118 | 0.119 | 0.120 |
| | (0.107) | (0.108) | (0.100) | (0.106) |
| COALIN | 0.0004 | -0.074 | -0.075 | -0.070 |
| | (0.102) | (0.160) | (0.146) | (0.154) |
| ALTRN | 0.055 | 0.048 | 0.048 | 0.050 |
| | (0.100) | (0.122) | (0.112) | (0.119) |
| Year Effect | Yes | Yes | Yes | Yes |
| No. of Observations | 434 | 434 | 434 | 434 |
| No. of States | 14 | 14 | 14 | 14 |

The time period used for the analysis is from 1981-82 to 2012-13.

Note: Dependent variable is Gross Fiscal Deficits of States (GFD). Bootstrapped standard errors are presented in parenthesis. We performed first order bias corrections while the number of bootstrapping repitations has been confined to 50.

*,**,*** denotes significance at 10 %, 5% and 1% respectively.

In Column 3, 4 and 5 of Table-4, we present the results obtained with the introduction of fiscal rule variable. Fiscal rule has a negative and significant impact on state fiscal deficit suggesting that the adoption of Fiscal Responsibility and Budget Management (FRBM) Act as a rule based institutional reforms has a beneficial impact on the state deficit. The introduction of this variable does not alter the sign of the other variables. According to the results, the lagged dependant variable appears to have a positive and significant impact. Similarly, the transfer dependency ratio, size of the state government and share of own tax revenue are positive and significant. As in the previous results, the lagged share of own tax revenue has negatively influence the sub-national budgets. The result is robust to all the three estimation techniques of biased corrected Least Square Dummy Variable (LSDVC) model (Anderson-Hsiao, Arellano-Bond and Blundell-Bond). Overall the results support the view that the sub-national fiscal discipline could be controlled by imposing strict fiscal rule and providing more autonomy of tax revenue over their tax instruments. A more interesting finding from this result is that fiscal rules imposed by states work as an effective tool to control sub-national fiscal indiscipline in a large federals of India.

## Conclusion

Recent work in public finance has shown that the choice of institutional arrangement for controlling sub-national deficits depends on the types of government and constitutional structures of the country. Using state level data from a large federation of India, this paper contributes to the literatures by examining whether fiscal rules imposed by sub-national governments have a discipline enhancing effects on their fiscal discipline. The econometric evidence finds negative and significant relationship between fiscal rules and deficit of states. It implies that fiscal rules have a beneficial impact on state sector fiscal performances. Another striking results from this paper is the negative and significant coefficient on lagged own tax revenue, that is consistent with the earlier claims that financing of sub-national expenditure from own tax revenue sources is linked to more responsible budgeting. Overall, this study finds that a properly designed fiscal rule which is imposed by sub-national sector improves fiscal performances. Since the financial markets are sensitive to fiscal health of state governments, the self-imposed fiscal rules are effective tool to control sub-national deficits. From a policy perspective, this paper shows that India should consider more sophisticated rule that address the important issue of counter cyclicality. Flexibility to adjust with cyclical fluctuations should be incorporated to State level Fiscal responsibility Legislature (FRL). Fiscal consolidation should also be made by the states.

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# An Analytical Study of Policies for Promoting Energy Efficiency in India with Reference to Industrial Sector

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## Abstract

India is emerging as one of the fastest growing economies with subsequent increase in energy consumption level. The industrial sector consumes almost 30% of the total commercial energy available in India and nearly 70% is directed towards energy-intensive industries. Although, the individual consumption of energy of Macro, Small and Medium Enterprises (MSMEs) is not high, yet their collective energy use is definitely much. Energy Efficiency stands as a best solution to the obstacles like climate change, economic growth and energy security. The industrial sector of India also has tremendous potential for energy savings which will in turn employ and influence millions of people, mitigate climate change and reduce energy consumption. The steps are taken by BEE to reduce their energy consumption by initiating various innovative policy actions under the realm of Energy Conservation Act 2001 in industrial sector. An attempt has been made to analyse the energy consumption scenario of industrial sector to prove the need of energy efficiency concept in industries by providing statistics while using secondary literature. The research paper also analyzed various energy conservation schemes put into practice by BEE to bring energy efficiency measures in large and small industrial units of India while discussing the reasons for its limited success and also provides some remedial measures to further improve in India. It has been found that there is a need to recognize the requirement of technology transfer, specific energy consumption norms, financing mechanisms and capacity building to implement energy efficient schemes systematically in industrial sector. Efforts in PAT direction must be continued, strengthened

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and widened and SMEs should also be included as currently they are outside the purview of PAT mechanism.

**Keywords:** Climate Change, Consumption, Energy Efficiency, Industries

## Introduction

Energy is important to the infrastructure sector for sustainable development. High per capita energy consumption results in higher per capita. There is no doubt that energy plays a vital role in accelerated industrial production, better employment opportunities, economic growth and comfort. (Sathaye, et al., 2006) However, in many states of India the electricity service provision is not adequate due to issues like (a) Lack of grid electricity connection to rural and urban poor, (b) Current Generation capacity is insufficient to meet peak demand (c) Blackouts and Brownouts (d) T and D losses (e) No access of electricity supply due to geographic locations. Therefore, the electrification of India faces a huge gap between demand and supply of electricity due to above listed reasons. From 2007-08 to 2017-18, generation of electricity has increased by 5.71 %, however consumption of electricity has increased by 7.39%. Moreover, the status of electricity distribution in India from 2008-09 to 2017-18 also highlights that there is no doubt that Transmission and Distribution (T and D) losses in India have decreased from 25.7% in 2008-09 to 21.15% in 2017-18, still the decreased percentage is not much significant. (MOSPI, 2019) In addition, if India wants to eradicate poverty and needs to grow at a rate of 8-9% for the next 25 years, there is a huge requirement of energy. Further more, the data entails that by 2031-32, from the existing capacity of 344,002.39 (2017-18) India's power generation capacity must increase between 800,000 and 950,000 MW (Planning Commission, 2006) to meet the future demands of energy consumption which means substantial increase in imports of crude oil, natural gas, coal and lignite. (Shukla and Zia, 2016) Moreover, according to IEA at global level when energy demand grows by 55% from 2005 to 2030 and $CO_2$ emission by 57%, then a revolutionary steps need to be taken. Therefore, in accordance to the current situation and future crisis, energy efficiency / conservation definitely has a huge potential to diminish environmental hazards and to bridge the increasing gap of demand and supply, as it is rightly quoted that energy saved is energy generated. (Bala, 2013)

The solution to improvise energy sector in India is to invest on Energy Efficiency measures to bring Sustainable development of nation. "According to World Energy Council (WEC) stated that energy efficiency at the micro level means to yield one unit of economic activity (per unit of GDP), only

optimum energy should be used. (Bala, 2013) To expand, it is possible to achieve energy efficiency when one can reduce energy intensity in a specific product or area of production or consumption while not affecting the current output, consumption or comfort levels. There are two sources of energy efficiency improvements (i) imparting greater technical efficiency while implementing energy efficiency technologies (ii) bringing structural economic changes which lead to less use of energy during production and consumption of goods.(IRENA, 2017) Moreover, energy efficiency also leads to other numerous benefits like access of quality power supply to more people through the existing energy infrastructure, facilitates economic growth, improves the affordability of energy services and curtails carbon emissions from atmosphere.(IEA, 2014)

The utilization of energy efficiency devices at national and regional level brings international competitiveness of energy efficiency products in world markets. As a result, the cost of production reduces which leads to sustainable development of every sector. This further brings effective distribution and rational use of resources and application system in all sectors for a long span of time which also results in preservation of the natural eco-systems.(Pavlovic, et al., 2006) IEA statistics reveal that over the period of 2000 to 2018, energy efficiency measures in India have avoided an additional 15% of energy demand of the country and pass up nearly 300 $MtCO_2$ emissions. As shown in Table-1, in 2017-18, due to implementation of energy efficiency measures, there was total energy savings of 16.62 mtoe i.e. 1.97% of total primary energy supply of India. Moreover, this leads to total cost savings of Rs 53,627 crores approximately and reduction of around 108 million tones of $CO_2$ annually.

**Table-1:** Total Energy Saving through Energy Efficiency Measures in India in 2017-18

| Type of Energy Saving | Total Energy Saving | Total Cost Saving | Total Reduction of $CO_2$ Emission |
|---|---|---|---|
| Electricity | 86.1 BU | Rs 41,799.40 Crore | 69.08 million tone |
| Thermal | 9.41 mtoe | Rs 11,828.38 Crore | 39.20 million tone |
| Total | 16.62 mtoe | Rs 53,627 Crore | 108 million tone |

**Source:** Bureau of Energy Efficiency, 'Annual Report 2018-19', p.10. Accessed from https://beeindia.gov.in/sites/default/files/Annual%20Report%20%202012-2013%20%282%29.pdf as on 18 March 2020

It is also rightly said that the end users of different sectors stand in front of different hurdles, having separate environmental policies and needs to adapt specific technological alternatives. Therefore, their potential to save energy also differs from each other. However, energy efficiency in the large energy intensive industries has the highest savings potential for India. In addition, initiatives have also been undertaken by Government / bilateral / multilateral organizations to help Micro, Small and Medium Enterprises (MSMEs)

improve their energy performance. Therefore, in order to sustain the contribution of industry sector in Indian economy, efforts need to be initiated.

It is quite evident that industrial energy efficiency results broadly in direct economic benefits, increasing competitiveness, quality, safety and productivity from a unit's perspective. Furthermore, this also reduces the industry's vulnerability to rapidly increasing energy prices, build their concern towards regulatory requirements for cleaner production and achieving green consumer's demand and also emphasize national benefits like energy security, new job creation and environmental protection. In addition, energy efficiency measures in industries also adds non-energy benefits such as improved working conditions, less noise pollution, reduce workforce stress, direct and indirect economic benefits from downsizing or elimination of energy intensive equipments.(Giovanni and Federico, 2012)

## Status of Energy Consumption in Industrial Sector

Industry sector shares a close linkage with country's overall growth as this sector adds a huge proportion to national income and GDP. Industry sector consumes maximum energy accounting about 56% of total energy consumption. Table-2 highlights the statistics related to electricity consumption of all sectors. In 2017-18, industry sector has utilized maximum electricity (41.48%), chased by domestic (24.20%), agriculture (18.08%) and commercial sectors (8.51%).

**Table-2:** Consumption of Electricity by Sectors in India (in Giga Watt Hour = $10^6$ Kilo Watt Hour)

| Year | Industry | Agriculture | Domestic | Commercial | Traction & Railways | Others | Total Consumption |
|---|---|---|---|---|---|---|---|
| 2008-09 | 2,09,474 | 1,09,610 | 1,31,720 | 54,189 | 11,425 | 37,577 | 5,53,995 |
| 2009-10 | 2,36,752 | 1,20,209 | 1,46,080 | 60,600 | 12,408 | 36,595 | 6,12,645 |
| 2010-11 | 2,72,589 | 1,31,967 | 1,69,326 | 67,289 | 14,003 | 39,218 | 6,94,392 |
| 2011-12 | 3,52,291 | 1,40,960 | 1,71,104 | 65,381 | 14,206 | 41,252 | 7,85,194 |
| 2012-13 | 3,65,989 | 1,47,462 | 1,83,700 | 72,794 | 14,100 | 40,256 | 8,24,301 |
| 2013-14 | 3,84,418 | 1,52,744 | 1,99,842 | 74,247 | 15,540 | 47,418 | 8,74,209 |
| 2014-15 | 4,18,346 | 1,68,913 | 2,17,405 | 78,391 | 16,177 | 49,289 | 9,48,522 |
| 2015-16 | 4,23,523 | 1,73,185 | 2,38,876 | 86,037 | 16,594 | 62,976 | 10,01,191 |
| 2016-17 | 4,40,206 | 1,91,151 | 2,55,826 | 89,825 | 15,683 | 68,493 | 10,61,183 |
| 2017-18 | 4,68,825 | 2,04,293 | 2,73,550 | 96,141 | 14,356 | 73,079 | 11,30,244 |
| Distribution (%) | 41.48 | 18.08 | 24.20 | 8.51 | 1.27 | 6.47 | 100.00 |
| CAGR 2008-09 to 2017-18(%) | 8.39 | 6.42 | 7.58 | 5.90 | 2.31 | 6.88 | 7.39 |

Source: Ministry of Statistics and Programme Implementation, 'Energy Statistics 2019', 26th Schedule, p.71. Accessed from http://www.mospi.gov.in/sites/default/files/publication_reports/Energy%20Statistics%202019-finall.pdf as on 20 May 2020

The Compound Annual Growth Rate (CAGR) analysis also indicates that industry sector leads in annual rate of growth in consumption of electricity (8.39%) in comparison with other sectors and this escalation will definitely continue during forthcoming years. To measure the progress of energy efficiency improvements, CAGR is used as an indicator because this provides aggregate data even if it does not consider the multi-dimensional nature of energy efficiency.(IRENA, 2017)

In industry sector, consumption of energy is mainly classified as either process or generic. The former means the utilization of energy in production process directly. To enlarge, process applications include motor systems, steam systems and temperature variation process heating. However, latter refers to using energy for Heating, Ventilation and Air Conditioning (HVAC), lighting purpose and to manage information technology in industry's establishment. Therefore, plans are mainly formulated in industrial sector for energy consumption related to process applications. Motor systems used in process functioning are used in fans, for pumping work, machinery drives, compressors and conveyors. In addition, high temperature course of action mainly concentrates in the iron and steel, non-ferrous metal, bricks, cement, glass and ceramic sectors which include items like coke ovens, blast furnaces and kilns. However, low-temperature process consist of chemical sector (heating and distillation), food and drink sector (baking and separation processes), paper manufacture sector (drying) and lastly textile sector (washing, scouring, dyeing and drying) in textiles. The consumption of energy of different industries widely depends on their energy intensity, fuel mix and split between different end uses.(Sorrell, et al., 2011) The Ministry of Statistics and Programme Implementation (MOSPI) report 2019 reveals that within the industry sector, iron and steel industry accounts for maximum energy utilization (15.05%) followed by Chemicals and Petrochemicals (4.54%) and lastly Construction (2.12%). Table-3 shows that the industry sector is consumes large amount of coal, lignite, natural gas, crude oil and also their end products. The CAGR analysis from 2008-09 to 2017-18 point towards that Natural Gas is majorly used followed by coal, lignite and petroleum products in industrial sector.

According to International Energy Agency, 'Energy efficiency is defined as a way of managing and restraining the growth in energy consumption'. Therefore, to bring energy management in different divisions of manufacturing units, few agencies and allied organizations are set up to bring energy efficiency in industries through various policy propositions.

**Table-3:** Total Consumption of Coal, Lignite, Natural and Petroleum Products in Industry Sector

| Year | Coal (Mt) | Lignite (Mt) | Natural Gas (Billion Cubic Meter) | | Petroleum Products* (000' tones) |
|---|---|---|---|---|---|
| | | | Energy Purpose | Non-Energy Purpose | |
| 2008-09 | 489.17 | 32.42 | 22.19 | 22.19 | 1,00,334 |
| 2009-10 | 513.79 | 33.43 | 31.37 | 31.37 | 1,01,587 |
| 2010-11 | 523.47 | 38.53 | 36.95 | 36.95 | 1,05,753 |
| 2011-12 | 608.17 | 41.88 | 42.42 | 60.68 | 1,09,495 |
| 2012-13 | 713.39 | 43.15 | 34.56 | 53.91 | 1,12,920 |
| 2013-14 | 739.34 | 43.90 | 29.46 | 48.99 | 1,10,667 |
| 2014-15 | 804.45 | 46.95 | 27.72 | 46.95 | 1,11,983 |
| 2015-16 | 836.73 | 42.21 | 26.68 | 47.85 | 1,21,634 |
| 2016-17 | 837.22 | 43.16 | 29.53 | 50.78 | 1,23,918 |
| 2017-18(P) | 896.34 | 45.82 | 32.06 | 52.83 | 1,28,382 |
| CAGR 2008-09 to 2017-18(%) | 6.24 | 3.52 | 8.54 | 4.05 | 2.5 |

*Petroleum products include High Speed Diesel Oil, Light Diesel Oil, Furnace oil, Low Sulphur heavy Stock, LPG, Naptha and Kerosene

Source: Ministry of Statistics and Programme Implementation, 'Energy Statistics 2019', 26th Schedule. Accessed from http://www.mospi.gov.in/sites/default/files/publication_reports/Energy%20Statistics%202019-finall.pdf as on 20 May 2020

## Institutional Framework and other Policy Implication to Promote Energy Efficiency Measures

A statutory body was set up on 1st March 2002 namely Bureau of Energy Efficiency (BEE) at the central level by Energy Management Centre of Ministry of Power to initiate policy programmes and coordination of implementation of energy conservation activities in all sectors of the economy. In addition, designate agencies are also directed in accordance to the act to coordinate, regulate, promote and enforce energy efficiency measures in the state. Moreover, Energy Efficiency Services Ltd. (EESL), an Energy Service Company (ESCO) was established to aid in financing several demand side management programmes. Lastly, a staff of professionally qualified Energy Managers and Auditors is created through Certification and Accreditation programme. They have expert knowledge in energy efficiency policy analysis and management of such project's facets such as financing and implementation.

In 2001, Indian government enacted Energy Conservation Act (EC Act) to reduce energy intensity of different sector. Then, the Electricity Act

2003 was enacted which mainly aims to synchronize the provisions of existing laws and also mandates efficiency in power sector through various forms in generation, transmission and distribution. According to Section 3(1) of the Act, the government of India further framed National Electricity Policy to promote optimal utilization of resources in power sector of India. (Vasudevan et al., 2011)

Later in 2008, Government of India announced National Action Plan on Climate Change (NAPCC) to mitigate and adapt to climate change which encompassed a range of measures and introduced eight missions. In 2010, National Mission on Enhanced Energy Efficiency, a mission under NAPCC was stated which recommended mandating steps to decrease energy consumption in large energy intensive industries by introducing a system of trading energy-saving certificates amongst the companies. Moreover, the mission also initiated financing for public–private partnerships, demand-side management programs in the municipal, buildings, and agricultural sectors, energy efficiency awareness scheme, institutional mechanism at regional and state level, star labeling of appliances and energy incentives which included reduced taxes on energy-efficient appliances etc steps for conserving energy through in the areas of industries, appliances, buildings, transport and agriculture sector.(Shakti Sustanable Energy Foundation, 2015)

In order to maintain the nation's economy which is highly based on industrial sector, GOI initiated certain measures to reduce energy consumption in large, medium and small scale industries without putting a halt to their working units and that too with a reasonable investment.

## An Overview of Energy Saving in Large Energy Intensive Industries

Some of the large industries are categorized as core energy consuming industries such as Aluminum, Cement, Chlor-Alkali, Refinery, Commercial Buildings, Iron and Steel, Pulp and Paper, Textile and Thermal Power Plant. During 11$^{th}$ plan BEE initiated energy efficient interventions within 25 energy intensive clusters belonging to 12 sectors and prepared 375 technologies based detailed project for them too. Moreover, there was also implementation of small group activities in 9 units of 3 clusters which also included capacity building activities of the local service providers.(BEE, 2012-13) The 12$^{th}$ Plan predicted the energy saving potential as 11.43 mtoe which majorly consist of 6.2 mtoe saving from the seven energy intensive industries and projected to save 5.23 mtoe from thermal power stations sector. (National Power Training Institute) Appendix 1 presents the projected trend of energy consumption and saving targets of 7 industrial sectors. It also highlights that both Electrical and Thermal Energy Consumption are

comparatively quite high and have consecutively increased from 2012-13 to 2019-20. There is no doubt that both Electrical and Thermal Savings have also progressively increased from 2012-13 to 2019-20, however still they lack far behind in comparison with the consumption rate. Therefore, schemes were introduced more rigorously to bring energy efficiency in large industries which are as follows:

### *Perform Achieve and Trade (PAT)*

The Perform Achieve and Trade scheme is a market-based mechanism which is formulated to enhance energy efficiency amongst large energy-intensive industries and facilities (Designated Consumers). The scheme includes the following steps (i) Goal setting which means to set a Specific Energy Consumption (SEC) target in percentage form for every industrial unit based on its energy consumption / output to improve its energy intensity from the base line value in a period of three years (ii) Reduction phase means to push the consumers to reduce their energy intensity in accordance to set target (iii) Trading phase which allows designated consumers to sell their tradable energy permits issued by government with other designated consumers who failed to meet their designated target. It is mandatory for designated consumers who fail to meet their targets to either buy these permits or they pay penalties.

### *PAT Status in India*

- PAT Cycle I: Implementation completed in 2015 which has led to energy saving of 8.67 mtoe and avoided 31 million tonne of $CO_2$ emission.
- PAT Cycle II: It was notified in March, 2016 and ended on 31$^{st}$ March 2019 which covered 621 DCs trom 11 sectors which included eight already existing sectors and railways, refineries and DISCOMs as three new sectors.
- PAT Cycle III: It started from 1$^{st}$ April, 2017 which aimed to achieve 1.06 mtoe of total energy saving. As a result, SEC reduction targets had been assigned to 116 DCs.
- PAT Cycle IV: It commenced from 1$^{st}$ April 2018 in which 109 DCs had been notified about their SEC reduction targets which included all the existing sectors and two new sectors i.e., Petrochemicals and Commercial Buildings (Hotels).
- PAT Cycle V: It commenced from 1$^{st}$ April 2019 in which 110 DCs from the existing sectors of PAT had been notified.(BEE, 2018-19)

Hence, it is envisaged that by 2020, about 11 mtoe of energy savings will be achieved through PAT implementation in industry sector. However, according to BEE annual report 2018-19, currently there are 956 energy intensive industries or Designated Consumers (DCs) from 13 sectors under PAT scheme which have adopted energy efficiency measures which will

result in saving of 20 million toe of energy and reduction of 70 million tonne of $CO_2$ by 2022. This proves that India's industry sector is achieving its energy saving target efficiently through PAT mechanism from energy intensive industries.(BEE, 2018-19)

## National Energy Conservation Award

To raise awareness on energy efficiency and its conservation, BEE recognizes and encourages industrial units, institutions and establishments in reducing energy consumption by felicitating them with Energy Conservation Awards on the occasion of National Energy Conservation Day which is celebrated on 14th December every year. In 2018-19, total 135 industrial units participated in event and out of them 7 units achieved first prize, 8 units achieved second prize and 8 units for Certificate of Merit. (BEE, 2018-19)

## Notification of Energy Intensive Sectors as Designated Consumers (DC)

In accordance to Energy Conservation Act, 2001, all the sectors covered in the Schedule to the act are covered as Designated Consumers. Therefore, on 12th March 2007, 9 energy intensive sectors (Aluminum, Cement, Chlor-Alkali, Fertilizer, Iron & Steel, Paper & Pulp, Railways, Thermal Power and Textile) have been notified as Designated Consumers and on 27th May 2014, GOI made it mandatory for these industrial units to get Energy Audit to enable them identifying energy saving opportunities in their establishments. As a result, more serious and effective initiatives had been undertaken by DC while incorporating exclusive energy management policies, by adding a separate EC cell and by improvising their energy monitoring and accounting system.(National Power Training Institute)

## Enhanced Capacity Building of Energy Management Professionals (National Certification Examination for Energy Auditors/Energy Managers)

As per EC Act 2001, it is mandatory for all the designated energy consumers to appoint an Energy Manager and get energy audit conducted periodically by an Accredited Energy Auditor. Therefore, since May, 2004, BEE has regularly conducted the National Certification Examination for Energy Managers and Energy Auditors. The country has now total 18684 Energy Auditors and Energy Managers, out of which 10049 are qualified as Certified Energy Auditors, from the previous 19 examinations conducted during 2004-2018. Moreover, at present there are 263 Accredited Energy Auditors and total 74 empanelled Accredited Energy Auditor firms in the country. (BEE, 2018-19)

## An Outline of Energy Saving in Small and Medium Enterprises

The MSME sector adds a huge proportion in India's GDP, manufacturing sector productivity and export of Indian products to outside world. Consequently, the energy consumption of MSME is also high which is almost 25% of the total energy consumption by industrial sector. Therefore, during 12th Plan, BEE targeted this sector to reduce their energy consumption by 5.75% which is equivalent to 1.75 mtoe. BEE introduced innovative business models and financial instruments for SMEs such as Venture Capital Fund / Revolving Fund, Partial Risk Guarantee Fund) to achieve the designated goal. Appendix 2 gives the details of projected energy consumption trend (electrical and thermal) and saving targets in energy intensive SMEs. This also highlights that both Electrical and Thermal Energy Consumption are comparatively quite high and have consecutively increased from 2012-13 to 2019-20, however the saving rate is quite low. Hence the schemes were initiated by BEE to accelerate energy efficiency in SMEs through various measures which are:

### *National Programme on Energy Efficiency and Technology Upgradation of MSMEs*

This scheme was initiated by Bureau of Energy Efficiency in 2007 to promote energy efficiency in MSME sector. During 12th Five Year Plan, BEE had implemented 21 pilot energy efficient technologies in 4 SME sectors (clusters). Case studies, audio visuals were developed to effectively manage and distribute the generated experience nationwide. During 2018-19, following are the key achievements of the programme:

- Financial assistance was provided to MSMEs for implementing energy efficiency technologies at Pali (Textile) cluster.
- More than forty knowledge dissemination workshops were organised across twenty states and nearly 2000 participants from SME sector attended these workshops.
- Memorandum of Understanding (MoU) was drafted between DC, MSME and Bureau of Energy Efficiency to jointly implement 'National Programme on Energy Security of MSMEs'.
- In total 117 energy efficient technologies for MSME sector were enlisted and 50 from them were shortlisted to develop multimedia tutorials on energy efficient technologies. In current year 10 such tutorials were developed and reviewed.
- In Kolkata and Coimbatore, regional meetings of Small and Medium Enterprises Knowledge Sharing Platform (SAMEEEKSHA) was convened. (BEE, 2018-19)

*Global Environment Facility (GEF) Supported Programmes in MSME Sector*

With support from Global Environment Facility through United Nations Industrial Development Organization (UNIDO) and World Bank, Bureau of Energy Efficiency is also implementing energy efficiency programmes in SME sector in India by promoting adoption of clean, energy efficient technologies and practices.

i) GEF-UNIDO-BEE Programme (2011-2020) - 'Promoting Energy Efficiency and Renewable Energy in Selected MSME Clusters in India'. The main objective of this programme is to develop and promote energy-efficient technologies through market force and boost exploitation of renewable energy technologies during the process applications of SMEs. The programme is currently operational in 12 MSME clusters in India from five sectors i.e., brass, ceramics, dairy, foundry and hand tools. Moreover, the programme is also planning to expand its project activities in 12 more clusters. Key achievements of this programme during 2018-2019 are that nearly 2250 SME personnel participated in this programme. As a result 478 Energy Efficiency and Renewable Energy measures were implemented during the 78 workshops conducted in 280 SMEs which lead to 7,894 toe annual energy savings and avoided 49,896 tonnes of annual carbon emission. Moreover, the programme helped to develop 220 case studies and 212 Detail Project Reports and also implemented 22 pilot projects in the same area. (BEE, 2018-19)

ii) GEF-World Bank-BEE Project - 'Financing of Energy Efficiency at MSMEs'

The main objective of this project is to add demand of SME clusters of energy efficiency investments and to strengthen them to access commercial finance in India. The key achievements of the programme are that there is designing and implementation of Energy Management System (EnMS) which includes ISO 50001 in 50 MSME units. As a result, more than 350 energy saving measures were identified and about 350 professionals and 100 supplier employees were trained for ISO 50001. Moreover, more than 133 shop floor employees were trained to implement energy efficiency measures and several capacity building workshops were organized at several cluster locations.(BEE, 2018-19)

## Analysis of Literature to Examine Implementation of Energy Efficiency Measures in Industries

Bhaskar (2013) gave an overview of significance of energy efficiency for achieving energy security and safeguarding environmental impacts of energy consumption in this chapter. The research paper also evaluates the implementation of various EE measures while recommending a transparent regulating system, sound infrastructure of transmission and

distribution and a perfect smart grid[1] to improvise their performance in India. Shakti Sustainable Foundation (2013) had studied the capability of SDAs of India while implementing PAT and MTEE scheme by conducting 4 Regional Workshops across India at Hyderabad, Kolkata, Chandigarh and Ahmedabad. The report reveals that SDAs are performing well in awareness programs but they lack regulatory role as required under the EC Act regarding issue of certificates, supervision and monitoring due to lack of physical and financial resources and their lean establishment with other additional responsibilities (promotion and implementation of Renewable Energy Sources) Abbi and Jain (2018) edited a book which outlined the scope to improve end use energy efficiency in industrial sector. This is a handbook which covers all the major energy consuming equipments used in industries and focuses on their energy losses and later substituting them with energy conservation options while quoting logical field testing and case studies. The book also pin points other steps like energy audit, exploring solar energy options, environmental management in industries. Shakti Sustainable Foundation (2014) had examined PAT scheme by interacting with key Government officials, domain experts in affiliated technical and academic institutions and independent research organizations. The study highlighted features of PAT scheme like the institutional mechanism, role assignments of various stakeholders, incorporation of detailed baseline evaluations, robust design of PAT and organize of workshops and training for stakeholders needs to be added for its better performance. Sorrell, et.al (2011) drafted a report which reviewed 160 recent studies of energy efficiency especially from industrial sector throughout the world. The research study entails to enlist different barriers while adopting energy efficient technologies in industries by analyzing their nature, operation and their existence in different backgrounds such as industrialized versus developing countries, energy-intensive versus non-energy-intensive industries and SMEs versus large companies. These characteristics enable policy makers to determine those areas where energy efficiency policy efforts are most needed in industries. The study also presented the detailed account of barriers faced by sample of industries from different countries by using either surveys or case study research.

Few other studies were also consulted to catalog some barriers which the management of industrial units faces in India while executing energy efficiency measures and later few recommendations to pass that phase. Firstly, high investment costs and production loss while implementing energy efficiency measures in the industrial units is definitely a worrisome part. To extend, both the large intensive industries and SMEs prefer to not

1 Smart Grid is a digital type of technology which adds sensors along the transmission line and allows the two way communication between the utility and its customer smartly.

to discontinue the operation of their plants to install new energy efficiency-related equipment because this can surely jeopardize their production and delivery schedules. Moreover, it is quite troublesome for small units operating with smaller module of production processes to invest in these energy saving technologies / equipments as they already have limited resources.(TERI, 2018) Secondly, there is lack of information amongst entrepreneurs and other stakeholders involved in SMEs regarding the benefits of energy efficient measures in the long run. There is no doubt that the government and media has brought the energy efficiency message to urban level, however the locale of many industries is rural area which is out of reach. In addition, the government also fails to promote the incentives in pricing and subsidy policies among the owners while bringing energy efficient improvements in industrial units.(Vasudevan et al., 2011) Thirdly, economies of scale plays a crucial role while administering the claim of high benefits from such technologies under Indian conditions as these energy efficiency improvements become more costly and relatively less effective due to government's rigid and complicated rules and regulations. Moreover, the diffusion of energy-efficient technologies is usually a slow process which can be retarded more by non supportive government policies that further distort prices too.(Bhattacharya and Cropper,2011) Fourthly, the evaluation process of energy efficiency measures is burdensome, premature, and expensive. In accordance to BEE terms and conditions, Energy Savings Companies (ESCOs) or Certified Energy Managers and Auditors are designated to measure energy savings by metering a sample of projects in all industries which is costly as well as tedious.(Kelkar, et al., 2018) Fifthly, there is a conflict between the provision of guidelines to implement energy efficiency concept in industries amongst the governance structure involved at national, state and regional level. Setting up of energy saving services and equipments follows certain codes and standards. Therefore, any kind of disruption in this routine due to diverging actions of agencies in different jurisdiction, partial authority to implement energy efficiency measures and pursue of scattered codes between the industrial clusters can be a huge problem.(Langlois-Bertrand, 2015) Sixthly, there is a huge gap in monitoring and supervision of energy efficiency measures in industries through designated agencies at state level. To continue, there is no system of follow-ups and submission of accountable reports between state agencies and industries implementing various energy conservation schemes. Moreover, BEE itself handles the PAT process with in-house and monitors and evaluates the reports sent by designated consumers. As a result, there is lack of performance energy audits in industries, and conduct of workshops for industry office.(Kaur) Lastly, behavior issue prevails

among industry owners especially SME's owners regarding dilemma towards initiation of energy efficiency measures because they always feel more focused exclusively on few core business activities. Moreover, for some industry managements, energy issues do not weigh more in comparison with firm's production and profits.

## Conclusion and Recommendations

Energy efficiency is the best solution to the obstacles like climate change, economic growth and energy security. IEA statistics present that industrial $CO_2$ emissions at global level has declined 0.6% to 8.5 $GtCO_2$ in 2018 (24% of global emissions). This decline mainly occurred due to initiation of EE measures in non-energy-intensive industries. In spite of this, some hurdles have still lemmatized the implementation of energy efficiency measures in industries. In order to align with IEA's Sustainable Development Scenario, industrial emissions must fall by 1.2% annually to 7.4 $GtCO_2$ by 2030. India stands fifth lowest in energy efficiency amongst all other countries, which can surely be improved because India has huge potential to save energy in all the sectors. Similarly, the industrial sector can also introduce innovative policies and methods which will also in turn employ and influence millions of people, mitigate climate change and reduce energy consumption.

Consequently, there is a need to recognize the requirement of technology transfer, specific energy consumption norms, financing mechanisms and capacity building to implement energy efficient schemes systematically in industrial sector. Efforts in PAT direction must be continued, strengthened and widened and SMEs should also be included as currently they are outside the purview of PAT mechanism. A beforehand detailed study should be initiated by industries to fine-tune the analysis of costs and benefits associated with energy efficiency measures to plan the execution efficiently. To avoid conflict between all stakeholders involved in execution of energy conservation schemes, principles like division of work and delegation of authority needs to be followed effectively. Additionally, there is also a need to conduct regular energy audits and strict implementation of techno economic viable recommendations in industries to improve monitoring mechanism. In lieu of establishing energy management system adequately in the industrial units, owners should manage resources and time properly. More and more workshops for industry officials and other staff should be organized by BEE in collaboration with state designated agencies to provide platform for the industry to exchange information regarding the problems faced by them in implementing various energy efficiency schemes and to communicate best practices on energy conservation and update themselves on the various innovative energy efficient technologies to industries.

## Appendix

**A.1:** Energy Consumption and Saving Projection in 7 Industrial Sectors (DCs)

| Particulars / Years | 2012-13 | 2013-14 | 2014-15 | 2015-16 | 2016-17 | 2017-18 | 2018-19 | 2019-20 |
|---|---|---|---|---|---|---|---|---|
| EEC | 94.80 | 101.02 | 107.68 | 114.9 | 122.68 | 131.00 | 139.94 | 149.53 |
| TEC | 82.44 | 87.84 | 93.63 | 99.93 | 106.68 | 113.91 | 121.69 | 130.02 |
| EES | 1.14 | 2.35 | 3.64 | 5.02 | 6.50 | 8.07 | 9.74 | 11.53 |
| TES | 0.99 | 2.05 | 3.17 | 4.37 | 5.65 | 7.02 | 8.47 | 10.03 |

Source: National Power Training Institute, 'Demand Side Management Energy Efficiency and Energy Conservation', Working Group on Power for 12th Plan, Chapter 5,p.255. Accessed from http://npti.gov.in/sites/default/files/report_documents/demand_side_management.pdf as on 10 March 2020

EEC-Electrical Energy Consumption and EES- Electrical Energy Saving (BU)

TEC-Thermal Energy Consumption and TES- Thermal Energy Saving (mtoe)

**A.2:** Energy Consumption and Saving Projection in Energy Intensive SMEs

| Particulars / Years | 2012-13 | 2013-14 | 2014-15 | 2015-16 | 2016-17 | 2017-18 | 2018-19 | 2019-20 |
|---|---|---|---|---|---|---|---|---|
| EEC | 41.2 | 44.0 | 47.0 | 50.1 | 53.5 | 57.2 | 61.1 | 65.2 |
| TEC | 20.06 | 21.42 | 22.88 | 24.44 | 26.10 | 27.87 | 29.76 | 31.78 |
| EES | 0.06 | 0.24 | 0.63 | 1.06 | 1.59 | 2.16 | 2.76 | 3.40 |
| TES | 0.07 | 0.27 | 0.72 | 1.22 | 1.83 | 2.48 | 3.18 | 3.91 |

Source: National Power Training Institute, 'Demand Side Management Energy Efficiency and Energy Conservation', Working Group on Power for 12th Plan, Chapter 5,p.257. Accessed from http://npti.gov.in/sites/default/files/report_documents/demand_side_management.pdf as on 10 March 2020

EEC - Electrical Energy Consumption and EES - Electrical Energy Saving (BU)

TEC - Thermal Energy Consumption and TES - Thermal Energy Saving (mtoe)

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# Emerging Power Scenario in Punjab – An Analysis

**Anushruti Agarwal***


## Abstract

Electricity plays an important role in the growth of any economy and so is the case of Punjab. In Punjab, there has been an increasing demand for the power sector because of the increased demand from the population for personal use as well as the commercial use. With the advent of technology and shift in the modes of production, there has been an increased demand for the electricity but there exists an opposite scenario for supply side. The present study aims to study the supply and demand pattern and also to explore the paradigm shift in Punjab's power sector. The secondary data for the period of 2006 to 2016 has been taken from various reports published by PSPCL quarterly, Management Information Report (MIR), Annual Revenue Reports etc. The descriptive analysis has been applied. The study shows that there has been a steep rise in the demand for electricity whereas supply is less in order to meet the increasing demand of the people which calls for a comprehensive electricity policy.


**Keywords**: Comprehensive, Demand, Electricity, Installed Capacity, Supply

## Introduction

Power is an important input that is common to all sectors in an economy. It is essential for the socio-economic development of any present day society. The, availability of power is also seen as an indicator of development. The growth of power sector is highly influenced by the demand and supply imbalance, transmission and distribution losses. The seasonal peak demand and supply constraints along with obsolete technology in power generation push this sector into high input cost sector with low returns. The high demand of India Industry, as largest demand sector, is not because of efficiency but because of the obsolete technology, lower capacity, utilization, causal metering and monitoring of energy consumption,

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lower automation, raw material quality and poor handling, operating and maintenance practices.

Further, India has seen an expansion in the total energy use for the past five decades, with a shift from non-commercial energy to commercial energy sources. Globalization has positively influenced almost every sector in the country, including the power sector. To keep pace with the new energy challenges, the Government embarked upon a number of structural and operational changes to reform the power sector. The modifications mainly focused on bringing competition in different segments, setting up an independent regulatory commission, and establishing a proper funding mechanism. The Indian power sector is often characterized by low accountability, low operational efficiency, and less customer service orientation. The electricity supplied into the state level transmission systems is lost due to technical and non-technical reasons, and cost recovery from tariffs is also at low level, as a result, the financial condition of the sector remains fragile, resulting in slow commercialization and a high degree of budget / debt dependence. The high distribution losses, poor financial performance and dependence on the state governments further restricts the private investment and also restricts the ability of the sector to invest in new generation capacity, consequently creates a vicious circle in which the state electricity have low fund flows to improve infrastructure. Further, industry-agriculture tariffs cross-subsidies, high degree of politicization of sector restrict the avenues of growth of this sector.

It is imperative to know various research works done earlier to study the current scenario of power sector in reference to past reforms along with the study the detriments of performance of Punjab State utility. Sood (2014) in his study on power sector in Delhi analysed that there was a lack of transparency in the working of Delhi Electricity Regulating Commission which led to mistrust. it was not clear as to how the tariff was being determined. Later, it was found that a consultant was hired to carry out the tariff adjustments but he never revealed the conflict of interest. Ahluwalia and Bhatiani (2000) studied tariff setting in five states- Maharashtra, Uttar Pradesh, Andhra Pradesh, Gujarat and Orissa and found that tariff reform would impact more where regulators avoid revising tariffs frequently and it would be have significant impact if financial independence is given to regulator. They also found that in five states showed that poor management skills, lack of accountability, lack of autonomy are some of the barriers in the financial viability of electricity supply.

Patil and Chavan (2012) studied the Maharashtra power sector and its management scenario and found that huge transmission and distribution losses. It has been observed that it is difficult to eliminate losses but efforts should be made to minimize the losses. Alam, Yasin and Gain studied

various losses in distribution sector and suggested ways to minimize it. Since the energy supplied does not reach the end consumer due to transmission and distribution losses and high loss impacts the tariff and the economy. Mathur and Mathur (2005) stated that SEBs are commercially unviable and are responsible for financial losses. They also observed that that rural electrification would have positive social development impact. Kumar in his study on Punjab and Haryana power sector emphasized on the importance of controlling the theft of power as it has emerged as an obstacle towards achieving the revenue from the sale of electricity. It is important to break the nexus so that the common man does not face the brunt of power shortage. Godbole (2004) in his study revealed that the free power subsidies given to farmers by various state governments fail to recognize the fact that the big farmers benefit by this and that too at the expense of taxpayers. Srinivasan in his article opined that there is a need to create environment for public sector to consolidate its presence in power generation. It is important that tariff should be based on commercial and technical, considerations. The state electricity boards need to be reformed into commercial enterprises that are free from political interferences to ensure power for all.

The present paper aims to study the supply and demand pattern of power in Punjab along with to study the paradigm shift in Punjab's power sector. In order to study the underlying objectives, the secondary data from the various reports published by PSPCL quarterly, Management Information Report (MIR), Annual Revenue Reports has been utilised. The investigation was undertaken with the help of descriptive statistics i.e. bar diagrams, bar graphs, line graphs and calculation of percentage changes.

## Power Scenario in Punjab

Power scenario is to study the power generation infrastructure that caters to this demand from potential of installed generation capacity to the limitations in distribution of power. The power distribution in Punjab is plagued by several issues like transmission and distribution losses of electricity. On the generation side, the huge power shortages with low scope of huge capital investment are biased towards conventional methods of power generation i.e. coal based power generation. The thermal power remains the mainstay of generation even though it is polluting, and the quality of coal is also not good as it contains high levels of ash have some serious environmental issues in that. Most of State Utility run power plants have obsolete machinery and have low operational efficiency. The share of renewable energy is very low however, solar and wind energy are picking up, but the government need to support further and incentivise these two non-polluting sources of energy.

On the transmission side, lack of integrated grid restricts the smooth flow of electricity from one region to another. The distribution infrastructure i.e. distribution lines and transformers are inadequate. The low billing efficiency as not all the consumers are billed and huge electricity theft pave the way of huge distribution losses. Further, insufficient upkeep of infrastructures such as lines and transformers result in much higher levels of losses. Moreover, cross subsidies and indiscriminate subsidies in power sector are further aggravating the problem.

## Supply of Power

There are various sources of the amount of power in Punjab-State owned thermal plants such as Bathinda thermal power plant, Lehra Mohabbat thermal power plant, Ropar thermal power plant. Hydropower plants include Ranjit Sagar Dam, Mukeria hydel plant, Anandpur Sahib hydel plant. Independent Power Producers (IPP) would consist of long term power purchase agreements with private producers. Various plants such as Talwandi Sabo power plant, Rajpura power plant, Govindwal Sahib power plant are included in this. Other sources of supply include open access (as the power is directly purchased by the industry from the free market), New and Renewable Source Energy Projects (NRSE) and lastly, share from the central sector power plants.

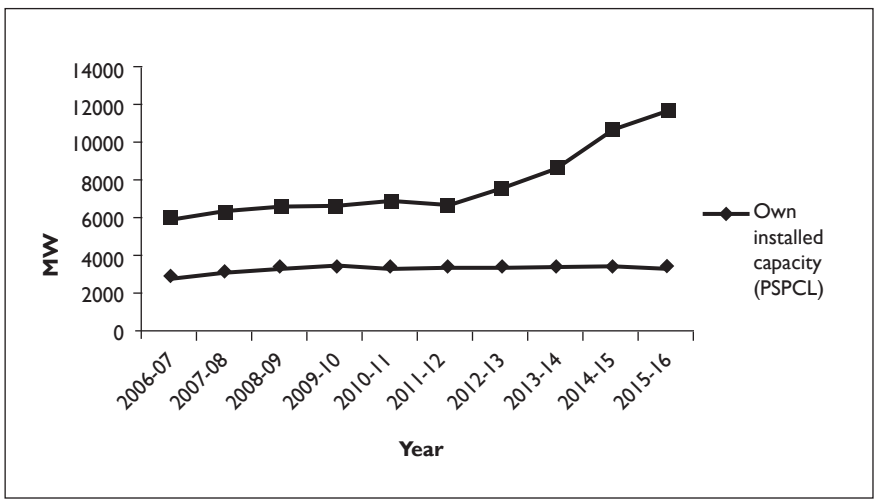
**Table-1:** Installed Capacity in Mega Watts (MW) from 2006-07 to 2015-2016

| S. No. | Description | 2006-07 | 2007-08 | 2008-09 | 2009-10 | 2010-11 | 2011-12 | 2012-13 | 2013-14 | 2014-15 | 2015-16 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Hydro | | | | | | | | | | |
| | a. Share from BBMB | 1257 | 1258 | 1258 | 1258 | 1258 | 1163 | 1110 | 1161 | 1161 | 1161 |
| | b. Hydro (PSPCL) | 999 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 |
| | Total Hydro (a+b) | 2256 | 2258 | 2258 | 2258 | 2258 | 2163 | 2110 | 2161 | 2161 | 2161 |
| 2 | Steam (PSPCL) | 2120 | 2370 | 2620 | 2620 | 2620 | 2620 | 2620 | 2630 | 2640 | 2640 |
| 3 | IPP | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 700 | 2060 | 2720 |
| 4 | Total PSPCL [1b+2] | 3119 | 3370 | 3620 | 3620 | 3620 | 3620 | 3620 | 3630 | 3640 | 3640 |
| 5 | Total including IPP + BBMB (4+3+1a) | 4376 | 4628 | 4878 | 4878 | 4878 | 4783 | 4730 | 5491 | 6861 | 7521 |
| 6 | Share from Central Sector | 1764 | 1918 | 1900 | 1940 | 1973 | 1933 | 2507 | 3071 | 3610 | 3671 |
| 7 | PEDA and other NRSE projects | 61 | 63 | 63 | 82 | 184 | 202 | 469 | 297 | 484 | 720 |
| 8 | Grand Total (5+6+7) | 6201 | 6609 | 6841 | 6900 | 7035 | 6918 | 7706 | 8859 | 10955 | 11912 |

Source: Electricity statistics of Punjab published by PSPCL every year

The primary sources of generation of power in Punjab are - Own power plants, BBMB, share from central sector power plants and independent private producers. The share from BBMB has more or less remained the same from 2006-07 to 2010-11 at 1258 MW and has decreased to 1161 MW till 2015-16, whereas the percentage of hydro PSPCL has remained approximately the same from 2006-07 to 2015-16 at 1000 MW. Total hydro capacity includes a share of PSPCL and shares from the Bhakra Beas Management Board (BBMB). The full hydro size had decreased from 2256 MW in 2006-07 to 2161 MW in 2015-16. The percentage of steam power of PSPCL has increased from 2120 MW in 2006-07 to 2640 MW in 2015-16. The total rate of PSPCL has increased from 3119 MW in 2006-07 to 3640 MW in 2015-16. The increase has been only 16.7% over ten years. The percentage of Independent Private Producer (IPP) has increased in recent years. From 2006-07 to 2013-14 their contribution was nil but it grew considerably from 700 MW in 2013-14 to 2720 MW in 2015-16.

**Figure-1:** Installed Capacity




Total installed capacity including PSPCL (hydro+ steam), IPP and BBMB; have increased from 4376 MW in 2006-07 to 7521 MW in 2015-16. The total installed capacity including central sector share, PSPCL+IPP+BBMB and NRSE sources, has increased from 6201 MW in 2006-07 to 11912 MW in 2015-16. A better picture captured through the Figure-1 where own installed capacity (PSPCL) has remained almost the same or has increased very marginally whereas the total installed capacity has risen sharply from 2011-12 onwards and peaked in 2015-16.

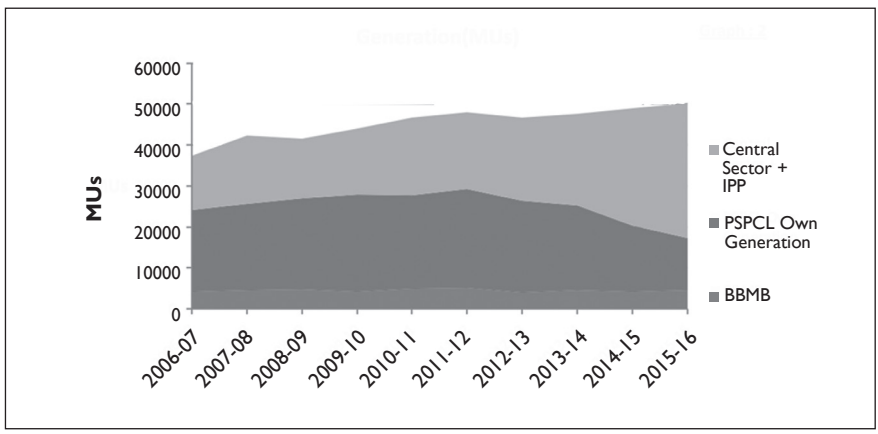
The Table-2 describes the generation of power during several years from 2006-07 to 2015-16 where the own total production includes both hydro and steam.

**Table-2:** Generation (MUs)

| S. No. | Description/ YEAR | 2006-07 | 2007-08 | 2008-09 | 2009-10 | 2010-11 | 2011-12 | 2012-13 | 2013-14 | 2014-15 | 2015-16 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | a) PSEB Power Houses | 4404.53 | 4585.52 | 4175.33 | 3389.18 | 4567.55 | 4909.86 | 4254.35 | 4285.94 | 4426.11 | 4642.81 |
| | b. Steam | 15434.64 | 16456.70 | 18066.36 | 20295.70 | 18326.14 | 19068.23 | 18013.29 | 16306.27 | 11691.99 | 8012.13 |
| | Total Own Generation (a+ b) | 19839.17 | 21042.21 | 22241.68 | 23684.88 | 22893.70 | 23978.09 | 22267.64 | 20592.21 | 16118.10 | 12654.94 |
| 2 | Share from BBMB | 4280.32 | 4628.91 | 4774.93 | 4121.56 | 4874.04 | 5201.43 | 4066.87 | 4611.64 | 4166.74 | 4600.70 |
| 3 | Total Own Generation + BBMB (1+2) | 24119.49 | 25671.12 | 27016.62 | 27806.44 | 27767.74 | 29179.52 | 26334.51 | 25203.85 | 20284.84 | 17255.64 |
| 4 | Central Sector + IPP + upen Access* | 13338.71 | 16569.65 | 14545.18 | 16139.00 | 18975.08 | 18762.15 | 20284.81 | 22449.44 | 28758.46 | 33030.91 |
| 5 | PEDA and other NRSE projects | 233.02 | 233.33 | 198.33 | 248.80 | 301.48 | 442.75 | 555.06 | 615.07 | 708.82 | 829.23 |
| 6 | Total Energy Available (3+4+5) | 37691.23 | 42474.10 | 41760.13 | 44194.24 | 47044.30 | 48384.42 | 47174.38 | 48268.36 | 49752.12 | 51115.78 |
| 7 | Auxiliary Consumption | 1427.93 | 1556.00 | 1658.32 | 1760.44 | 1597.00 | 1665.58 | 1560.03 | 1442.62 | 1078.25 | 781.27 |
| 8 | Net Energy Available (6-7) | 36263.30 | 40918.10 | 40101.82 | 42433.80 | 45447.30 | 46718.84 | 45614.35 | 46825.74 | 48673.87 | 50334.51 |

*Open Access is not sold by PSPC1, it is directly purchased by industry Source : Electricity statistics of Punjab published by PSPCL every year

**Figure-2:** Generation (MUs)




Entire own generation had increased from 19839 Million Units (MUs) in 2006-07 to 23684 MUs in 2009-10. From 2010 onwards the production has been more or less at the same level. But in 2014-15 there has been a fall in the own total output from 20592 MUs in 2013-14 to 16118 MUs in

2014-15. It had further dropped to 12654 MUs in 2015-16. Whole own generation, including share of BBMB, has increased from 24119 MUs in 2006-07 to 29179 MUs in 2011-12. There has been a slight decline over two years till 2013-14. There has been a considerable drop to 20284 MUs in 2014-15 and further 17255 MUs in 2015-16. It is due to the decrease over the years in the share of steam power plants. The generation from thermal power plants was 15434 MUs in 2006-07 and peaked 20295 MUs in 2009-10. It declined over the years, especially in 2014-15 and 2015-16, in case of latter 8012 MUs - the lowest.

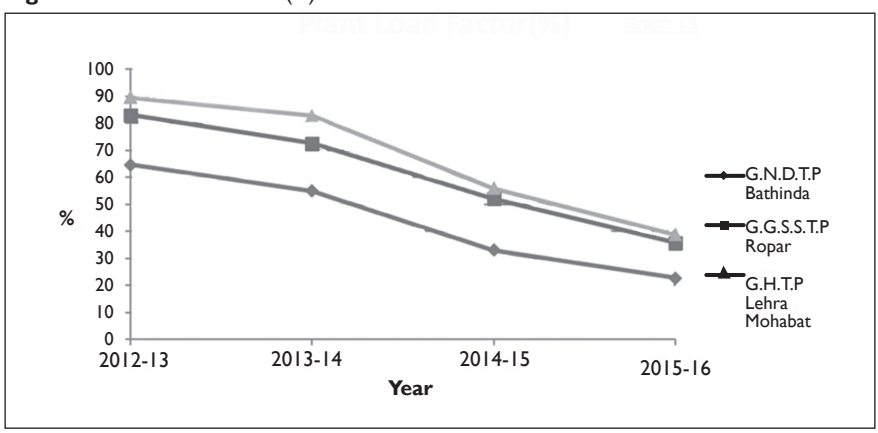
Table-3 shows the plant load factor of State-owned three thermal power plants - Bathinda, Ropar and Lehra Mohabbat.

**Table-3:** Plant Load Factor(%) of own plants

| S. No. | Name of Plant / No Year | 2006-07 | 2007-08 | 2008-09 | 2009-10 | 2010-11 | 2011-12 | 2012-13 | 2013-14 | 2014-15 | 2015-16 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | a. G.N.D.T.P Bathinda | 56.80 | 77.83 | 73.83 | 70.66 | 46.06 | 48.72 | 64.68 | 54.91 | 32.97 | 22.73 |
| 2 | b. G.G.S.S.T.P Ropar | 88.52 | 88.54 | 87.07 | 91.11 | 88.04 | 86.41 | 83.05 | 72.53 | 52.11 | 35.77 |
| | c. GHTP Lehra | | | | | | | | | | |
| 3 | Mohabat | 93.58 | 95.10 | 94.89 | 96.44 | 84.79 | 94.31 | 89.53 | 82.70 | 55.93 | 38.79 |

Source : Electricity statistics of Punjab published by PSPCL every year Energy Sold(MUs) Source Electricity statistics of Punjab published by PSPCL every year

**Figure-3**: Plant Load Factor (%)




The plant load factor is an indicator of efficiency and plant utilisation. It decreased from around 57% into 23% in case of Bathinda. In Ropar, it fell from 88.52% to 35.77% and in Lehra Mohabat from 93.58% to 38.79% in the period from 2006-07 to 2015-16. A lower percentage shows that the plants are not operated at their full capacity, which is not a good sign. Why Punjab is underutilizing its power plants in recent years will be examined later. Figure-3 shows a sharp decline over the years for all the three plants. The three lines depicting the efficiency levels reached a peak point and then declined to reach the lowest point.

## Demand for Power (Energy Sold)

When it comes to the demand side, the three sectors such as Agriculture, Industry, Domestic & Commercial constitutes the total demand for electricity. Others would include street lighting, board's works and bulk supply, which mainly constitute the railways.

**Table-4:** Energy Sold (MUs)

| S. No. | Description | 2006-07 | 2007-08 | 2008-09 | 2009-10 | 2010-11 | 2011-12 | 2012-13 | 2013-14 | 2014-15 | 2015-16 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | General (Domestic +General) | 7253.55 | 8175.45 | 8326.90 | 9020.49 | 10275.92 | 11227.67 | 11973.74 | 13285.29 | 14284.18 | 15249.10 |
| 2 | Industrial | 10115.56 | 10864.73 | 10739.32 | 10947.57 | 11030.55 | 11497.40 | 12119.42 | 12348.05 | 13844.63 | 12997.34 |
| 3 | Agriculture | 8229.50 | 10022.20 | 9325.42 | 10469.30 | 10116.89 | 10248.63 | 10779.03 | 10223.57 | 10641.40 | 11513.88 |
| 4 | Others (Bulk Supply +Street Lighting + | 710.06 | 743.11 | 752.29 | 773.65 | 808.36 | 832.38 | 869.84 | 925.71 | 985.25 | 1007.59 |

Source: Electricity statistics of Punjab published by PSPCL every year

**Figure-4:** Energy Sold in Different Sectors

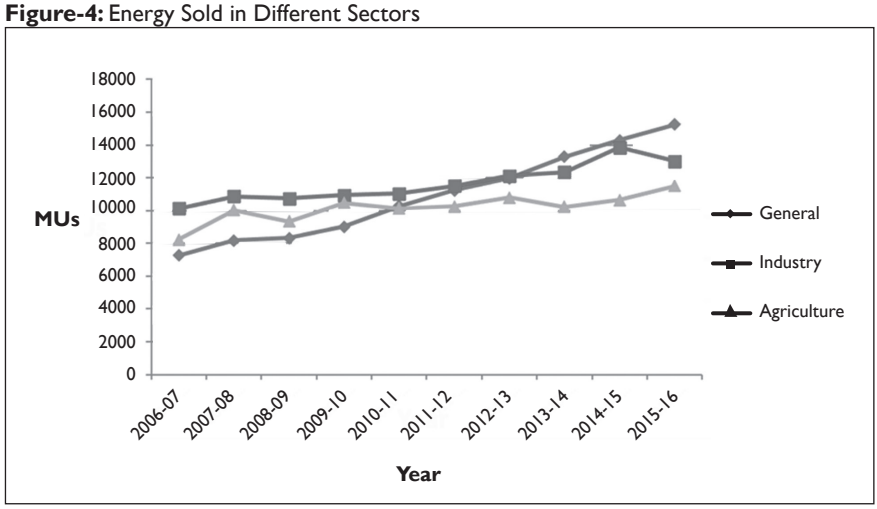



Table-4 shows the energy sold within the state (MUs) for several years. In 2006-07, the power sold to the general sector (domestic+ commercial) was 7253 MUs, and it has increased every year to 15249 MUs an increase of 110%. In the case of agriculture, it had risen from 8229 MUs in 2006-07 to 11513 MUs in 2015-16. It has increased by 39.9%. It can be attributed to the increase in the number of tube wells and the declining levels of water table. The share of the other sector in the sale of energy has increased from 710 MUs in 2006-07 to 1007 MUs in 2015-16. The industry sector presents a fascinating picture. The power sold to the industrial sector has risen from 10115 MUs in 2006-07 to 13884 MUs in 2014-15. It decreased to 12997 MUs in 2015-16. In the last nine years, it has increased by only 28.4%.

When Punjab was a power deficient state and hypothesized that with the increase in the power and improvement in the quality of power being supplied the demand for energy especially in the industrial sector would substantially increase. But alas in 2014-15 the state transformed from an energy-deficient state to a power surplus state and the latent demand which was supposed to show did not materialize.

The demand for general (domestic & commercial) has increased substantially, but in the case of industry, the growth in the market is not much. In fact, in 2015-16, there has been a dip in the energy sold as shown in the figure in case of the industry sector.

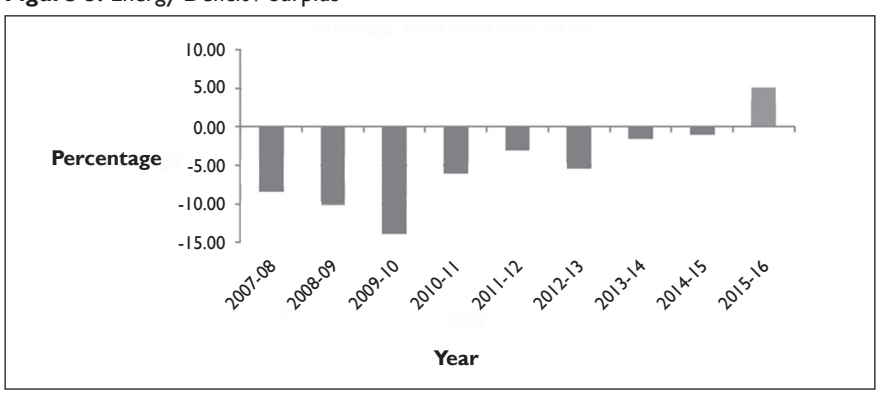
When the energy requirement is more than the energy available then that state is said to be under the case of deficiency whereas when the energy available is more than the energy required then the state of energy surplus prevails. Table-5 depicts the deficient/surplus state of an economy.

**Table-5:** Energy Deficit / Surplus

| S. No. | Period(FY)/ Items | Unit | 2007-08 | 2008-09 | 2009-10 | 2010-11 | 2011-12 | 2012-13 | 2013-14 | 2014-15 | 2015-16 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Energy Requirement | MU | 42372 | 41365 | 46426 | 45249 | 46264 | 47996 | 47342 | 48834 | 51268 |
| 2 | Energy Availability | MU | 38795 | 37238 | 39977 | 42513 | 44824 | 45389 | 46604 | 48351 | 53864 |
| 3 | Energy Deficit/ Surplus(-/+) | MU | -3577 | -4127 | -6449 | -2736 | -1440 | -2607 | -738 | -483 | 2596 |
| 4 | Energy Deficit/ Surplus(-/+) | % | -8.44 | -9.98 | -13.89 | -6.05 | -3.11 | -5.43 | -1.56 | -0.99 | 5.06 |

Source 24 * 7 Report of PSPCL

**Figure-5:** Energy Deficit / Surplus




The timeline is from 2007-08 to 2015-16. The energy requirement has increased from 42372 MUs to 51268 MUs, whereas the availability also increased from 38795 MUs to 53864 MUs. In absolute numbers initially,

from 2007-08 to 2014-15, the availability increased at a slower rate as compared to the requirement. But it is good to note that the gap between demand and availability reduced over the years and finally in 2015-16 the power available was more significant than the energy required. In terms of percentage, Punjab turned into a power surplus state in 2015-16 by 5.06%.

The same is depicted in Figure-5. On the X-axis, the many years represented whereas, on Y-axis, the % of energy deficit/surplus is described. The deficit gradually decreased over the years, which can be seen by the downward bar table. In 2015-16 the state turned energy surplus which is shown by the upward bar.

So far, we have studied the supply and demand side. Punjab has undergone a paradigm shift, from a power deficient state it has transformed into a power surplus state. Following things were observed -

- Over the years, the total generation increased, the share of thermal power plants being higher than hydel power plants. The independent private producer came up in a big way in the last two-three years.
- Though the power surplus in 2015-16 the state could not run its plants efficiently, the plant load factor being deficient.
- Power is demanded mainly by the agriculture sector, industrial sector, and the general sector (domestic & commercial). With the supply of power increasing every year the demand also grew across all the areas. The market grew at different rates for various deficient. The industrial sector is the largest consumer of power, the exchange raised by only 28.4 percent in nine years.
- The peak power demanded is in summer and the differences vary in the agriculture and industrial sector, mostly the variations being in the former.

In order to check the reality, whether Punjab is surplus power state or not? There is need to understand the distribution and magnitude of sale intra-state and inter-state as power cannot be stored. The basic economics principal of Total Cost (TC) which is the summation of fixed price (FC) and variable cost (VC), i.e. TC=FC+VC has been used to understand the basics of power surplus status of Punjab State.

The Punjab State Power utility i.e. PSPCL has signed long term power purchase agreements, in case if not avail the power as per the contract then it shall have to pay the capital component of the power surrendered (FC). The purchase of power reveals that in 2015-16 the total capacity charges (Capital Cost) paid by the government were Rs. 1324 crores. Further, Table-7(b) shows the power surrender cost estimated for the year 2016-17 as per the estimate of Punjab State Electricity Regulatory Commission. The fixed cost varies from as high as 158.56 paise per unit to as low as

16.41 paise per unit. The power surrendered varies from plant to plant. The difference again is enormous. The lowest surrendered power is 27.34 MUs which goes as high as 9367.63 MUs. The total fixed charges would be paid due to the surrender of cost are Rs. 2482.78 crore!

Further, the affordable surplus power for all categories of consumers in Punjab is not based on reality . Sufficient but costly power is likely to be made available in Punjab after the commissioning of all the thermal units in private sector. The over dependence on private sector for power generation in Punjab may lead to tariff hike with low consumer gains. The consumers will have to bear the brunt of fixed capacity charges of private sector thermal plants in case State utility fails to purchase power as per internal purchase agreements.

Table-7(a) shows the cost of the power purchased from the central sector power plants and the IPPs.

**Table-7(a):** Power Purchase Cost (Year 2015-16)

| S. No. | Source | Declared MUs (As per availability) | Gross Purchase (MU) | Surrendered (MUs) | Total Rate Actual Ps/ Unit | FIXED RATE (Ps/ Unit) | Fixed charges paid due to surrender of power (Rs. Crs.) |
|---|---|---|---|---|---|---|---|
| 1 | Anta (G/F) | 457.36 | 99.94 | 352.18 | 599.26 | 67.00 | 23.60 |
| 2 | Anta (R/F) | | 5.24 | | | | |
| 3 | Anta (L/F) | | 0.00 | | | | |
| 4 | Auraiya (G/F) | 755.41 | 128.18 | 621.88 | 651.03 | 50.95 | 31.68 |
| 5 | Auraiya (R/F) | | 5.35 | | | | |
| 6 | Auraiya (L/F) | | 0.00 | | | | |
| 7 | Dadri Gas (G/F) | 1153.13 | 308.58 | 840.83 | 528.85 | 52.22 | 43.91 |
| 8 | Dadri Gas (R/F) | | 3.69 | | | | |
| 9 | Dadri Gas (L/F) | | 0.03 | | | | |
| 10 | Singrauli | 1657.67 | 1503.53 | 154.14 | 187.53 | 53.23 | 8.20 |
| 11 | Rihand-I | 810.41 | 614.69 | 195.72 | 276.84 | 77.76 | 15.22 |
| 12 | Rihand-II | 841.30 | 638.34 | 202.95 | 276.80 | 91.48 | 18.57 |
| 13 | Rihand-III | 647.57 | 508.72 | 138.85 | 362.32 | 148.20 | 20.58 |
| 14 | Unchahar-I | 290.33 | 131.62 | 158.71 | 425.28 | 84.16 | 13.36 |
| 15 | Unchahar-II | 512.36 | 270.64 | 241.72 | 404.87 | 87.82 | 21.23 |
| 16 | Unchahar-III | 143.07 | 75.64 | 67.43 | 492.80 | 137.57 | 9.28 |
| 17 | Farakka (ER) | 151.04 | 109.91 | 41.13 | 377.53 | 78.85 | 3.24 |
| 18 | Kahalgaon-I (ER) | 369.04 | 205.10 | 163.94 | 392.71 | 93.37 | 15.31 |
| 19 | Kahalgaon-II (ER) | 936.61 | 692.55 | 244.06 | 361.86 | 115.73 | 28.25 |
| 20 | NCTPS- 2C (DADRI II) | 66.43 | 26.16 | 40.27 | 677.08 | 158.56 | 6.39 |
| 21 | IGSTPS Jhajjar (NTPC JV) | 115.85 | 15.78 | 100.07 | 1489.86 | 170.76 | 17.09 |
| 22 | Koldam-I | 444.75 | 196.60 | - | 519.76 | 91.48 | - |
| 23 | LPS & TDS | - | - | - | - | - | - |
| **B** | **NHPC** | | | | | | |
| 24 | Bairasuil | - | 330.66 | - | 213.90 | 47.53 | - |
| 25 | Sala! | - | 910.89 | - | 191.29 | 41.27 | - |

| S. No. | Source | Declared MUs (As per availability) | Gross Purchase (MU) | Surrendered (MUs) | Total Rate Actual Ps/ Unit | FIXED RATE (Ps/ Unit) | Fixed charges paid due to surrender of power (Rs. Crs.) |
|---|---|---|---|---|---|---|---|
| 26 | Tanakpur | - | 58.23 | - | 363.21 | 101.59 | - |
| 27 | Chamera-I | - | 260.80 | - | 170.92 | 37.14 | - |
| 28 | Chamera-II | - | 192.28 | - | 273.33 | 76.08 | - |
| 29 | Uri | - | 438.73 | - | 186.82 | 62.26 | - |
| 30 | Dauli Ganga | - | 133.53 | - | 281.60 | 67.65 | - |
| 31 | Dulhasti | - | 245.12 | - | 562.04 | 168.04 | - |
| 32 | Sewa-II | - | 57.92 | - | 461.06 | 112.43 | - |
| 33 | Chamera-III | - | 105.29 | - | 447.06 | 118.42 | - |
| 34 | Uri-II | - | 111.17 | - | 516.20 | 164.51 | - |
| 35 | Parbati-III | - | 68.81 | - | 513.04 | 53.93 | |
| **C** | **NPCIL** | | | | | | |
| 36 | NAPP | - | 413.61 | - | 249.31 | - | - |
| 37 | RAPP-3 &4 | - | 752.16 | - | 280.27 | - | - |
| 38 | RAPP-5 & 6 | - | 436.56 | - | 345.44 | - | - |

It is a considerable cost incurred by PSPCL for not availing the power. Surplus power has become an insurmountable financial problem which will may plunge PSPCL into a financial crisis. PSPCL should explore the immediate sale of power to avoid surrendered cost and try to earn some profit out of it. Power can be sold through national power exchange or by entering into long term power purchase agreements with the other states. Many power deficit states are purchasing power in the open market by floating tenders. PSPCL is not able to sell its surplus power as it is expensive. PSPCL should immediately reduce its power cost to make it more saleable. For that, the immediate solution is to reduce the variable value, which primarily consists of fuel cost, maintenance cost and workforce cost. In concise term, only fuel cost can decrease as most of the variable cost comprises of the fuel cost.

Table-7(b): Estimated Power Surrender Cost (Year 2016-17)

| S. No. | Source | Fixed Cost on the Basis of FN 2016-16 (Ps/Unit) | Surrenders (MUs) | Fixed Charges Paid Due to Surrender of Power (Rs. Crs.) |
|---|---|---|---|---|
| 1 | Anta (G/E) | 67.00 | 142.00 | 9.51 |
| 2 | Anta (R/F) | 0.00 | 0.00 | 0_00 |
| 3 | Anta (L1E) | 0.00 | 0.00 | 0.00 |
| 4 | Auraiya (G/F) | 50.95 | 126/4 | 6.46 |
| 5 | Auraiya (R/E) | 0.00 | 0.00 | 0.00 |
| 6 | Auraiya (LiE) | 0.00 | 0.00 | 0.00 |
| 7 | Dadri Gas (G/F) | 52.22 | 283.38 | 14.80 |
| 8 | Dadri Gas (R/E) | 0.00 | 0.00 | 0.00 |

| S. No. | Source | Fixed Cost on the Basis of FN 2016-16 (Ps/Unit) | Surrenders (MUs) | Fixed Charges Paid Due to Surrender of Power (Rs. Crs.) |
|---|---|---|---|---|
| 9 | Dadri Gas (LIE) | 0.00 | 0.00 | 0.00 |
| 10 | Singrauli | 53.23 | 0.00 | 0.00 |
| 11 | Rihand-I | 77.76 | 0.00 | 0.00 |
| 12 | Rihand-II | 91.48 | 0.00 | 0.00 |
| 13 | Rihand-III | 148.20 | 0.00 | 0.00 |
| 14 | Unchahar-I | 84.16 | 174.04 | 14.65 |
| 15 | Unchahar-II | 87.82 | 319.04 | 28.02 |
| 16 | Unchahar-III | 137.57 | 97.05 | 13.35 |
| 17 | Farakka (ER) | 78.85 | 129.12 | 10.18 |
| 18 | Kahalgaon-I (ER) | 93.37 | 260.15 | 24.29 |
| 19 | Kahalgaon-II (ER) | 115.73 | 758.66 | 87.80 |
| 20 | NCTPS- 2C (DADRI II) | 158.56 | 52.17 | 8.27 |
| 21 | IGSTPS | 126 | 27.34 | 3.44 |
| 22 | DURGAPUR | 0 | 0.00 | 0.00 |
| 23 | PRAGATI | 110.32 | 131.46 | 14.50 |
| 24 | MUNDRA | 0 | 0.00 | 0.00 |
| 25 | SASAN | 16.41 | 0.00 | 0.00 |
| 26 | IPS | 135.18 | 9367.63 | 1266.32 |
| 27 | NPL | 146.33 | 2464.03 | 360.56 |
| 28 | GVK | 164 | 3784.32 | 620.63 |
| | Total | | | 2482.78 |

Source : PSERC Tariff Order 2016-17 and MIR published by PSPCL quarterly

## Conclusion

The power scenario of Punjab State reveals that the domestic and commercial consumption has increased by 110 percent in the last nine years, whereas there has been meager growth in the industrial sector. It declined by 6.10 percent last year, and in previous nine years, it has increased by only 28.50 percent (Table-4, Figure-4). In a deficit regime, industrial consumption doesn't reach its full potential due to supply constraints, and the expectation was that in a surplus system when there are no supply constraints there would be a spurt in industrial consumption and has not happened in case of Punjab.

- As surplus power cannot be stored, ideally, Punjab should be earning good revenues by selling power in the open market again; it has not happened. Instead, Punjab is paying a huge amount as a capacity charge by not availing power committed in the power purchase agreements signed with various power companies. It has been observed that in year in 2015-16 PSPCL has paid Rs. 1324 Crore as capacity charge by surrendering 11563 MUs of power, and in the year 2016-17 it may be as estimated by the Punjab State Regulatory Authority is Rs. 2482 Crore.

- Another consequence of surplus power in Punjab is that PSPCL is not running its thermal power plants to their full capacity, it is done to minimize the payment of capacity charge to IPPs in Punjab. It is evident from declining Plant Load Factors (PLF) of PSPCL power plants It has been found that in last nine years, PLF of Bathinda power plant has decreased from 77.83 to 22.73. Similarly, PLF of Ropar and Lehra Mohabbat power plants has reduced from 88.52 to 35.77 and 96.44 to 38.79, respectively.
- PSCL has signed a power purchase agreement with various central sector power plants. Some of this power is very expensive. In the case of 16 power plants, the power is more than Rs 5 per unit.
- PSPCL thermal power plants are getting a poor quality of coal that too from a very far distance and substantially increases the fuel cost.
- In the last ten years, no power plant has come in the state sector. The three thermal plants (Talwandi Sabo, Nabha, Govindwal sahib) that have happened are in private industry which shows the biased dependence on private players for power requirements of the State.

Further, in order to achieve the maintain the demand supply imbalance, transmission and distribution losses, the following policy recommendations has been made.

PSPCL should make all efforts to sell its surplus power and avoid payment of the capacity charge. The proposal of Punjab Government to sell surplus power to Pakistan will need the full support of Government of India as international trade of power is already taking place with Nepal and Bangladesh.

The supply of additional power to industry and other consumers at cheaper rates barely to recover fixed and variable charges will not only recover fixed cost but also may explore the possibility of industrializing the State. In order to achieve this following measures are suggested

- Promote industry by the ease of doing business.
- The government should set up more industrial parks having a robust distribution system and ensure 24x7 power supply to the industry in such parks.
- The new industry can be supplied power at a cheaper rate with some assured period and at fixed cost.

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