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MONSOON FLUCTUATION AND CONSUMPTION EXPENDITURE IN INDIA

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Abstract
Developments in monsoon have caught the attention of policy makers in India. As more than half of India's farmland remains rain-fed, monsoon decides the fate of agriculture sector output. Though the farm sector forms just one-seventh of gross domestic product, yet it provides livelihood to nearly 55 per cent of the populace. Through demand and supply inter-linkages with other sectors of the economy, India's farm sector significantly influences economic activity. Against this backdrop, this paper seeks to validate empirically if the performance of monsoon influences economic activity in India. Employing GMM estimation, this paper finds that the former had a significant influence on the growth in real Private Final Consumption Expenditure (PFCE) for India in the period prior to 1990s. It is also argued that the influence of rainfall on economic activity seems to have diminished, especially since the 1990s, which, inter alia, may be attributed to the growing predominance of the non-agricultural sector, which is not found to be influenced significantly by monsoon variation; rise in net sown area (facilitated by an improvement in irrigation facilities), and institution of public welfare programmes, which might have helped smoothen consumption volatility. Furthermore, structural transformation in the economy, could also have altered consumption expenditure pattern in the economy resulting in declining and rising proportion of income being spent on food items and non-food items, respectively. Such a case study of the Indian economy could have implications for similarly placed agrarian economies.

JEL Code: E20, Q10 and Q15

Keywords: Monsoon, Consumption Expenditure, Agriculture, India

Introduction

Agriculture remains the mainstay of Indian economy as more than half of the populace Agricultural sector output, however, has been so much dependent on the monsoon rainfall that Indian agriculture had been described as a gamble with the monsoons. The influence of monsoon on the economy had been profound [Mall (2001), Patnaik and Sharma (2002), Paul (2008), Shah and Patnaik (2010), Ghate *et. al* (2011), Gulati *et. al* (2013)]. Farm sector significantly influences demand outlook and price developments in the non-farm sector through demand and supply inter-linkages. As such, policy makers have accorded due importance to monsoon developments in the economy.

Mall (2001) argued that agricultural output in India is, by and large, dependent on weather and inter-play of market forces had a limited role in influencing it. Patnaik and Sharma (2002) ascribed monsoon as the primary factor for fluctuations in economic activity in India. Paul

(2008) also found that monsoon has a significant influence on agricultural sector growth in India. He found that monsoon affects India's manufacturing sector growth with a lag of one year through its influence on the agricultural sector growth. Shah and Patnaik (2010) while analysing business cycle in India argued that in the pre-1990s performance of monsoon determined whether it was a good year for growth or not.

However, in the last two decades or so, farm sector output in the country has been becoming lesser and lesser dependent on monsoon developments. In the aftermath of economic reforms (since 1991), however, structural transformation in the economy seems to have reduced the dependence of economic activity on monsoon. (Following the balance of payments crisis in 1991, the Indian economy initiated a number of economic measures (including liberalization), which made the economy more market-oriented. The measures brought sea changes in the production structure and consumption pattern across the economy. Given the fact that economic reforms of 1991 marked a structural break, a general distinction is made between the two periods. Period prior to economic reforms is referred to as the pre-reform period, while the period after the initiation of economic reforms (in 1991) is called as the post-reform period.) Ghate *et. al* (2011) noted that Indian economy has transformed significantly since the mid-1990s from a monsoon-driven economy to one, which is mainly driven by the variations in inventory and investment.

RBI (2015) studied the relationship between monsoon rainfall and performance of Indian agriculture and found that crop output is more sensitive to net area sown than to monsoon variations. It also observed that allied activities of the agriculture sector are less sensitive to variations in the monsoon.

IMF (2015) estimated global VAR model for India to find out the impact of El Nino weather events on the Indian economy. (El Nino is prolonged warming in the Pacific Ocean Sea, which raises its surface temperatures above the average value and affects the monsoon rainfall adversely in the Indian sub-continent.) Using quarterly data for 1979Q2 to 2013Q1 in respect of various real and financial variables and a measure of El Nino intensity, it found that India's GDP growth now gets only moderately affected by El Nino events; GDP growth falls by only 0.2 per cent after a quarter following an El Nino shock. The study attributed the following factors for mitigating the impact of monsoon shocks on the Indian economy such as declining share of agriculture in the economy, increased contribution of Rabi crops (sown after monsoon season in winter), which are not affected by monsoon rainfall; growing yield in agriculture; developed agricultural markets and policies; and increased use of drought resistant varieties of crops by farmers in the country.

Notwithstanding the fact that the above-said studies have documented the impact of adverse monsoon rainfall on agricultural sector and the economy as a whole, none of the studies have so far examined empirically the channel through which monsoon shock impacts the economic activity on the demand side for the pre-reform period (prior to the 1990s). Using general method of moment (GMM) estimation, this study captures the influence of monsoon shocks on the economic activity.

Against this backdrop, an attempt is made in this study to investigate whether monsoon rainfall deviation had a considerable influence on economic activity in India in pre-reform period. The paper is structured as follows: Section II examines the influence of monsoon rainfall on both the agrarian and non-agrarian sectors. Section III scrutinizes the influence of monsoon on consumption expenditure in India. Empirical estimation is covered in Section IV, while the last section lays down the concluding observations.

Influence of Monsoon on Economic Activity in India

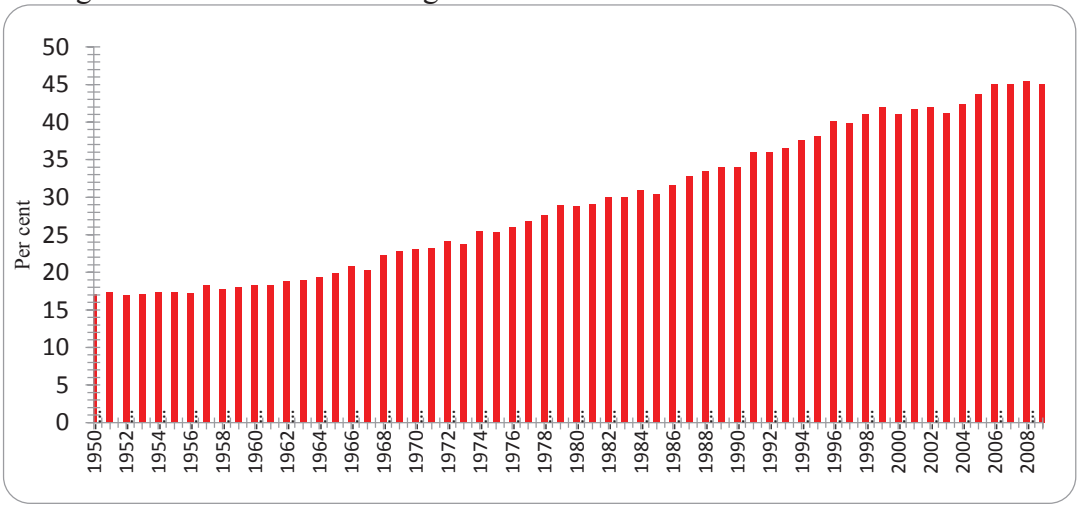
India receives rainfall in four spells. South-West Monsoon, which accounts for three-fourth of total rainfall, is the most crucial for India's agriculture sector (Table 1). Monsoon has a considerable influence on the performance of agriculture sector in India as the latter remains heavily dependent on rains since only about 45 per cent of gross cropped area in India remained under irrigation facilities as during 2010-11 (Figure 1). (GOI, Agricultural Statistics at a Glance, 2013.) The same is validated by studies (Gulati *et. al*. 2013; Banik and Biswas, 2012). Banik *op. cit.* reported that agricultural sector in India exhibited higher volatility as compared to that of the industrial and services sector. Using agricultural GDP data for four states in India, namely, Bihar, Punjab, Uttar Pradesh, and West Bengal, they probed whether fluctuation in agricultural output was demand-driven or supply driven. They found that rainfall has a significant impact on cyclical component of agricultural GDP in India, which suggested that the later is more responsive to supply-side shock rather than demand-side shock. Using quarterly agricultural GDP data for the period 1996 to 2013, Gulati *op. cit.* by employing ordinary least square (OLS) estimation found that amongst the price incentive, agriculture capital formation and rainfall, the latter was found to have the highest elasticity suggesting that monsoon rainfall had the greatest impact on agricultural production.

Table 1: Distribution of Annual Rainfall According to Seasons during 2012-13

Rainfall	**Duration**	**Actual Rainfall (MM)**	**Approx % of annual rainfall**
Pre-Monsoon	March-May	101.9	9.5
South-West Monsoon	June-September	819.5	76.3
Post- Monsoon	October-December	100.6	9.4
North-East Monsoon	January-February	51.4	4.8
Total		**1073.4**	**100**

Source: Agriculture Statistics at a Glance 2013, Directorate of Economics and Statistics, Department of Agriculture and Cooperation.

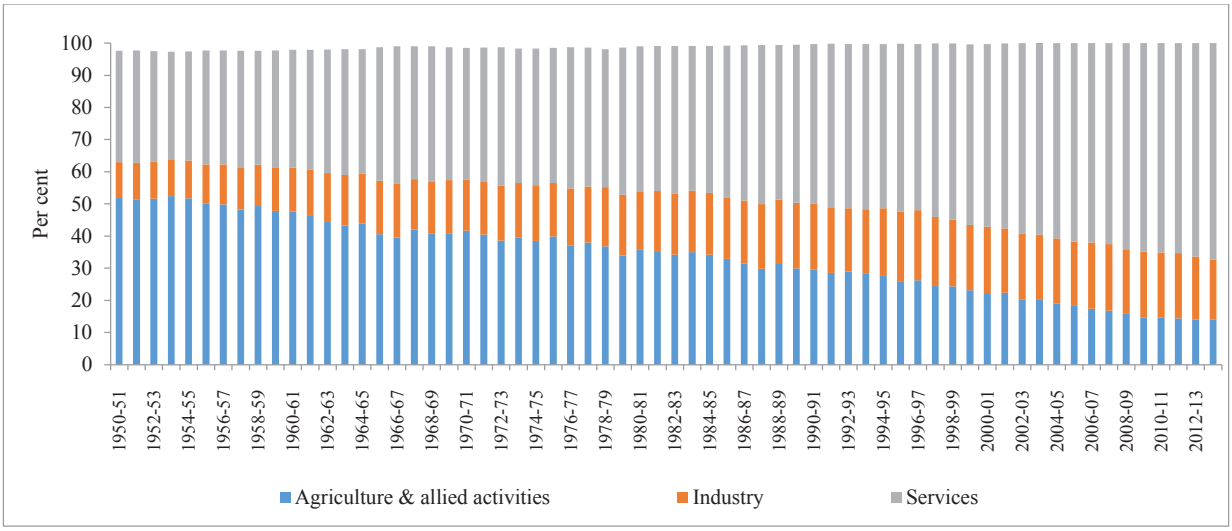
Figure 1: Trend in Gross Irrigated Area as a % of Gross Sown Area in India



Source*: Ministry of Agriculture, Govt. of India.

Economic activity in India has considerably been influenced by rainfall through the latter's impact on the agriculture sector. Over the years, share of agriculture and allied activities sector, per se, has been shrinking in the GDP; reducing substantially from 51.9 per cent during 1950-51 to 13.9 per cent during 2013-14 (Figure 2). With the decline in share of farm sector output in GDP, it is likely that the influence of monsoon on economic activity of in India would have also got reduced to certain extent.

Figure 2: Sectoral Composition of GDP at Factor Cost of the Indian Economy: Share



Source: Author's Calculations based on RBI Data.

Variation in rainfall had a considerable influence on agricultural output in the country. (Rainfall in the analysis includes the total precipitation received in the country during South-West Monsoon (June-September).) To validate the same, correlation coefficient was calculated and checked for its significance. (For calculating the correlation coefficients, cyclical components of GDP, non-agricultural GDP and agricultural GDP were obtained using HP filter with parameter $\lambda = 100$.) It was found that rainfall deviation had a significant influence on agricultural activity as also overall economic activity in the country (Table 2). (Rainfall deviation based on departure of South-West monsoon rainfall from the long-period average rainfall.) Correlation between change in rainfall and cyclical agricultural output was found to be significant, albeit the strength of correlation has weakened since the 1990s. (Several studies have considered the year 1991 as the breakpoint [Paul (2008)]. The year 1991 was considered as the breakpoint and accordingly correlation analysis was undertaken for the pre-reform and post-reform phases, respectively.) Improved innovations in agriculture (such as introduction of drought-resistant and high-yielding varieties of seeds) as also better irrigation facilities might have helped the agriculture in overcoming the vagaries of monsoon failures to some extent. Furthermore, increased use of fertilizers in agriculture has also raised farm level productivity. (Figure 3). Since the late 1960s, there had been a substantial expansion in the use of fertilizers, which has contributed in raising farm level productivity.

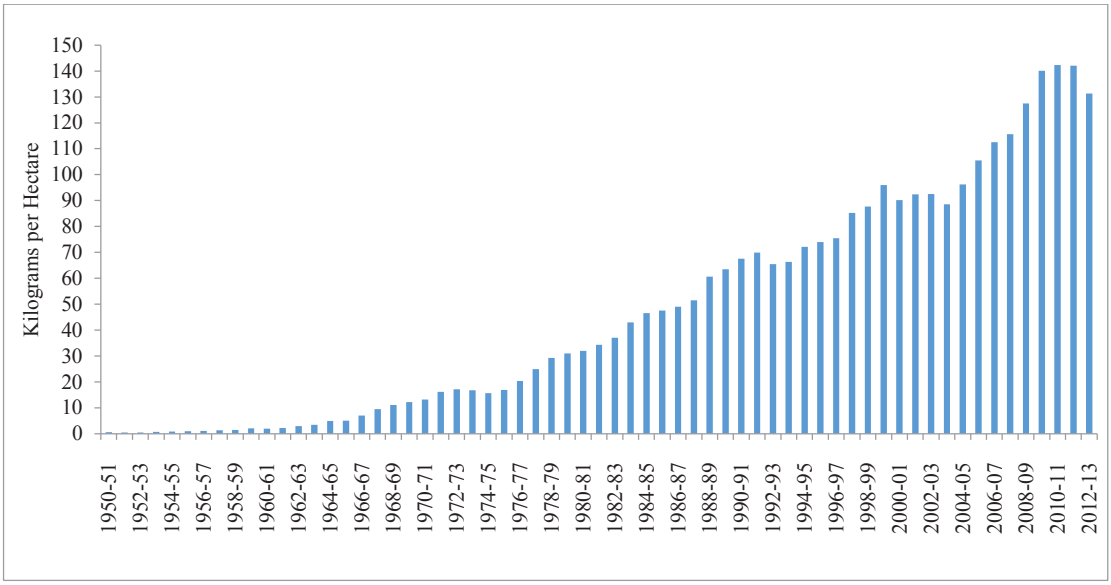
Plot of the cyclical component of agricultural output against rainfall suggests that they are positively associated with each other (Figures 4 and 5).

Table 2: Correlation between Rainfall Deviation and Economic Activity

	1950-51 to 1989-90	1990-91 to 2012-13	1950-51 to 2012-13
Cyclical Agricultural GDP and rainfall deviation	0.89*** (0.00)	0.59*** (0.00)	0.83*** (0.00)
Cyclical Non-agricultural GDP and rainfall deviation	0.18 (0.25)	0.19 (0.38)	0.19 (0.130)
Cyclical GDP and rainfall deviation	0.65*** (0.00)	0.37* (0.08)	0.59*** (0.00)
Note: Figures in parentheses are probabilities. *: Indicates significance at 10% level of significance; **: Indicates significance at 5% level of significance. ***: Indicates significance at 1% level of significance.			

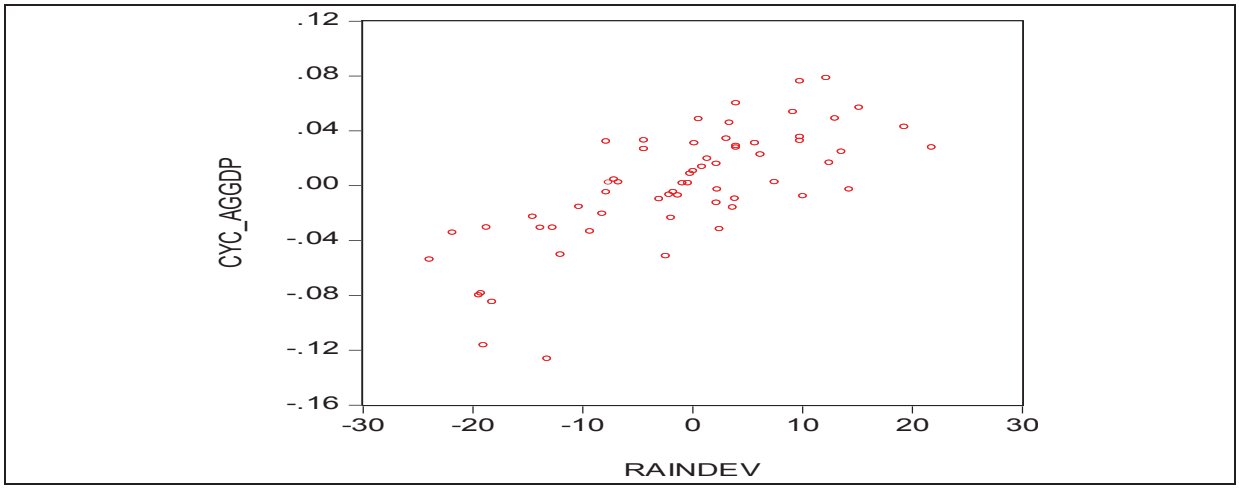
Source: Based on Authors' Own Calculations.

Figure 3: Consumption of Fertilisers Per Hectare Gross Sown Area in Indian Farms



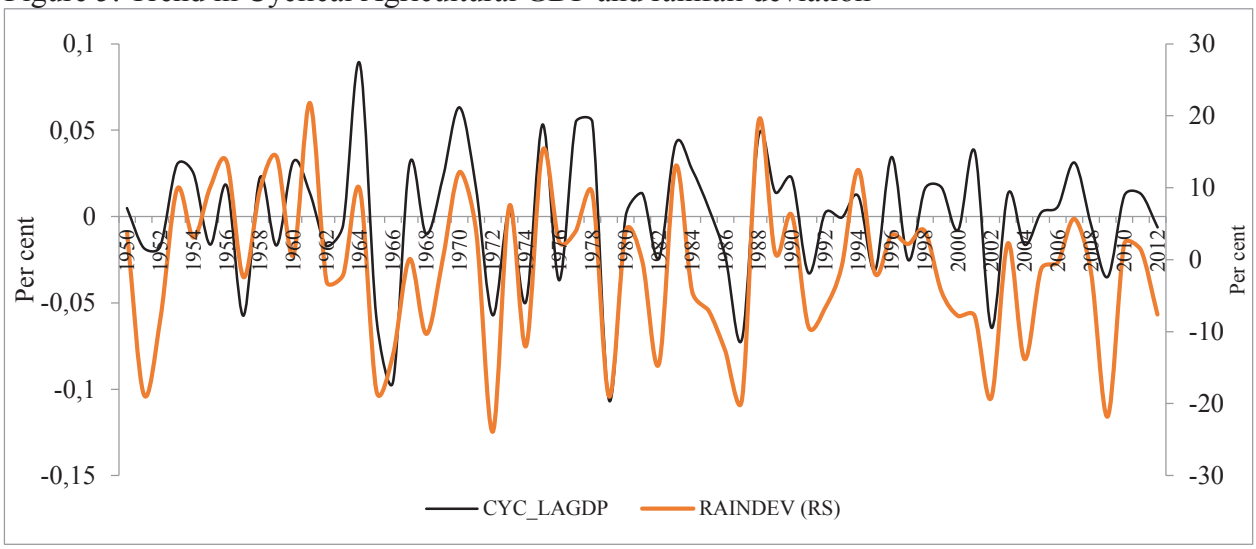
Source: RBI.

Figure 4: Scatter plot of Rainfall deviation and Cyclical Agricultural GDP (1950-51 to 2012-13)



Source: Based on Authors' Own Calculations.

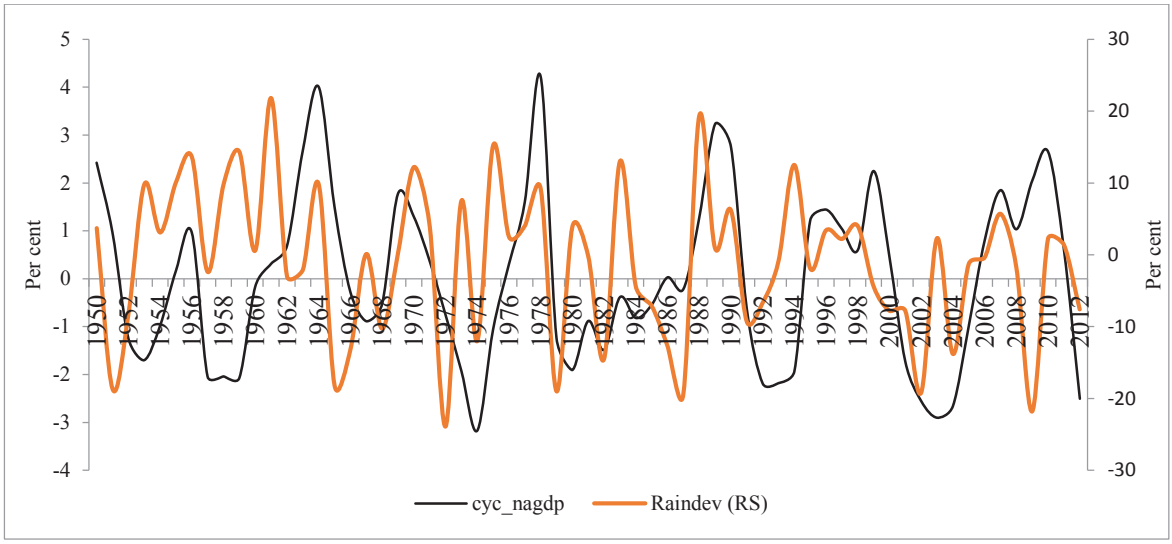
Figure 5: Trend in Cyclical Agricultural GDP and rainfall deviation



Source: Based on Authors' Own Calculations.

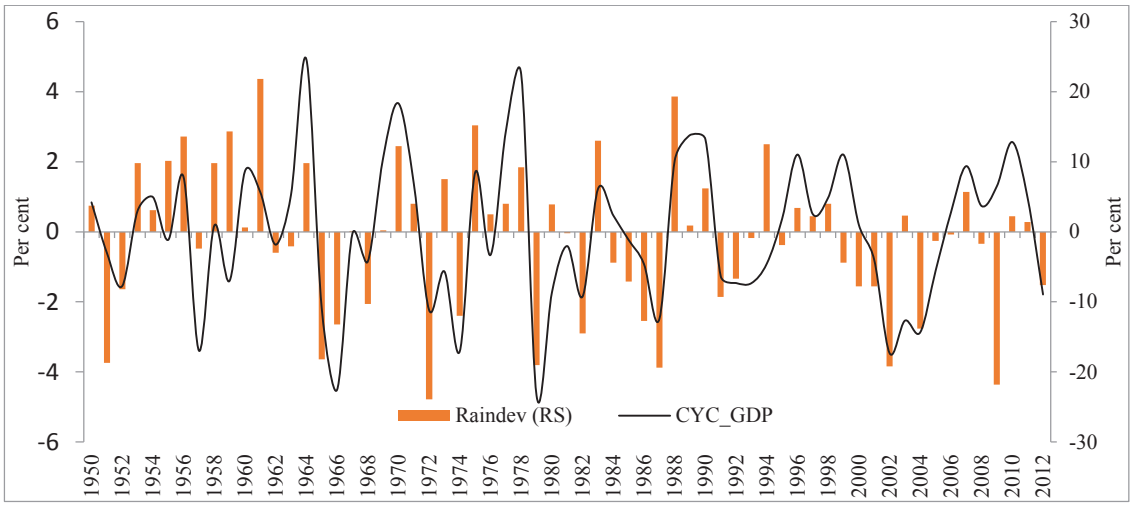
Non-agricultural GDP was not found to be co-moving and correlated with rainfall deviation; both in pre-reform and post-reform periods (Figure 6). Aggregate GDP was found to be co-moving and correlated with the monsoon activity (Figures 7 and 8). However, the strength of correlation GDP with rainfall deviation has weakened especially in the post-reform phase. This might be attributable to sharp rise in the share of the non-agricultural sector in the country's GDP, which does not seem to be much responsive to rainfall deviation.

Figure 6: Trend in Cyclical Non-agricultural GDP and rainfall deviation



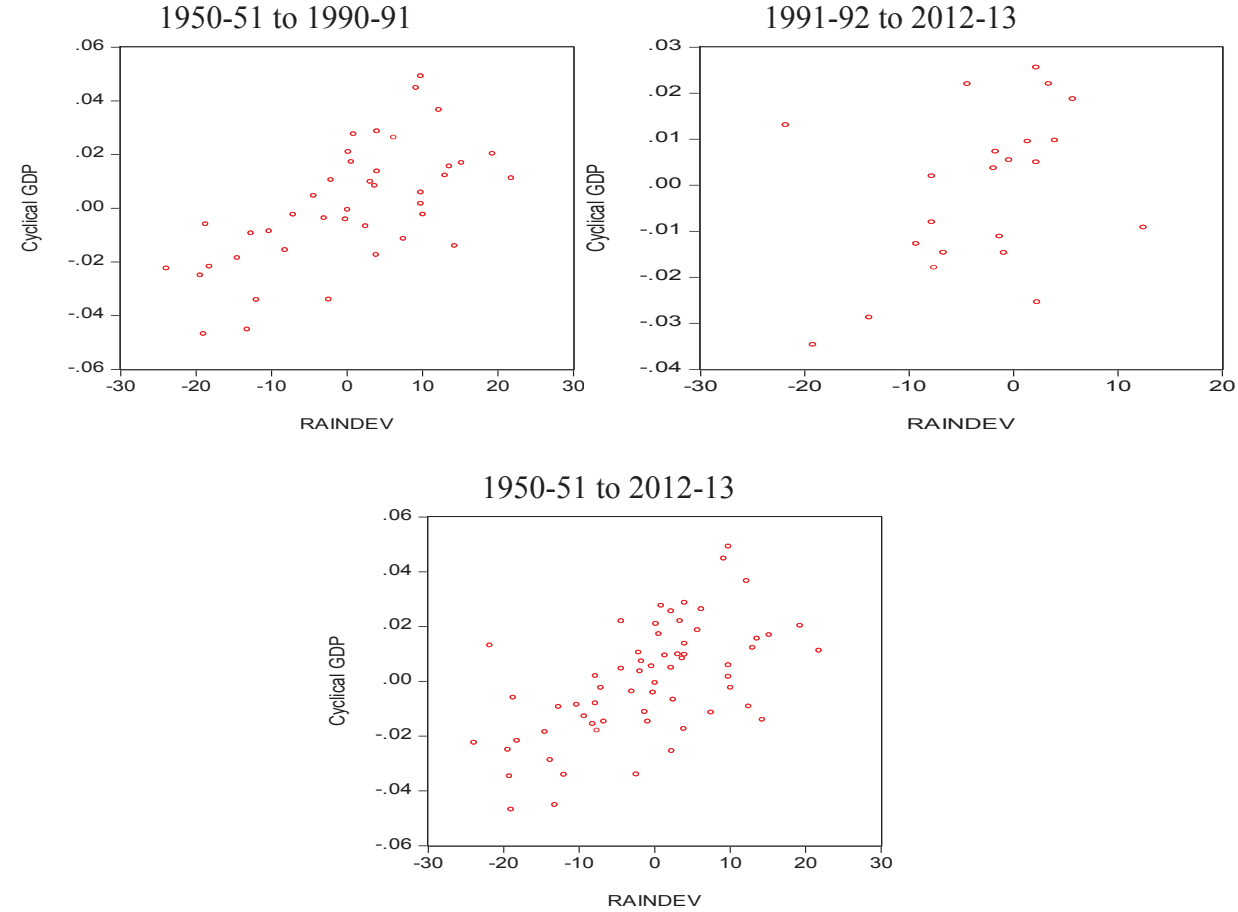
Source: Based on Authors' Own Calculations.

Figure 7: Trend in Cyclical GDP and Rainfall Deviation



Source: Based on Authors' Own Calculations.

Figure 8: Scatter plot of Rainfall deviation and Cyclical Component of GDP (1950-51 to 2012-13)



Source: Based on Authors' Own Calculations.

Monsoon and its Influence on Consumption Activity in India

In the foregoing analysis, the influence of monsoon on economic activity was established. In this section, the channel through which monsoon shock impacts the economic activity on the demand side is examined. The oldest theories of the business cycle link the causes of fluctuations in business cycle to meteorological conditions. Sunspot theory (originally proposed by William Stanley Jevons and later advanced by H. S. Jevons and H.L. Moore) seeks to establish a causal link between meteorological condition, which impacts agricultural activity, income and the economic activity. It is premised on the belief that the real cause of business cycle lies in variation in weather, which impacts the general economic activity. This theory was, by and large, developed in the context of arid and semi-arid areas where irrigation facilities were not fully developed. As per this theory, solar activity displays cyclical behaviour and causes climatic variations, which impacts the agricultural sector. Such changes in agricultural production induce variations in industrial sector through it backward and forward linkages and eventually the overall economic activity. Of late, with emergence newer business cycle theories, and declining importance of agriculture sector in various economies, Sunspot theory of business cycle has been discredited. On the demand side, aggregate GDP is comprises of five components, *viz*., Private Final Consumption Expenditure (PFCE), Government Final Consumption Expenditure (GFCE), Gross fixed Capital Formation (GFCF), export and import. PFCE remains the major component of GDP on the demand side. Prior to 1990s, PFCE

accounted for about more than three-fourth of the GDP and this had a considerable influence on the movement of GDP in India (Table 3).

Table 3: Components of GDP at Factor Cost: Shares
(At 2004-05 Prices)

(Per cent)

	PFCE	GFCE	GFCF	EXPORT	IMPORT
1950-51	87.6	6.4	14.6	7.3	8.3
1960-61	87.2	6.2	16.3	4.6	8.2
1970-71	81.0	10.4	18.2	4.9	5.5
1980-81	82.8	11.9	22.3	7.6	8.0
1990-91	74.3	13.6	25.8	7.5	8.5
2000-01	67.2	13.8	25.2	13.8	16.6
2010-11	62.9	11.9	36.0	24.3	31.4
2012-13	64.7	12.1	36.5	26.4	36.3
Note: Respective components of GDP may not add to 100 as the changes in stock components were not taken into account.					

Source: RBI.

As per the occupational distribution, a majority of population, more than about 50 per cent depends on agriculture as a primary occupation for their living (Table 4). Thus, it seems highly likely that performance of agricultural sector would have an influence on the PFCE. This is in line with what RBI (2002) had also observed. (RBI (2002) had also noted that the output of agriculture sector is influenced by weather and not by market forces, and that its performance significantly influences the level of aggregate demand through its impact on private consumption expenditure.)

Following the work of Ragnar Frisch (1933) on the role of random shocks originating in agricultural sector in generating business cycles in India, Chitre and Paranjape (1987) decomposed growth cycle fluctuations in non-agricultural income of Indian economy into those emanating from the fluctuations in agricultural sector and other impulses. They contended that even if other shocks/ impulses were absent in the Indian economy, random uncorrelated shocks originating in agricultural sector would have produced cyclical movement in non-agricultural sector (also see Chitre, 1990).

Mall (1999) had also argued that growth in agricultural output produces strong demand incentives, by and large, in the form of increased rural demand, which fosters expansion in various sectors of the economy. Of late, some studies have emerged, which have sought to highlight the implications of the performance of agriculture sector for business cycles. Da-Rocha and Restuccia (2002) found that agricultural sector has certain distinctive characteristics (it is relatively more volatile and not positively correlated with the rest of the economy and its employment is counter-cyclical) because of which notwithstanding its declining share in GDP, agriculture plays an essential role in understanding aggregate business cycles. They report that the behavior of agriculture during cycles improves the quantitative implications of the standard real business cycle model. They also contend that as the size of the agricultural sector falls, business cycle properties across countries should converge.

Table 4: Occupational Distribution of Total Workers in India

(Per cent)

Year	Agricultural Workers			Non-agricultural Workers		
	Male	Female	Total	Male	Female	Total
1981	63.5	82.3	68.4	36.5	17.7	31.6
1991	60.9	82.4	67.1	39.1	17.6	32.9
2001	52.2	71.9	58.4	47.8	28.1	41.6
2011	49.9	65.1	54.6	50.1	34.9	45.4

Source: Census of India.

Data and Methodology

Data for the study were sourced from various Ministries and Departments of the Government of India and the Reserve Bank of India. Data on workforce were taken from of India, Government of India. Data on rainfall were sourced from Indian Meteorological Department. Ministry of Agriculture formed the source for data on gross sown area and irrigated area. Data on national accounts and its components were sourced both from the Government of India and the Reserve Bank of India. In the present study, econometric estimation was undertaken using various time series analysis techniques, *viz*., granger causality analysis and general method of moments (GMM) estimation.

Estimation

A scatter plot between cyclical components of real private final consumption expenditure (PFCE) and real agricultural GDP shows a positive association between the two **(Figure 9**). For the period 1950-51 to 2012-13, the correlation between the two was found to 0.66, which was found to be significant at 1 per cent level of significance (**Table 5**). The strength of correlation is found to be much higher for the pre-reform period. Non-contemporaneous correlation between the two, to see if there exist any lead-lag relationship, worked out to be not significantly different from zero.

Table 5: Correlation Analysis between Cyclically adjusted components of $RPFCE_t$ and $RAGDP_t$

	1950-51 to 1989-90	1992-93 to 2012-13	1950-51 to 2012-13
$AGDP_t$	0.71*** (0.00)	0.60*** (0.00)	0.66*** (0.00)
$AGDP_{t-1}$	-0.075 (0.65)	0.27 (0.26)	0.01 (0.94)
$AGDP_{t+1}$	-0.241 (0.14)	0.05 (0.85)	-0.18 (0.16)
Note: Figures in parentheses are p-values.			

Source: Based on Authors' Own Calculations.

Figure 9: Scatter plot of Cyclical Real PFCE versus Cyclical Real Agricultural GDP

Figure 9a: Scatter plot (1950-51 to 1989-90)

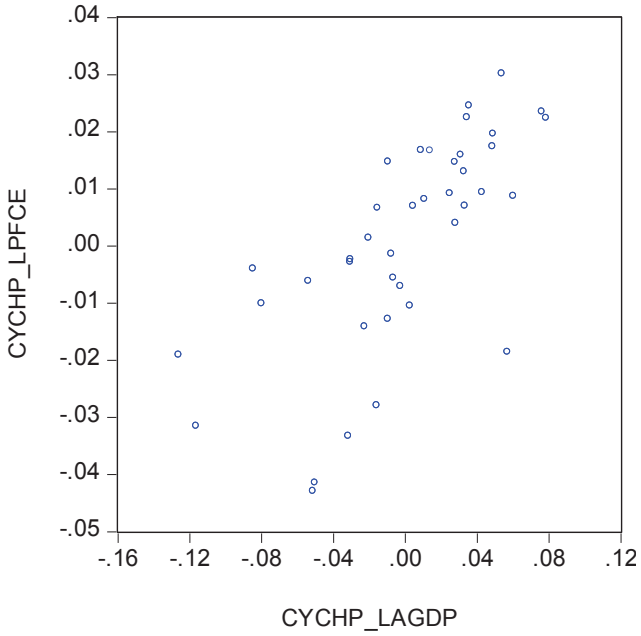


Figure 9b: Scatter plot (1992-93 to 2012-13)

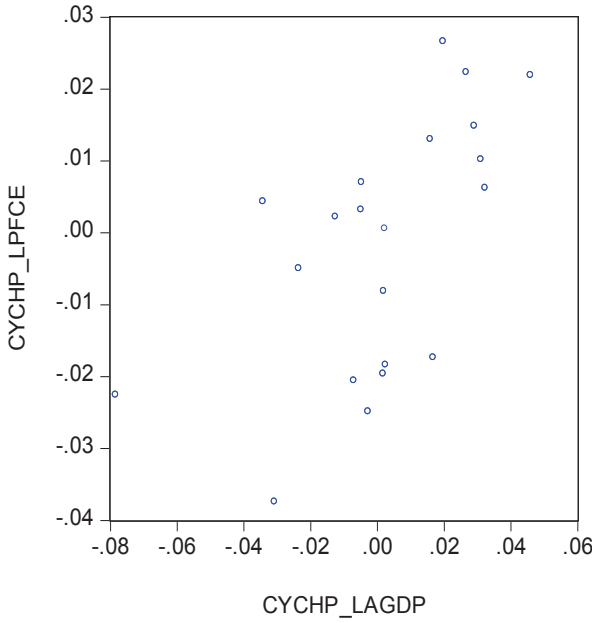
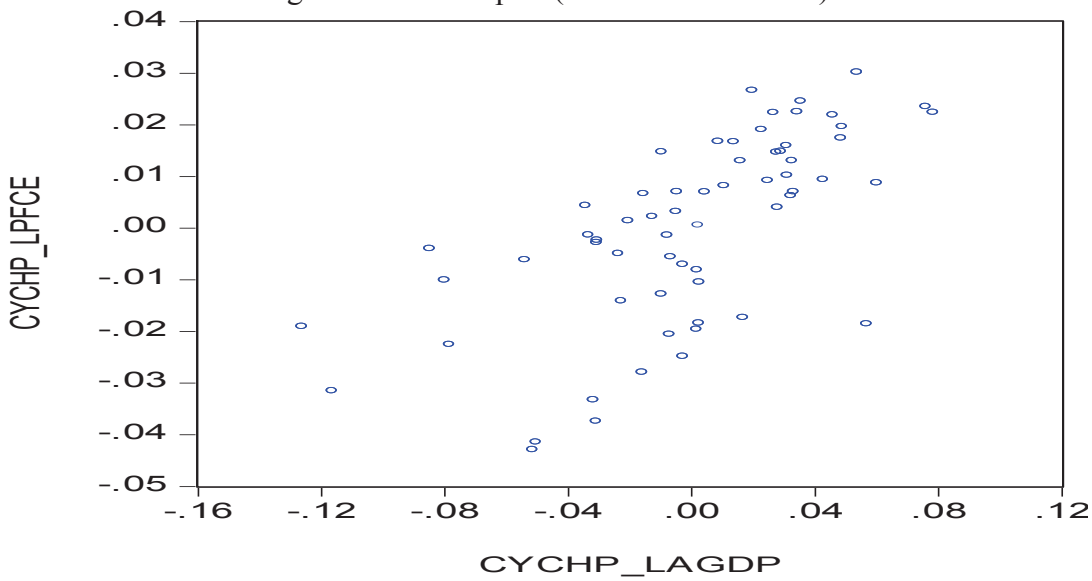


Figure 9c: Scatter plot (1950-51 to 2012-13)



Source: Based on Authors' Own Calculations.

Given strong positive association between agricultural GDP and PFCE in the pre-reform period (1950-51 to 1989-90), causality analysis using block exogeneity test/ granger causality between the two was undertaken using their growth rates. Rainfall deviation, inflation expectation and bank rate (as a proxy for interest rate) were taken as an exogenous variable. Since causality analysis is sensitive to the number of lagged terms included, selection of lags and other diagnostic tests were conducted. A lag length of two years was found appropriate as per SBC and LR criteria. The estimated VAR model was also found to be stable. Various diagnostic tests such as normality of residuals, absence of serial correlation and heteroskedasticity in the residuals validate robustness of VAR estimate. Bi-directional causality was found for growth of real PFCE and real agricultural output for the period 1950-51 to 1989-90 (Table 6).

Table 6: VAR Granger Causality/Block Exogeneity Wald Tests

Sample: 1951-52 1989-90			
Dependent variable: gr_RAGDP			
Excluded	Chi-sq	Df	Prob.
PFCE	7.86	2	0.001
Dependent variable: gr_RPFCE			
Excluded	Chi-sq	Df	Prob.
AGDP	5.50	2	0.007

Source: Based on Authors' Own Calculations

Given the fact that real agricultural GDP and real PFCE were highly correlated and endogenously determined, General Method of Moments (GMM) estimation was undertaken for the period 1950-51 to 1989-90. GMM estimation is an improvement over the 2SLS as it overcomes the problem of omitted variable bias. GMM estimation typically accounts for heteroskedasticity and/or serial correlation. Given the fact that consumption expenditure is influenced by the income level, both agricultural and non-agricultural GDP were considered as explanatory variables. The specification of the model is as follows:

$$\text{gr\_RPFCE}_t = \propto + \beta_1 \text{gr\_RAGDP}_t + \beta_2 \text{gr\_RNAGDP}_t + \varepsilon_t \quad (1)$$

where gr_RPFCE is the growth of real PFCE and gr_RAGDP is the growth of real agricultural GDP, and gr_RNAGDP is the growth of real non-agricultural output.

Before the estimation, test for presence of breakpoint (which would influence the estimation) during the analysis period was undertaken using Quandt-Andrews unknown breakpoint test. The null hypothesis of no breakpoints within the estimated period (1950-51 to 1989-90) is found to be rejected at 10 per cent level of significance (Table 7). Accordingly, a dummy (dum84) was created to control for the breakpoint; it assumes a value equal to 1 for the year 1984, and is zero for the rest of the years.

Table 7: Quandt-Andrews unknown breakpoint test (1950-51 to 1989-90)

Null Hypothesis: No breakpoints within 15% trimmed data		
Equation Sample: 19511989		
Test Sample: 1957 1984		
Number of breaks compared: 28		
Statistic	Value	Prob.
Maximum LR F-statistic (1984)	4.99	0.095
Ave LR F-statistic	1.29	0.24
Note: probabilities calculated using Hansen's (1997) method		

Source: Based on Authors' Own Calculations

Rainfall deviation was used as an instrument for agricultural sector growth. For the Indian case, researchers have examined the influence of monsoon on other macroeconomic variables such as manufacturing sector growth, by using monsoon as an instrument for agricultural sector growth [see Paul (2007)]. Paul (2007) using 2SLS examined the influence the growth of agricultural on manufacturing sector in India by deploying monsoon rainfall as an instrument

for the former. He found that monsoon rainfall influenced the growth of manufacturing sector in India with a lag of one year through agricultural growth. Furthermore, inflation expectation and interest rate (proxied by bank rate) are also expected to have influence on the consumption expenditure and, therefore, used as instruments for non-agricultural GDP. The GMM estimation (standard errors & covariance consistent; computed using HAC) results are as follows (Table 8).

Table 8: GMM Estimate with gr_RPFCE as the dependent Variable

Explanatory Variable	**Coefficient**
Intercept	16.7
gr_RAGDP_t	0.52***
gr_RNAGDP_t	0.76***
dum84	-161.2
Diagnostics	
Adj R^2	0.75
Prob (JB stats)	0.55
Prob (J-stats)	0.64
List of instruments used	$RAINDEV_t$; $RAINDEV_{t-1}$; INFLNEXP, INTRATE.
Note: ***: Significant at 1% level of significance. **: Significant at 5% level of significance. *: Significant at 10% level of significance.	

Source: Based on Authors' Own Calculations.

Some of the diagnostic tests were undertaken to check for the robustness of the estimates. The null hypothesis that the instruments used were valid was not found to be rejected. The null hypothesis of orthogonality (*i.e.* not correlated with error term) of all the instruments used was also not found to be rejected, which support robustness of the estimates.

The estimation result suggests that growth in agricultural income has a positive influence on the growth in private consumption expenditure in the Indian economy. This validates our hypothesis that variability in monsoon had a considerable impact in influencing economic activity. Comparatively, however, non-agricultural sector growth was found to have relatively greater influence on the consumption activity in the economy, which is on expected lines given the shrinking share of agriculture and dominant share of non-agricultural activity in national income.

Concluding Observations

In the present study, we wished to investigate the influence of monsoon (through its impact on agricultural sector growth) on private sector consumption expenditure. For the same, monsoon deviation was used as an instrument for agricultural sector growth. VAR block exogeneity/ granger causality analysis suggested bi-directional causality between agricultural sector growth and private final consumption expenditure growth. Given the endogeneity of the variables, GMM estimation was undertaken. GMM estimation validated that growth in the consumption expenditure in the pre-reform period is found to be significantly influenced by the monsoon

variation through its impact on agricultural sector output. Various diagnostic tests validated the robustness of the estimate.

The influence of monsoon on agricultural sector output and thereby on economic activity, however, seems to have reduced in the post-reform period. Since the non-agricultural GDP comprises a major chunk of the economy and is not found to be significantly influenced by monsoon variation, the influence of rainfall on economic activity seems to have diminished to some extent, especially in the post-reform period.

For the post-reform period, the reduction in influence of monsoon variation on the consumption expenditure at an aggregate economy level could, *inter alia*, be attributed to the structural transformation in the economy, which might have altered the consumption expenditure pattern in the economy. Rising income levels, shrinkage of agricultural GDP and rising share of non-agriculture GDP (which is not found to be significantly influenced by monsoon variation) as also shift in consumption expenditure from food to non-food items might have reduced the influence of agriculture sector on the private consumption expenditure. Further, in the post-reform phase, the Government instituted various public welfare programmes such as MGNREGS, which would have also helped smoothen the consumption expenditure cycle and to some extent shielded it from the influence of monsoon variations. Instituted in 2005, MGNREGS seeks to provide enhancement of livelihood security in rural areas of the country by providing at least 100 days of guaranteed wage employment in a financial year.

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