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Econometrics Analysis of Business Cycle in India

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Abstract:

Business cycles reflect the real economic picture of any economy. In the era of globalization, economic activities are highly fluctuating and different components of economy are working in different direction with varied moment and density function and ultimately it tends to disturb the growth rate. This Paper tests the growth rate of business cycles in Indian states. We have considered the non-agricultural GDP and NSDP as a measure of aggregate economic activity. This study, by applying the Hodrick-Prescott and Baxter-King filter for de-trending the growth rate series, finds that the volatility in non-agricultural GDP cycles had come down in the post liberalisation period. The rising business cycles volatility in 1990s compared to 1980s was also widely visible among regional business cycles. The view of earlier researches about Indian business cycle as "monsoon cycle" during the pre-liberalization period is also of limited relevance. Therefore, we argue that the conventional business cycle existed for the entire period of our study i.e. 1951-2010. This study also finds that the trend growth rate as well as deviation from the trend i.e. cycles is showing a downward trend in many of the states in the recent past years.

1. Introduction

In the era of globalization, economic activities are highly fluctuating and different components of economy are working in different direction with varied moment and density function and ultimately it tends to disturb the growth rate. This Paper tests the growth rate of business cycles in Indian states. We have considered the non-agricultural GDP and NSDP as a measure of aggregate economic activity. A large literature documents India's business cycles stylized facts (Chitre, 1982, 1986; Gangopadhyay and Wadhwa, 1997; Mall, 1999; Dua and Banerjee, 2000) and recently (Ghate et al., 2011). However, there is no study in our knowledge which looked at the regional business cycles in India. This paper aims to fill this gap by examining the regional business cycles of fifteen major states of India. Moreover, this paper also aims to re-examine the business cycles attributes of Indian economy.

Burns and Mitchell (1946) defines business cycle, "Business cycles are a type of fluctuation found in the aggregate economic activity of nations that organize their work mainly in business enterprises: a cycle consists of expansions occurring at about the same time in many economic activities, followed by similarly general recessions, contractions and revivals which merge into the expansion phase of the next cycle; this sequence of changes is recurrent but not periodic; in duration business cycles vary from more than one year to ten or twelve years; they are not divisible into shorter cycles of similar character with amplitudes approximating their own."

Burns and Mitchell definition of business cycle emphasizes that business cycles organizes their work mainly in business enterprises. However, in earlier studies, researchers have used GDP series (Dua and Banerjee, 2000; Ghate et al., 2011) as the coincident indicator which includes Agriculture sector; prone to monsoon fluctuations. On the other hand, researchers have also used Industrial production series (Chitre, 1986; Gangopadhyay and Wadhwa, 1997; Mall, 1999) as coincident indicator which is a narrow measure for aggregate business enterprises output; given its sectoral contribution in India's GDP.

In what follows, we mainly consider the non-agricultural series of domestic product as the coincident indicator and growth rate cycle methodology for analyzing cyclical movements in economic activities of India's and its states. The remaining of the paper is divided into following sections. Section 2 describes the data and methodology used compute Indian and its States business cycle. Section 3 provides the empirical evidence for Indian business cycle. Section 4 provides the detailed stylized facts of India's regional business cycle. Section 5 Concludes the paper.

2. Data and Methodology

This study covers the period from 1950-51 to 2010-11. Data on annual gross domestic product (GDP) and net domestic product (NDP) at the aggregate and sectoral levels at 2004-05 constant prices were taken from National Accounts Statistics (NAS), published by the Central Statistical Organization (CSO). Data for gross state domestic product is only available from 1980, but data for net state domestic product is available from 1960. Therefore to have a longer time span, we have considered the annual net domestic products for Indian States. The data for 15 major states annual net state domestic product (NSDP) and its component at constant prices at different base year, for the period 1960-61 to 2010-11, were obtained from Domestic Product of States of India an electronic database of Economic and Political Weekly Research Foundation and National Account Division, published by the Central Statistical Organization (CSO). We have considered the state income (NSDP) data and its component at 2004-05

constant prices. Splicing technique has been used for linking the NSDP and its component at constant prices prior to 2004-05 to base year 2004-05. The splicing technique has been adopted for the years prior to 1999-00 mainly with the purpose of maintaining the growth rates of the old series at detailed and at aggregate level. Therefore, the data are non-additive between the detailed level and the aggregate level. Data for divided Bihar, Madhya Pradesh and Uttar Pradesh are available only from 1993-94. Therefore, we have taken ratio of NSDP and its components of divided Bihar, Madhya Pradesh and Uttar Pradesh to undivided Bihar, Madhya Pradesh and Uttar Pradesh respectively in the year 1993-94 and had used this ratio to derive the divided Bihar, Madhya Pradesh and Uttar Pradesh NSDP and its components for the period 1960-61 to 1992-93. By doing this we are assuming divided Bihar, Madhya Pradesh and Uttar Pradesh grew at the same rate as undivided Bihar, Madhya Pradesh and Uttar Pradesh for the period 1960-61 to 1992-93. The other advantage of doing this exercise is that the NSDP and its components for divided Bihar, Madhya Pradesh and Uttar Pradesh do not show a sharp downfall in the year 1993-94. We are constrained to make this rather arbitrary assumption because we lack a reliable time series on the rate of growth of NSDP and its component for divided Bihar, Madhya Pradesh and Uttar Pradesh for the period 1960-61 to 1992-93.

In this study, we divide the economy into agriculture and allied sector and non-agriculture sector using following classification:

1. Agriculture and Allied Sector- Agriculture, Forestry and Fishing
2. Non-Agriculture Sector - Mining and Quarrying; Manufacturing; Electricity, Gas and Water Supply; Construction; Trade, Hotels and Restaurants; Transport, Storage and Communication; Financing, Insurance, Real Estate and Business Services; Community, Social and Personal Services.

The business cycle components are considered as deviation from trend. In this study we are considering the growth rate cycle; therefore we filter the first difference of log transformed series to extract the trend and cyclical components. A widely used method for obtaining the trend and cyclical component is to apply the Hodrick-Prescott filter (Hodrick and Prescott 1997). The Hodrick-Prescott (H-P) filter λ was set equal to 6.25 following Ravn and Uhlig (2002) suggestion for annual data. To check the robustness of our result we have also applied the band-pass filter proposed by Baxter and King (1999). Baxter-King (B-K) band-pass filters removes slow moving components and high frequency noise. Baxter-King filter belong to the category of band-pass filters that allows extracting data corresponding to the chosen frequency components. For annual data Baxter and King recommend that the minimum periodicity and maximum periodicity should be 2 and 8 years respectively and the lead-lag length of the filter should be 3 years. The periodicity suggested by Baxter-King corresponds to the business cycle periodicity. However, by setting lead-lag length equal to 3 years, 3 observations are lost at each end of the filter.

3. Indian Business Cycle

Figure 1 and Figure 2 presents the H-P and B-K filtered trend and cyclical component of non-agriculture GDP. Both Figure 1 and 2 confirm that the non-agriculture GDP trend was upward trending from 1951-52 to 1961-62 and after that it started its downward movement upto 1972-73. The trend again started moving up from 1973-74, reached its peak in 1976-77 and after that kept falling till 1979-80. From 1980-81 the trend of non-agriculture GDP again turned to upward, reached its peak in 1987-88 and after that the trend turned downward and reached at its trough in 1991-92.

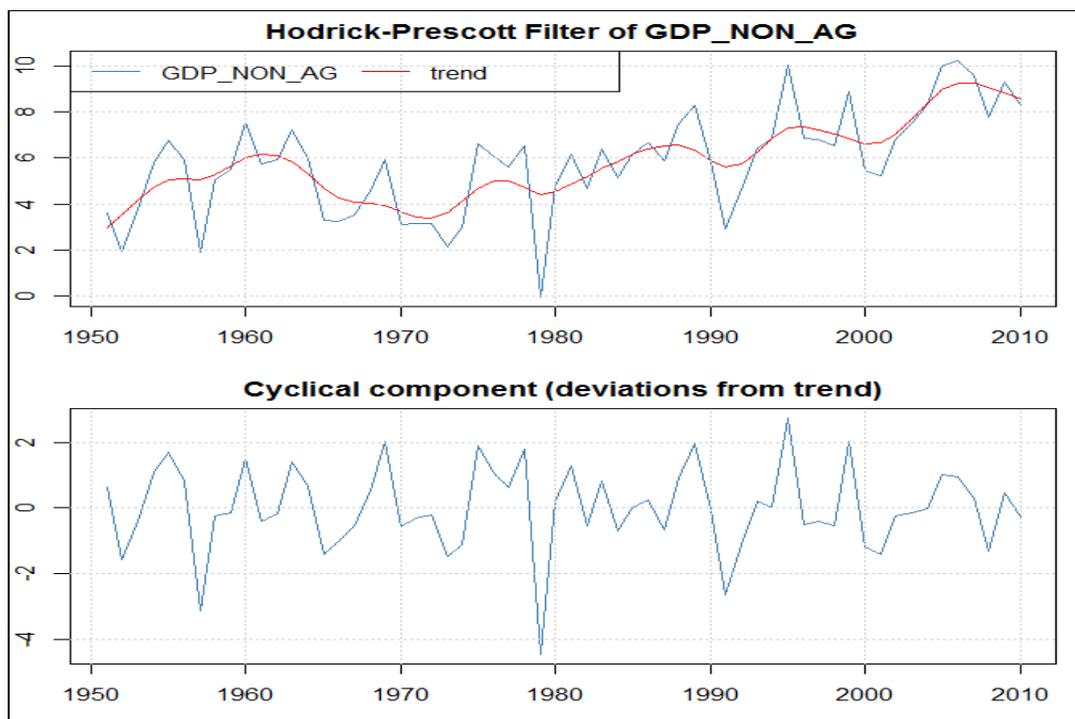


Figure 1: H-P Filtered Non-Agriculture GDP

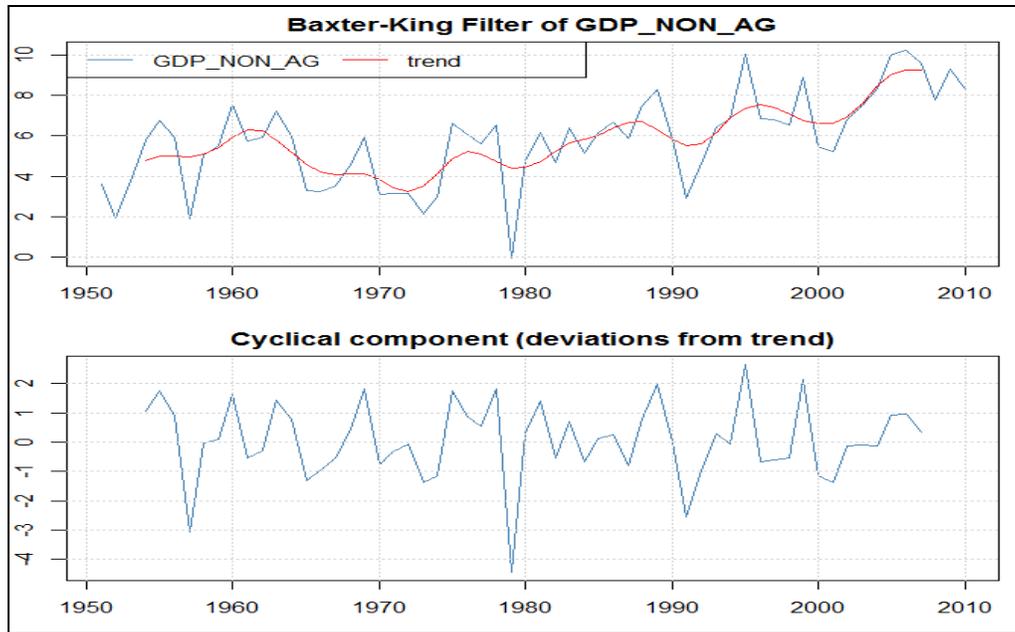


Figure 2: B-K Filtered Non-Agriculture GDP

The period from 1991-92 onwards, the post liberalization period, witnessed two peaks in the trend on non-agriculture GDP. The first peak arrived in 1996-97 followed by a trough in 2001-02 and again a peak in 2006-07 after which the trend had started falling.

The cyclical peak and trough of non-agriculture GDP are presented in Table 1. The dates are based on the results obtained from H-P filter and the same dates have been confirmed by the cycle extracted from the B-K filter.

Peak	Trough
1951-52	1952-53
1955-56	1957-58
1960-61	1961-62
1963-64	1965-66
1969-70	1973-74
1975-76	1979-80
1981-82	1982-83
1983-84	1984-85
1986-87	1987-88
1989-90	1991-92
1995-96	1998-99
1999-00	2001-02
2005-06	2008-09

Table 1: Peak and Trough in Non-Agriculture GDP (1951-2011)

Volatility is a measure of aggregate fluctuations in the variable of interest. In past literature volatility in macroeconomics has been considered as measure of development. High macroeconomic volatility is considered both a source as well as reflection of underdevelopment (Loayza et al., 2007). It is measured by the standard deviation of the variable. Relative volatility is the ratio of volatility of the variable of interest and the variable used as a measure of aggregate business cycle activity. A relative volatility of more than one implies that the variable has greater cyclical amplitude than the aggregate business cycle.

	1951-1991	1991-2011
GDP (H-P Filtered)	2.932	1.320
GDP (B-K Filtered)	3.048	1.320
Non-Agriculture GDP (H-P Filtered)	1.344	1.214
Non-Agriculture GDP (B-K Filtered)	1.352	1.261
Agriculture GDP (H-P Filtered)	6.003	4.007
Agriculture GDP (B-K Filtered)	6.288	4.249

Table 2: Pre and post liberalization period business cycle volatility (standard deviation) in the Indian economy

Table 2 presents the standard deviation of the de-trended cycles, extracted using both H-P and B-K filter, as measure volatility for pre and post liberalization period. Table 2 clearly indicates that business cycle volatility has decreased in aggregate GDP, non-agriculture component of GDP and also in agriculture component of GDP in the post liberalization period. Moreover, the cyclical volatility was lowest in the non-agriculture component of GDP compared to GDP in the post as well in pre liberalization period. Ghate et al. (2011) had found a similar trend in aggregate GDP and for India’s agricultural GDP sector. Based on their results Ghate et al. (2011) suggests that fall in GDP volatility due to a decline in volatility in the agricultural component of GDP. In their study Ghate et al (2011) use GDP as a measure of aggregate activity in the economy. However, Patnaik and Sharma (2002) had suggested that in terms of business cycle fluctuations, the Indian economy moved away from monsoon cycles to business cycles in the conventional sense in the post liberalization period. Therefore, in our study, we are considering non-agricultural GDP as measure of aggregate activity in the economy which will be helpful in assessing the claim that whether pre-reform period was mainly monsoon cycle or there was existence of conventional business cycle in India.

	1951-1960	1961-1970	1971-1980	1981-1990	1991-2000	2001-2010
GDP (H-P Filtered)	2.497	3.266	4.035	1.936	1.570	1.098
GDP (B-K Filtered)	2.92	3.350	4.037	1.925	1.573	1.140
Non-Agriculture GDP (H-P Filtered)	1.487	1.083	1.869	0.894	1.560	0.824
Non-Agriculture GDP (B-K Filtered)	1.647	1.061	1.828	0.912	1.543	0.799
Agriculture GDP (H-P Filtered)	4.283	6.602	8.378	4.843	3.898	4.319
Agriculture GDP (B-K Filtered)	4.962	6.825	8.427	4.880	3.965	4.923

Table 3: Decadal business cycle volatility (standard deviation) for the Indian economy

Table 3 presents the decadal volatility (standard deviation) for GDP, non-agriculture component of GDP and also in agriculture component of GDP, extracted using both H-P and B-K filter. Here the story changes. The volatility in GDP and agricultural GDP was rising in 60’s and 70’s. In 1980s and 1990s volatility kept falling in aggregate GDP and agricultural GDP. For the period 2001-10 GDP had registered minimum volatility in the past six decades, whereas the agricultural GDP volatility had again gone up in this period compared to 1991-2000 period. On the other hand, the volatility in non-agricultural GDP came down in the period 1961-70, went up in 1971-80, again came down in 1981-90, again went up in 1991-00 and had registered minimum volatility in for the period 2001-10. Therefore, the fall in volatility in GDP for the period 2001-10 was mainly due to falling volatility in the non-agricultural GDP and not due to agricultural GDP because the volatility in agricultural GDP has increased in the 2001-10. Moreover, as presented in Table 3 the volatility in non-agricultural GDP came down in 1960s compared to 1950s whereas in agricultural GDP the volatility went up. This gives us some evidence that Indian business cycle in the pre liberalization period cannot be coined as solely monsoon cycle. Figure 3 presents the B-K filtered cyclical component of agricultural GDP and non-agricultural GDP and it seems very hard to find a relation between the two cycles. On one hand the agricultural GDP cycle are more erratic due to monsoon factor, the non-agricultural GDP cycle seems to be smoother.

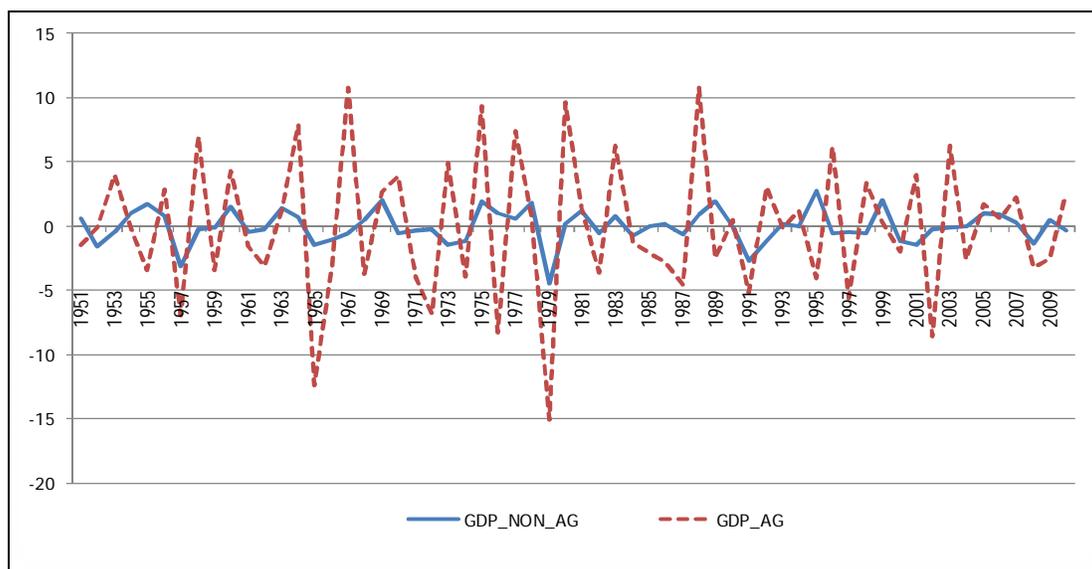


Figure 3: B-K filtered cycles of agricultural GDP and non-agricultural GDP (1951-2010)

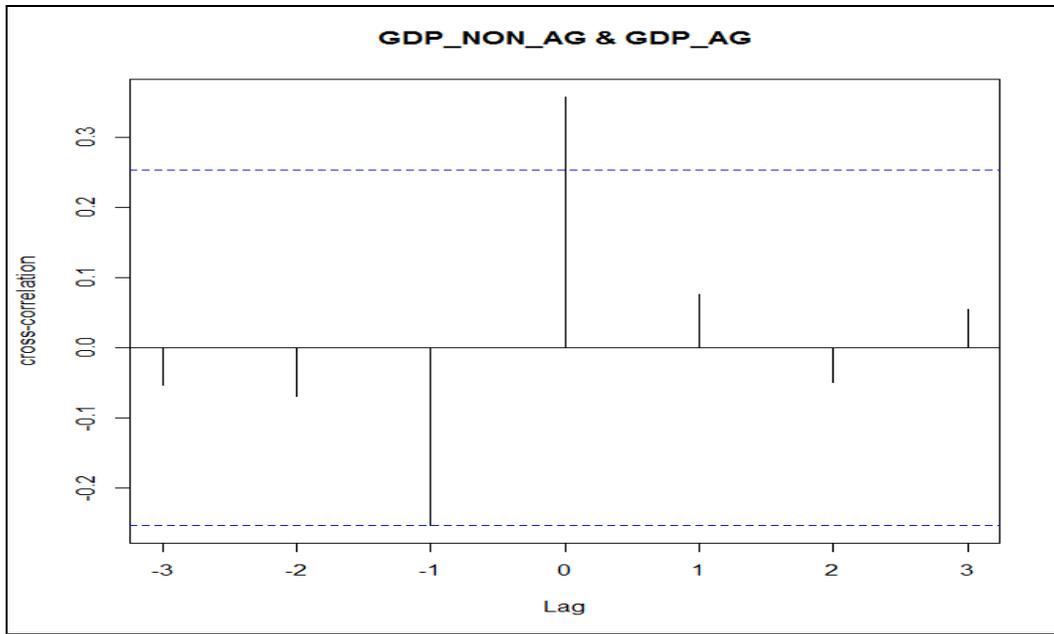


Figure 4: Cross-Correlation between H-P filtered cycles of non-agricultural GDP and agricultural GDP (1951-2010)

Figure 4 presents the cross-correlation results of B-K filtered cycles of agricultural GDP and non-agricultural GDP for the period 1951. The positive value of lag represents non-agricultural GDP as lagging variable and agricultural GDP as the leading variable. We find that only the contemporaneous correlation between the two variables is significantly positive (coefficient of correlation 0.358) and at all the leads correlation between cycles of agricultural GDP and non-agricultural GDP is insignificant. Figure 5 presents the cross-correlation results of B-K filtered cycles of agricultural GDP and non-agricultural GDP for the pre liberalization period. Figure 4 also suggest that only the contemporaneous correlation between agricultural GDP and non-agricultural GDP is significantly positive. If in the pre-liberalization there was existence of only monsoon cycle then the agricultural GDP must have acted as a leading indicator for non-agricultural GDP atleast at lag 1. The contemporaneous coefficients of correlation between the two cycles are though significantly positive but it is less than even 0.5. This evidence suggest the existence of conventional business cycle in non-agricultural GDP which comes mainly from the business enterprises.

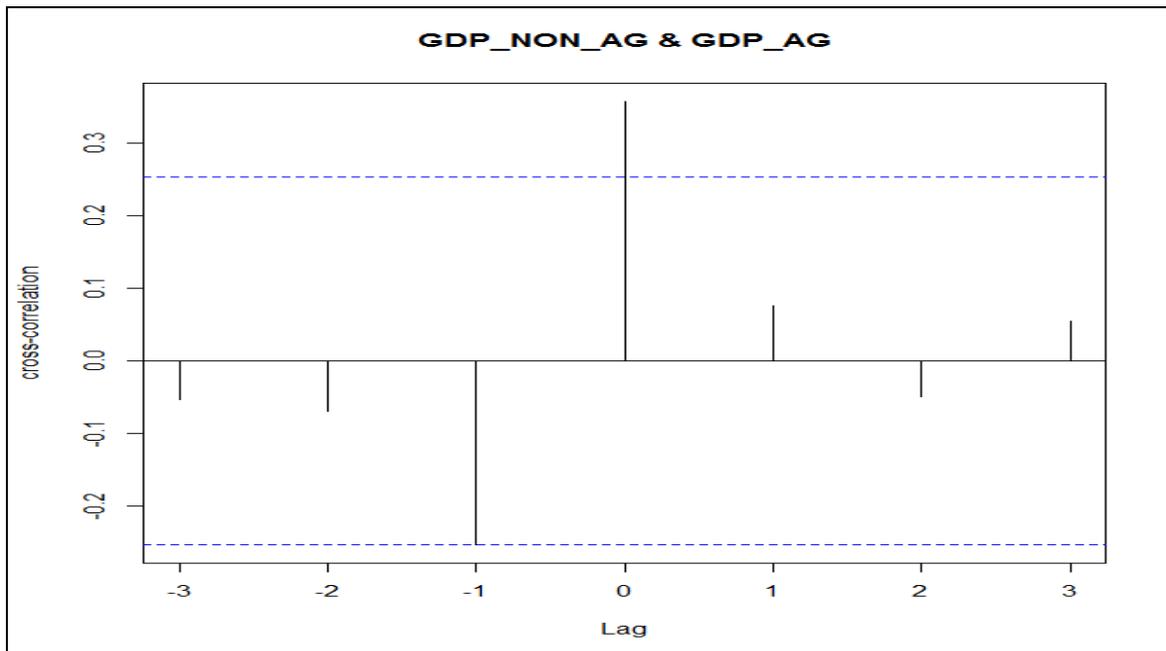


Figure 5: Cross-Correlation between H-P filtered cycles of non-agricultural GDP and agricultural GDP (1951-1990)

4. Regional Business Cycle

Table 4 presents the business cycle volatility for the period 1971-1990 and 1991-10 separately. To keep our analysis comparable among states we considered the period starting 1971-72, because data for all the states are available for this period. The volatility in non-agricultural NSDP for Andhra Pradesh, Haryana, Himachal Pradesh, Madhya Pradesh, Odisha, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal had shown a decline in the post liberalization period. On the other hand, in the post liberalization period the volatility in non-agricultural NSDP had increased in Bihar, Gujarat, Maharashtra and slightly in Karnataka. In Kerala the volatility had remained same in the pre and post liberalization period.

States	1971-1990	1991-2010
Andhra Pradesh	2.977	2.729
Bihar	3.606	5.563
Gujarat	4.118	5.576
Haryana	4.473	2.297
Himachal Pradesh	3.077	2.988
Karnataka	2.529	2.735
Kerala	2.334	2.332
Madhya Pradesh	4.082	3.190
Maharashtra	2.892	3.651
Odisha	5.074	4.411
Punjab	2.325	1.913
Rajasthan	6.013	4.052
Tamil Nadu	4.679	3.060
Uttar Pradesh	3.128	2.466
West Bengal	2.322	1.215

Table 4: Pre and Post reform non-agricultural NSDP cyclical volatility (standard deviation) for Indian States using H-P filter

Table 5 presents the decadal H-P filtered non-agricultural NSDP cyclical volatility of Indian State. The table provides very similar results for the period 2001-2010 for most of the states covered in this study. Barring, Himachal Pradesh, Punjab and Tamil Nadu, volatility in non-agricultural NSDP had declined in all the 12 states in the period 2001-10 compared to 1991-00. In Himachal Pradesh the volatility had remained same and in Punjab and Tamil Nadu the volatility had increased in the period 2001-10 compared to 1991-2010.

States	1961-1970	1971-1980	1981-1990	1991-2000	2001-2010
Andhra Pradesh	1.831	2.390	3.556	3.728	1.325
Bihar	4.699	3.361	3.755	7.406	3.228
Gujarat	1.909	3.199	5.043	7.633	2.653
Haryana	-	4.425	4.741	2.611	2.055
Himachal Pradesh	-	2.686	3.572	3.520	2.533
Karnataka	1.927	2.699	2.474	3.112	2.456
Kerala	3.066	1.920	2.792	3.110	1.328
Madhya Pradesh	4.266	4.183	4.190	4.040	2.271
Maharashtra	1.072	2.231	3.539	4.616	2.589
Odisha	-	3.627	6.412	5.289	3.584
Punjab	-	3.140	1.227	1.887	2.036
Rajasthan	2.945	6.576	5.654	4.949	3.153
Tamil Nadu	1.317	5.445	3.942	3.062	3.215
Uttar Pradesh	3.200	3.158	3.228	3.437	0.984
West Bengal	2.785	2.892	1.734	1.476	0.968

Table 5: Decadal non-agricultural NSDP cyclical volatility (standard deviation) of Indian State using H-P filter

In the appendix we have presented the results of H-P filtered trend and cycles for all the 15 States. These results suggest that the growth trend of non-agricultural GDP for Bihar, Madhya Pradesh, Uttar Pradesh and West Bengal is clearly on an upward trend in

the year 2010-11. On the other hand growth trend in Andhra Pradesh, Himachal Pradesh, Karnataka, Maharashtra, Odisha, Punjab, Rajasthan and Tamil Nadu had turned down in the recent years. The business cycle is also in the downward phase for most of the States considered in this study.

5. Conclusion

Using the data of national output and sub-national output growth rate this study shows that the cyclical volatility increased in the national business cycle in 1990s compared to 1980s and this phenomenon was widely reflected in regional business cycle. However, the volatility had considerably come down in the first decade of twenty-first century in the national business cycle and again this was widely reflected in the states business cycles. Moreover, the volatility in national and sub-national business cycle cannot be segregated on the basis of pre and post liberalization period due to its varying nature in the post independence period. We do not find support for the argument given by Ghate et al.(2011) that the business cycle volatility in the post liberalization period came down due to fall in agricultural GDP volatility. We argue that the volatility in India's GDP came down in the period 2001-10 mainly due to fall in volatility in non-agricultural GDP. We also argue that the Patnaik and Sharma (2002) claim of existence of monsoon cycle before the pre liberalization period and more conventional business cycles evolved in the post reform period has also little relevance.

6. References

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Appendix

