Entrepreneurial Impulse, Investment Behavior, and Economic Fluctuations–A VAR Analysis with Indian Data

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This study analyzes the observed behavior of growth cycles and the dynamics of economic fluctuations in terms of entrepreneurial impulse with Indian macroeconomic time series data for more than 60 years. The fluctuations of investment are explained in terms of persistence, volatility, and comovements of the cyclical components. The study observes that the growth cycles of private investment were much more volatile than the growth cycles of public investment and gross domestic product. Investments in India were procyclical, but their growth cycles became acyclical. This study observes that the fluctuations of growth cycle frequencies of private investment appeared even when there were no shocks to gross domestic product. Such investment behavior may be because of the self-fulfilling beliefs of investors. Private investment in India has not been badly affected by the severe balance of payments crises. Rather, a cyclical downturn was seen as an opportunity to invest by the large business houses.

Keywords: animal spirits, growth cycles, Indian economy, time series decomposition
JEL codes: C32, E32, N10

I. Introduction

This study analyzes the observed behavior of investment and output dynamics in explaining growth cycles in India. The existence of highly volatile and persistent cycles affecting overall economic activity is an inherent feature of a market-based modern economy. A large number of competing theoretical models provide the essential causes for economic fluctuations, but there has been a discrepancy between them in explaining what actually happens in the real world. The empirical literature on business cycles has indeed shown that, at the aggregate level, investment is considerably more volatile than output, and fluctuations of both output and investment are highly synchronized. Furthermore, at the micro level, firms' investment behavior appears to be lumpy and strongly affected by a firm's financial structure. Whether

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the growth cycles follow optimal responses by rational agents to erratic changes in technology, or the cycles are influenced by the "animal spirits" of investors is an important issue in the context of recent financial crises and economic slowdowns that have appeared in both the developed and the developing world. If economic fluctuations are really guided by the outcome of Arrow–Debreu types of general equilibrium models, then allocations will be Pareto optimal and there will be no cause of concern, at least from regulators' point of view. But if growth cycles are independent of market fundamentals, then there may be an important role for policy makers in designing regimes that can reduce fluctuations and increase economic welfare.

John Maynard Keynes' animal spirits explanations were used globally to look into the behavior of economic fluctuations until the late 1970s. Subsequently, it was thought that the animal spirits hypothesis, like sunspots, appeared as a theoretical curiosity that did not have much to add to modern theories of the business cycle based on the rational expectations hypotheses. However, some scholars, particularly the post-Keynesians, believe that crises, in the form of a severe cyclical downturn in the advanced capitalist world such as the recent global financial crisis, occur because the expectations of economic agents, particularly the entrepreneur, are guided not by rationality alone. Farmer and Guo (1994) observed that fluctuations in business cycle frequencies appeared in the United States' (US) economy not by the shocks to the fundamentals of the economy, but by the self-fulfilling beliefs of investors. Investors become overly optimistic as the economy grows, but disappointed when profits fall short of their inflated forecasts. In fact, because of this kind of entrepreneurial behavior, every expansion sows the seeds of recession. In the process of fluctuations, while the upswing is slow and steady, the collapse is sudden and steep (Harvey 2010).

Against this backdrop, the objective of this paper is to analyze the dynamics of economic fluctuations in terms of entrepreneurial impulse with Indian macroeconomic time series data for more than 60 years. The theoretical background of the study relies primarily on Chapters 12 and 22 of Keynes' *The General Theory of Employment, Interest, and Money*. During the Great Depression, Keynes attributed the business cycle to alternating waves of optimism and pessimism, which he termed animal spirits.[1] Keynes (1921), in *A Treatise on Probability*, argued that, as the rational quantitative calculation alone cannot justify action under uncertainty, investment becomes inadequate and the economy settles into collapse without animal spirits. The fluctuations in aggregate economic activity might be driven at least in part by the waves of optimism or pessimism, and not by "the outcome of a weighted average of quantitative benefits multiplied by quantitative probabilities."[2] According to Keynes (1936), the formation of entrepreneurial expectations on

[1] See Barens (2011) for detailed sources of Keynes' use of the term "animal spirits."

[2] Keynes, J. M. 1921. *A Treatise on Probability*. London: Macmillan.

investment in an uncertain environment depends largely on conventional judgments and animal spirits. He argued that, given fundamental uncertainty, rationality alone is insufficient to justify action. Animal spirits are neither rational nor irrational in indicating the psychological urge to action which explained decisions being taken in spite of uncertainty (Dow and Dow 2011). When there is no basis for rational belief, investment behavior is dictated by psychological motivations and nonrational forces. Reasons and evidence can provide only a partial justification for decisions.

The questions of how economic fluctuations and investment decisions are interrelated and how the animal spirits hypothesis is relevant in analyzing growth cycles have been extensively debated in the literature. Samuelson's (1939) multiplier-accelerator model and Harrod's (1939) business cycle model were accounted as contributions of the early Keynesian literature to this debate. Kalecki (1937) and Goodwin (1951) studied the endogenous formation of business cycles by bringing in the heterogeneity and distributional aspects. While the underlying theoretical model implied by Keynes has proven to be rather complex, many studies have attempted to assess the Keynesian belief in relation to the psychological factors (Azariadis 1981; Crotty 1992; Howitt and McAfee 1992; Lawson 1981, 1985; Robinson 1979; Shleifer 1986). Dequech (1999) examined how animal spirits influence both expectations and confidence by demonstrating that animal spirits are interrelated with cognition. In a dynamic setting, Kiyotaki (1988) and Weil (1989) explored the role of animal spirits in the formation of business cycles in the presence of investment externalities. The inherent interaction of financial markets and investment has caused a wave of new research (see, for example, Fazzari 1988, Fazzari and Petersen 1993). In such studies it is observed that limited access to finance, higher transactions costs, and asymmetric information adversely affect investment. The underlying close association of the fluctuations of internal finance, profits, and business cycles suggest that the cost of external credit increases during recessions. Again, in many cases, the investment behavior has been affected more by fiscal policy parameters than by the cost of capital (Fazzari 1993).

Most of the research in this area, however, is theoretical or quantitative in nature and based mainly on the developed industrial world. The relevance of animal spirits in understanding investment behavior and economic fluctuations in a developing economy like India has not been examined empirically as such by scholars. There has also been some research on business cycles with Indian data. For example, Hatekar (1994) studied the historical paths and comovements of annual time series data in the Indian economy for the period 1951–1985 after detrending the series. The Reserve Bank of India (2002), via the Working Group on Economic Indicators, examined business cycles in India with quarterly time series data of nonagricultural gross domestic product (GDP). The empirical analysis in our study is based on growth cycles of GDP, public investment, and private investment over the period 1950–2013.

This study sets out to provide empirical estimations of growth cycles of output and investments in India to look into the investment behavior of the economy by decomposing the observed time series of real GDP, total investment, and private investment into trend and cyclical components. Private investment in India has not been badly affected by the severe balance of payments crises. Rather, a cyclical downturn was seen as an opportunity to invest by the large business houses. This type of entrepreneurial decision can hopefully be analyzed with rising animal spirits. Keynes' fundamental insight that animal spirits play an important role in affecting investment decisions may be relevant in analyzing fluctuations in economic activities and investment behavior in India not only during the recent global financial crisis, but also during different phases of state control. In this paper, we examine the interrelations between waves of optimism and pessimism, and the subsequent economic fluctuations around the turning points.

The empirical work of this paper is based on Keynes' theory of trade cycles, where instability in investment has been the major cause of economic fluctuations. Keynesian theories of business cycles are inherently endogenous because animal spirits originate investment instability, which in turn causes output fluctuations. Following Keynes (1936) on trade cycles, we assume that inescapable market uncertainty and individual expectations play a key role in shaping investment dynamics and triggering fluctuations in overall economic activity. In this framework, agents, both firms and workers, are heterogeneous, rationally bounded, and endowed with adaptive expectations. As in the case of Dosi, Marengo, and Fagiolo (2004), agents interact in an endogenously changing environment characterized by substantial uncertainty. The microeconomic dynamics of production and investment induce macroeconomic dynamics for aggregate investment and output.

We have examined the stochastic behavior of growth cycles of the macroeconomic time series of output, private investment, and total investment in India from 1950 until 2013. The cyclical variation in investment is examined in terms of persistence, volatility, and comovements of the cycles of GDP. The fluctuations of GDP in real terms obviously indicate the overall economic fluctuations that may affect the behavior of aggregate investment. In our analysis, we have concentrated mainly on the reverse causality—that is, how growth cycles of investment are causally related to the growth cycles of output. According to the real business cycle hypothesis, the entrepreneur's impulse in taking investment decisions is affected by economic fluctuations. If the real business cycle hypothesis is actually effective in an economy, there is no role for animal spirits in analyzing investment behavior. However, self-fulfilling expectations may also be the driver of business cycles in the presence of expectational indeterminacy in investment in a real business cycle model. This study concentrates on the real sector of the economy to carry out an empirical exercise in investigating the growth cycles as observed in India in a partial equilibrium framework. We hypothesize that entrepreneurial activity toward investments is affected largely by some nonrational factors in given political, social, and economic situations. Entrepreneurs do not have access to a full information set and they are not capable of describing fully the statistical distribution of economic shocks, but they try to forecast by following adaptive types of expectations.

This paper observes that the fluctuations of growth cycle frequencies of private investment appeared even when there were no shocks to GDP, the major macroeconomic fundamental. This type of investment behavior may be because of the self-fulfilling beliefs of investors. The insignificant relationship between growth cycles of output and investment may imply the role of animal spirits in analyzing investment behavior of an economy, at least in a statistical sense. The paper is organized in the following manner. Section II describes the data. Section III analyzes the stochastic behavior of trend and growth cycles of GDP, public investment, and private investment in India. Volatility, persistence, and comovements of the growth cycles are investigated in Section IV. Section V deals with the dynamic relationship between the cycles of investment and GDP. Section VI concludes.

II. Data

The Central Statistical Office (CSO) of the Ministry of Statistics and Programme Implementation and the Reserve Bank of India are the sources of the data used in this study. The estimates of India's national income have been revised by the National Accounts Division of the CSO in preparing National Accounts Statistics (NAS) from time to time. Base years have been revised periodically by the CSO in the past, starting from 1948–1949. The 2004–2005 series widens the database for different sectors by the inclusion of several items not previously covered. GDP at constant 2004–2005 prices, the most important macroeconomic aggregate of national accounts, is used as an output variable. Real gross capital formation is taken as a proxy for investment. In NAS, gross capital formation has two components: gross fixed capital formation (GFCF) and change in stocks. GFCF is the gross value of goods that is added to the fixed domestic capital stock in a year. The change in stock is the difference between market values of the stocks at the beginning and end of the period. We have treated GFCF as total investment. NAS also provides GFCF by the household sector, the private corporate sector, and the public sector. We have used data for GFCF by the private corporate sector as private investment. All data used in this study are reproduced in the *Handbook of Statistics on Indian Economy, 2013*, published annually by the Reserve Bank of India.

III. Trend and Cycles of Outputs and Investments

Identification of trends and cycles of a macroeconomic variable is often an important empirical issue in macroeconomic analysis, particularly in analyzing growth behavior in an economy. Different methodologies have been suggested in the empirical literature in identifying business cycles or growth cycles. While the National Bureau of Economic Research methodology is simple to understand, we do not follow it in this study because the trend–cycle decomposition is needed to identify the importance of economic growth and productivity.[3] Moreover, empirical investigation of the behavior of fluctuations of the macroeconomic time series around its trend assumes significance in order to identify the possible sources of economic instability. We define the fluctuations of a variable around its trend as the growth cycle and it differs in stochastic character from the conventional business cycle as defined in the National Bureau of Economic Research literature. In most cases, however, growth cycles and business cycles are not distinguishable (Canova 1999).

It is very unlikely that any given type of linear deterministic trend would persist over long stretches of time. For this reason, the trend stationary approach to view growth and fluctuations as a sum of deterministic trends and stochastic cycles may not be a proper methodology. In the difference stationary process, trends are stochastic because of interactions with shorter fluctuations as well as structural breaks. They have no tendency to return to linear trends (Nelson and Plosser 1982). The components of stochastic trends are purely unpredictable and there is little to be done about the unpredictable shocks, their hypothetical long-term effects, and the stochastic variations in economic activity with this approach (Diebold and Rudebusch 1999).

The trending behavior has been examined by carrying out Augmented Dickey–Fuller (ADF) and Phillips–Perron (PP) unit root tests. Perron (1989) argued that the evidence in favor of unit roots has been overstated, as standard tests have low power against trend stationary alternatives with structural breaks in trend level or growth rate. He resolved this problem by modifying the ADF test with dummy variables to account for a single structural break. Zivot and Andrews (1992) extend this methodology to an endogenous estimation of the break date. In this study, a unit root test is performed after incorporating the major break, if any, in the series. Tables 1 and 2 display the break points estimated on the basis of the likelihood ratio test and estimated statistics for testing unit root, respectively.

A visual inspection of the data, as shown in Figure 1, shows that GDP, public investment, and private investment in India appear to have experienced growth with some short-run fluctuations as normally observed in any economy, but the growth of private investment contained severe fluctuations. The time series of GDP

[3]In the classical cycle approach, followed particularly in the studies of the National Bureau of Economic Research, the expansions and contractions in the level series could be analyzed without considering the trend adjustment process. But, the empirical studies conducted recently on business cycles provide serious attention to trend adjustment. The trend adjustments, however, reduce the variations of cyclical behavior both across series and within series over time (Burns and Mitchell 1946). In effect, the time series decomposition of macroeconomic variables associated with growth cycles is difficult because trends and cycles interact with and influence each other (Baxter and King 1999). A step function linking the average levels of a variable in successive business cycles was effectively the trend representation complementing the cyclical measures. This approach formalized the concept and estimation of the phase average trend for analyzing fluctuations in detrended variables.

Table 1. **Test Statistics for Structural Break**

Series	**Break Point**	**QLR Supremum Statistics**
GDP	2003	12.588
Growth cycle of GDP from HP filter	1964	12.535
Growth cycle of GDP from BK filter	1964	11.545
Private investment	2003	11.030
Growth cycle of private investment from HP filter	No break	
Growth cycle of private investment from BP filter	1959	31.154
Public investment	No break	
Growth cycle of public investment from HP filter	1961	13.159
Growth cycle of public investment from BP filter	1958	11.628

BK = Baxter–King, BP = band-pass, GDP = gross domestic product, HP = Hodrick–Prescott, QLR = Quandt Likelihood Ratio.
Source: Author's estimation with data from Reserve Bank of India. 2014. *Handbook of Statistics on Indian Economy*. Mumbai.

Table 2. **Estimated Statistics for Testing Unit Root**

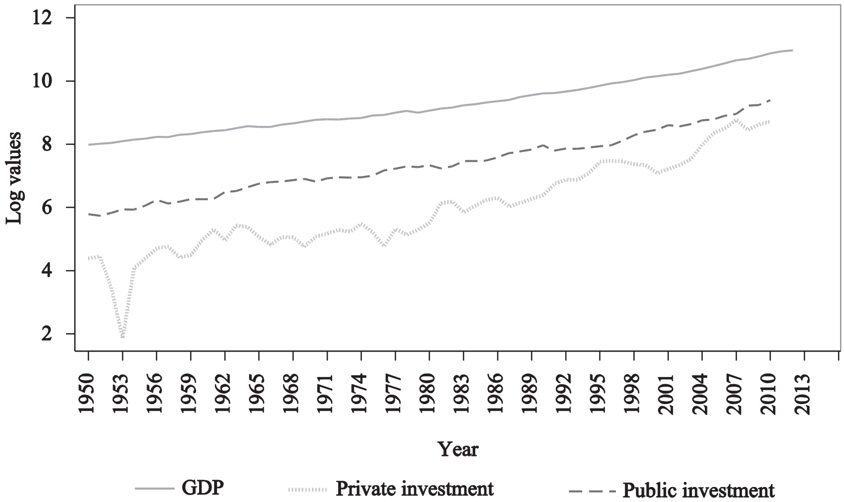
Series	**ADF Statistics**	**PP Statistics**
GDP	3.432	4.215
Δ GDP	−5.056	−7.463
Private investment	−0.519	−0.296
Δ Private investment	−7.685	−8.95
Public investment	1.054	1.291
Δ Public investment	−5.752	−8.865
Growth cycles from HP filter		
GDP	−7.174	−7.634
Private investment	−8.441	−7.722
Public investment	−6.51	−8.394
Growth cycles from BK filter		
GDP	−6.852	−7.84
Private investment	−6.818	−12.796
Public investment	−6.447	−7.75

BK = Baxter–King, GDP = gross domestic product, HP = Hodrick–Prescott.
Source: Author's estimation with data from Reserve Bank of India. 2014. *Handbook of Statistics on Indian Economy*. Mumbai.

and investments, both public and private, are integrated of order 1, implying the presence of a stochastic trend (Table 2). A major significant break appeared in the trends of both GDP and private investment in 2003, but there was no significant break in public investment during the period 1950–2013 (Table 1). The apparently observed smoothness in the time series typically hides severe cyclical turbulences affecting economic aggregates. If we isolate the cyclical components, output and investments exhibit a completely different pattern.

We decompose the time series of GDP, public investment, and private investment into a cyclical and a trend element by using Hodrick–Prescott (HP) filters

Figure 1. **Trends in GDP and Investments in India**



GDP = gross domestic product.
Note: All variables are in logarithmic form.
Source: Author's estimation with data from Reserve Bank of India. 2014. *Handbook of Statistics on Indian Economy*. Mumbai.

(Hodrick and Prescott 1997) and the Baxter–King (BK) version of a band-pass filter (Baxter and King 1999).

A seasonally adjusted time series can be viewed as the sum of a trend component (y_t^g) and a cyclical component (y_t^c):

$$y_t = y_t^g + y_t^c \tag{1}$$

The deviation from trend of a time series is commonly referred to as the growth cycle component. The HP filter removes a smooth trend (y_t^g) from a time series y_t by solving the following minimization problem:

$$\min \sum_{t-1}^{T} \{(y_t - y_t^g)^2 + \lambda((y_t^g - y_{t-1}^g) - (y_{t-1}^g - y_{t-2}^g))^2\}, \text{ with respect to } y_t^g$$

The first component is the squared cyclical part and the second is the squared second difference of the trend component. The sum of the second part is exactly zero for a linear trend, but differs from zero if the slope of the flexible trend is not constant. The weight λ is used to adjust the relative importance of these two criteria. The larger is λ, the more tightly the HP trend will be constrained to be linear. The smaller the value of λ, the more fluctuations will be admitted into the trend. If $\lambda = 0$, then we would minimize only the first summation and would do so by setting

$y_t = y_t^g$ for all t. The trend series is just the series itself and there is no linear trend in the traditional sense at all. The other extreme, $\lambda \to \infty$, implies that the linearity constraint becomes perfectly binding. In this case, the HP trend is identical to the linear trend estimated with a standard regression. For intermediate values of λ, we get a trend series that is, in smoothness, somewhere between the perfectly smooth linear trend and the perfectly unsmooth series itself. As annual data are used in this study, we have chosen the value of $\lambda = 100$.[4]

The HP filter removes unit root components from the data. Further, the filter is symmetric, so there is no phase shift. The cyclical component of the HP filter places zero weight on the zero frequency (King and Rebelo 1993). The HP filter allows only the components of stochastic cycles at or above a specified frequency to pass through, and removes the components corresponding to the lower-frequency stochastic cycles. The BK version of the band-pass filter is also a symmetric approximation, with no phase shifts in the resulting filtered series. It allows the components in the specified range of frequencies (6 to 32 quarters) to pass through and eliminates all the other components. The BK filter provides stationary cycles by carrying out moving averages based on 3 years of past data and 3 years of future data as well as the current observation if the underlying time series is integrated of order 1 or 2:[5]

$$y_t^* = \sum_{k=-K}^{K} a_k y_{t-k}, \quad with \quad \sum_{k=-K}^{K} a_k = 0 \tag{2}$$

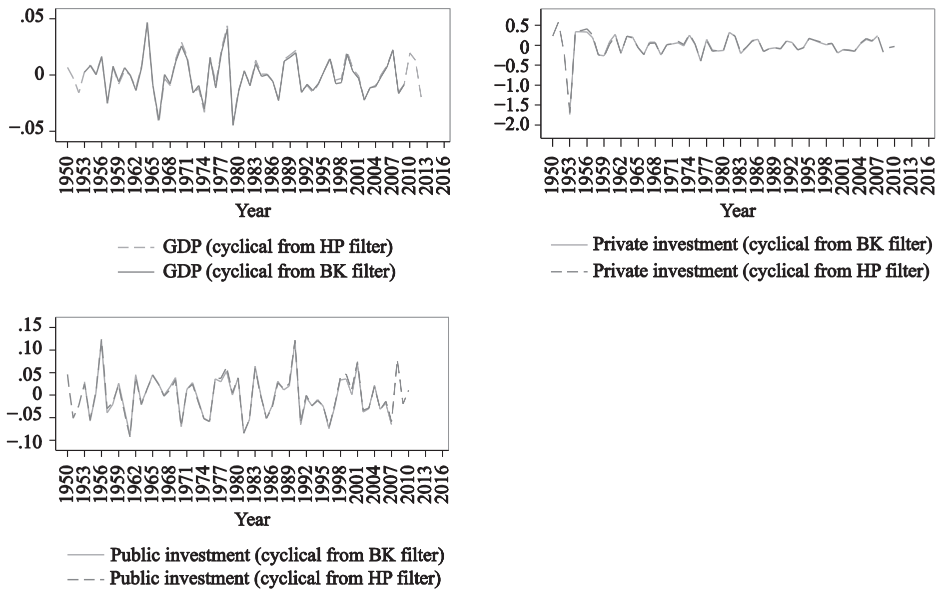
The Indian economy frequently exhibited significant cyclical variations of distinct pattern and origin comprising a boom and a recession. Figure 2 presents the HP-filtered and BK-filtered cycles of real GDP, public investment, and private investment. There is a very close correspondence between the growth cycles isolated by the HP filter and those generated by the BK filter. In this study, the HP filter is a reasonable approximation of the BK filter. There was a significant break in the growth cycles of GDP (obtained from both the HP and BK filters) in 1964. The HP cycle of public investment exhibited a major break in 1961, while the major break in the BK cycle appeared in 1958. In the case of private investment, the BK cycle experienced a break in 1959 and there was no significant break in the HP cycle. The estimated statistics as shown in Table 2 suggest that the growth cycles of GDP and investments, both public and private, and obtained either from the HP or BK filter, are integrated of order 0 as expected.

Volatility in GDP was higher during the period between the mid-1960s and late 1970s. The rate of volatility, however, declined beginning in the early 1980s.

[4]Hodrick and Prescott recommend choosing $\lambda = 1{,}600$ for quarterly series and argue that the value of λ should vary with the square of the frequency of the series. This implies a λ of 100 for annual data and 14,400 for monthly data.

[5]See Baxter and King (1999) for detail.

Figure 2. **Growth Cycles of GDP and Investment**



BK = Baxter–King, GDP = gross domestic product, HP = Hodrick–Prescott.
Source: Author's estimation with data from Reserve Bank of India. 2014. *Handbook of Statistics on Indian Economy*. Mumbai.

The growth cycles identified during the 1990s were less erratic over time (Figure 2). The growth cycles of both public investment and private investment were more volatile than those of output, but private investment was even more volatile than public investment. The volatility of investment cycles was even more explosive during the 1950s, and these cycles were highly erratic after the 1990s as well.

Declines in public investment in India were severely deep in 1962, 1981, 1997, and 2008. Cyclical phases of investment and output were grossly mismatched, violating the classical observations on business cycles. Private investment in India was more erratic than public investment. The cyclical variation of private investment was more frequent than those of output and public investment. There was no synchronization between the growth cycles of private investment and output. We have shown below that the path of cycles of private investment did not follow the cyclical path of output at all. This reflects a gross violation of the stylized facts of advanced industrial economies supported mostly by the real business cycle hypothesis.

The growth cycles of investments and output as described above are highly mismatched and exhibit very different patterns in every cyclical phase. We have shown below that the cyclical movement of investments did not follow the cycles of output. The share of public investment was significantly dominating before the 1990s. Moreover, during the regime of state control prior to the 1990s the government owned roughly half of the economy's productive capacity. Indian recessions in that phase were mainly triggered by bad monsoons, along with social and political factors that cannot be predicted fully by market fundamentals. Since the early 1990s, however, the free market has come to dominate the economy. During this phase, particularly after 2003–2004, the share of private investment was more than public investment, largely because of the absolute fall in public investment after the initiation of economic reforms, and the cycles appeared in this phase can be explained mostly, at least theoretically, by market fundamentals.

We perform ADF and PP unit root tests for the observed series of public investment, private investment, and GDP, and their growth cycles obtained by detrending with HP and BK filters. The choice of lag length is crucial in performing unit root test to determine the order of integration; the number of lags used in the ADF regressions has been selected by the Akaike Information Criterion.[6] The estimated test statistics are shown in Table 2. As for most of the macroeconomic time series, the output and investments contain unit root, implying the presence of a stochastic trend that is completely unobservable (Das 2007).[7] The ADF and PP statistics as shown in Table 2 suggest that all the original series are integrated of order 1. The presence of unit roots in the original data series has serious macroeconomic policy implications. Any external shock from economic reforms, for example, could have a permanent effect (either positive or negative) on real output and investment. On the other hand, the growth cycles are stationary. The hypothesis that the presence of unit roots is rejected for the growth cycles both in terms of ADF and PP statistics.

IV. Volatility and Persistence of Growth Cycles

This section focuses on the variance and covariance properties of growth cycles. In this study, the standard deviation measures the extent of volatility of the different growth cycles with a 95% confidence interval, while the covariance component captures the persistence of the cycles. The analysis of the covariance and autocorrelation structure of the original series, as well as their cyclical components, allows us to single out some stylized facts that seem to represent investment patterns at the macro level in the Indian economy. The standard deviation and correlation measures of the original series and the growth cycles from HP filter are shown in Table 3.[8] Both public investment and private investment were more volatile than GDP, but private investment exhibited significantly higher volatility than public investment. The volatility of the cyclical components was significantly lower than

[6]See Akaike, H. 1969. Fitting Autoregressive Models for Prediction. *Annals of the Institute of Statistical Mathematics.* 21 (1). pp. 243–47.

[7]Nelson and Plosser (1982) observed first by applying ADF test with US 14 macroeconomic time series that most of the macroeconomic time series contain unit root.

[8]As the growth cycles from the HP filter are highly synchronized with those from the BK filter, we have used only cycles from the HP filter to analyze the cyclical behavior of the Indian economy.

Table 3. **Estimated Statistics of Growth Cycles, 1950–2013**

Variables	Standard Deviation	Relative Standard Deviation	First Order Autocorrelation	Contemporaneous Correlation with GDP
GDP	0.86	1	0.95	1
Public investment	1.21	1.41	0.93	0.96
Private investment	1.43	1.66	0.91	0.95
HP cycles				
GDP	0.02	1	0.02	1
Public investment	0.05	2.5	0.21	0.36
Private investment	0.29	14.5	−0.06	0.09

GDP = gross domestic product, HP = Hodrick–Prescott.
Source: Author's estimation with data from Reserve Bank of India. 2014. *Handbook of Statistics on Indian Economy*. Mumbai.

the volatility in the original series for obvious reasons. However, the growth cycles of private investment were much more volatile than the growth cycles of public investment and the growth cycles of output. This stylized fact is roughly similar to those observed in advanced industrialized economies, supporting the hypothesis of classical business cycle theory.

An autocorrelation structure of the series allows us to single out the persistence of the stochastic character in the macroeconomic cycles. The persistence indicates the inertia in growth cycles and captures the length of observed fluctuations. To explain statistically the persistence of the growth cycles, we have examined the pattern of the autocorrelation function of the original as well as the detrended series of GDP, public investment, and private investment. Higher autocorrelation implies a longer cycle. A positive autocorrelation coefficient indicates that higher cycles will induce higher ones (and vice versa), while a negative coefficient indicates that higher cycles will be followed by lower ones (and vice versa).

The large and positive values of the first order autocorrelation coefficient of the original time series indicate the persistence of the behavior of the series of GDP and investments. But, the degree of persistence was very low for the growth cycles (Table 3). For private investment, the first order autocorrelation coefficient was negative, implying that a lower cycle in the current period induced a larger cycle in the subsequent period (and vice versa). The contemporaneous correlation between the series is a rough measure of comovement, or degree of synchronization, between them. While the correlation coefficients between public investment and GDP and between private investment and GDP were positive and very high, the correlation between growth cycles of GDP and public investment was very low and the correlation coefficient between growth cycles of GDP and private investment was nearly equal to zero. Thus, investments in terms of the original series were procyclical, but they became acyclical after detrending the series. This stylized fact, as observed from the original series in India, follows the classical business cycle

Table 4. **Estimated Relationship between Growth Cycles of Public Investment and Output**

Variables	Coefficient	z-statistic	P>z
Y^c	0.37	1.03	0.302
Constant	−0.0001	−0.02	0.984
ARMA			
AR1	−0.19	−0.60	0.551
Σ	0.04	10.79	0

ARMA = autoregressive moving average.
Source: Author's estimation with data from Reserve Bank of India. 2014. *Handbook of Statistics on Indian Economy*. Mumbai.

theory. Traditionally, business cycle fluctuations of investment and output are highly synchronized and exhibit very similar patterns (Stock and Watson 1999). But the cyclical behavior of investment and output as observed in this study has not been supported by the classical business cycle hypothesis.

V. Dynamics of Growth Cycles

In terms of the autocorrelation function, we measure the persistence of the growth cycles. A high autocorrelation coefficient implies a very persistent economic fluctuation. We examine, here, the relation between the cyclicality of real GDP and investments. We have estimated separately the relationship between the growth cycles of private investment and GDP, and between the cycles of public investment and GDP in a dynamic frame. We also carry out vector autoregressive (VAR) analysis to locate the direction of causality, if any between the cycles.

The econometric model for estimating the relationship is specified as

$$\ln I^c_{T,t} = \phi_{01} + \phi_{11} \ln y^c_{t-1} + u_{1t}$$

$$\ln I^c_{P,t} = \phi_{02} + \phi_{12} \ln y^c_{t-1} + u_{2t} \quad (3)$$

$I^c_{T,t}$, $I^c_{P,t}$, *and* y^c_t present the cyclical components of public investment, private investment, and output (or GDP) in period t, respectively, and u_{it} is the white-noise error.

As the order of integration of the observed series of investments and output is the same, they may be cointegrated. However, we are interested in the dynamic relation between the growth cycles of investments and output. As the growth cycles are stationary, we can estimate the relationship between the cycles of public investment and GDP, and between the cycles of private investment and GDP in an autoregressive moving-average (1, 0) structure. The relationships are specified in Equation (3) and the estimated results are shown in Tables 4 and 5. The cycles of

Table 5. **Estimated Relationship between Growth Cycles of Private Investment and Output**

Variables	Coefficient	z-statistic	P>z
Y^c	1.59	0.44	0.663
Constant	−0.0001	−0.12	0.998
ARMA			
AR1	0.03	0.24	0.811
Σ	0.29	23.24	0

ARMA = autoregressive moving average.
Source: Author's estimation with data from Reserve Bank of India. 2014. *Handbook of Statistics on Indian Economy*. Mumbai.

Table 6. **Estimated Coefficient of VAR Model**

	I_P^c	I_T^c	Y^c
Constant	−0.01	−0.001	0.00
I^c_{Pt-1}	0.06	0.01	−0.01
I^c_{Tt-1}	0.82	−0.07	−0.04
Y^c_{t-1}	1.12	0.42	0.04
R^2	0.02	0.04	0.02
χ^2	1.14	2.75	0.99
$P> \chi^2$	0.69	0.43	0.80

VAR = vector autoregressive.
Note: The estimated coefficients are not statistically significant.
Source: Author's estimation with data from Reserve Bank of India. 2014. *Handbook of Statistics on Indian Economy*. Mumbai.

both public investment and private investment are not related significantly to that of GDP. The AR1 coefficients are also statistically insignificant. Thus, the cyclical movement of investments did not follow the cycles of GDP supporting the fact that investment in India, both public and private, had not been badly affected by the cyclical downturn of the economy. Thus, investments in the Indian economy might not be determined fully by the rational actions of the entrepreneurs but by the animal spirits, at least partly.

We also estimate the following VAR model to look at the dynamics and the direction of causality, if any, between the growth cycles of investments and output:

$$\ln I^c_{T,t} = \alpha_{01} + \beta_{11} \ln I^c_{T,t-1} + \beta_{12} \ln I^c_{P,t-1} + \beta_{13} \ln y^c_{t-1} + \varepsilon_{1t}$$

$$\ln I^c_{P,t} = \alpha_{01} + \beta_{21} \ln I^c_{T,t-1} + \beta_{22} \ln I^c_{P,t-1} + \beta_{32} \ln y^c_{t-1} + \varepsilon_{2t}$$

$$\ln y^c_t = \alpha_{03} + \beta_{31} \ln I^c_{T,t-1} + \beta_{32} \ln I^c_{P,t-1} + \beta_{33} \ln y^c_{t-1} + \varepsilon_{3t} \quad (4)$$

The VAR structure has been specified in Equation (4) and the estimated results are displayed in Table 6. The estimated coefficients are statistically insignificant in every equation. We do not have causality in either direction. Neither the growth cycle of public investment nor the growth cycle of output have had a significant effect on the growth cycle of private investment. The estimated figures shown in the lower panel of Table 6 also suggest there is not a significant relationship between them.

VI. Conclusions

This study attempts to look into the behavior of growth cycles of private investment in India in terms of the entrepreneurial impulse. Animal spirits, in Keynes' view, characterize the entrepreneur's decision to undertake investments in the absence of sufficient information to gauge the probability of success. Keynes' fundamental insight that animal spirits play an important role in affecting investment decisions may be relevant in analyzing fluctuations in output and investment in India not only during the recent global financial crisis, but also during different phases of state control. In India, private investment has exhibited significantly higher volatility than output. This finding in our study is roughly similar to observations in advanced industrialized economies. For private investment, lower cycles in the current period induced larger cycle in the subsequent period (and vice versa). Investments were procyclical, but after detrending, the series investments became acyclical. The cyclical pattern of investment in India did not follow the classical business cycle hypothesis. The growth cycles of private investment and output as observed in this study are not similar and exhibit very different patterns in every cyclical phase. It is evident that the cyclical movement of private investment did not follow the cycles of output. The fluctuations at growth cycle frequencies of private investment appeared even when there were no shocks to GDP. These fluctuations in private investment may be due to the self-fulfilling beliefs of investors.

References

Akaike, H. 1969. Fitting Autoregressive Models for Prediction. *Annals of the Institute of Statistical Mathematics*. 21 (1). pp. 243–47.

Azariadis, C. 1981. Self-Fulfilling Prophecies. *Journal of Economic Theory.* 25 (3). pp. 380–96.

Barens, I. 2011. Animal Spirits in John Maynard Keynes's General Theory of Employment, Interest, and Money—Some Short and Sceptical Remarks. Discussion Papers in Economics (201). Darmstadt, Germany: Darmstadt University of Technology.

Baxter, M. and R. G. King. 1999. Measuring Business Cycles: Approximate Band-Pass Filters for Economic Time Series. *Review of Economics and Statistics.* 81 (4). pp. 575–93.

Burns, A. F. and W. C. Mitchell. 1946. *Measuring Business Cycles.* New York: National Bureau of Economic Research.

Canova, F. 1999. Does Detrending Matter for the Determination of the Reference Cycle and the Selection of Turning Points? *Economic Journal.* 109 (2). pp. 126–50.

Crotty, J. R. 1992. Neo-Classical and Keynesian Approaches to the Theory of Investment. *Journal of Post Keynesian Economics.* 14 (4). pp. 483–96.

Das, P. 2007. Economic Growth and Structural Break in India: Testing Unit Root Hypothesis. *The Journal of Income and Wealth.* 29 (2). pp. 29–43.

Dequech, D. 1999. Expectations and Confidence under Uncertainty. *Journal of Post Keynesian Economics.* 21 (3). pp. 415–30.

Diebold, F. X. and G. D. Rudebusch. 1999. *Business Cycles: Durations, Dynamics, and Forecasting*. Princeton, NJ: Princeton University Press.

Dosi, G., L. Marengo, and G. Fagiolo. 2004. Learning in Evolutionary Environment. In K. Dopfer, ed. *Evolutionary Principles of Economics*. Cambridge, UK: Cambridge University Press.

Dow, A. and S. C. Dow. 2011. Animal Spirits Revisited. *Capitalism and Society.* 6 (2). pp. 1–23.

Farmer, R. E. A. and J. T. Guo. 1994. Real Business Cycles and Animal Spirits Hypothesis. *Journal of Economic Theory.* 63 (1). pp. 42–72.

Fazzari, S. 1988. Financing Constraints and Corporate Investment. *Brooking Papers on Economic Activity.* 19 (1). pp. 141–95.

——. 1993. Investment and US Fiscal Policy in the 1990s. Public Policy Brief No. 9. Annandale-on-Hudson, NY: Jerome Levy Economics Institute.

Fazzari, S. and B. Petersen 1993. Working Capital and Fixed Investment: New Evidence on Financing Constraints. *Rand Journal of Economics.* 24 (3). pp. 328–42.

Goodwin, R. 1951. The Non-Linear Accelerator and the Persistence of Business Cycles. *Econometrica.* 19 (1). pp. 1–17.

Harrod, R. 1939. An Essay on Dynamic Economic Theory. *Economic Journal.* 49 (193). pp. 14–33.

Harvey, J. T. 2010. Keynes' Business Cycle: Animal Spirits and Crisis. Working Paper No. 1003. Fort Worth, TX: Department of Economics, Texas Christian University.

Hatekar, N. 1994. Historical Behaviour of the Business Cycles in India: Some Stylized Facts for 1951–85. *Journal of Indian School of Political Economy.* 6 (4). pp. 684–706.

Hodrick, R. J. and E. C. Prescott. 1997. Postwar US Business Cycles: An Empirical Investigation. *Journal of Money, Credit, and Banking.* 29 (1). pp. 1–16.

Howitt, P. and R. P. McAfee. 1992. Animal Spirits. *American Economic Review.* 82 (3). pp. 491–507.

Kalecki, M. 1937. A Theory of the Business Cycle. *Review of Economic Studies.* 4 (2). pp. 77–97.

Keynes, J. M. 1921. *A Treatise on Probability*. London: Macmillan.

——. 1936. *The General Theory of Employment, Interest and Money*. London: Macmillan.

King, R. G. and S. T. Rebelo. 1993. Low Frequency Filtering and Real Business Cycles. *Journal of Economic Dynamics and Control.* 17 (1–2). pp. 207–31.

Kiyotaki, N. 1988. Multiple Expectational Equilibria under Monopolistic Competition. *Quarterly Journal of Economics.* 103 (4). pp. 695–714.

Lawson, T. 1981. Keynesian Model Building and Rational Expectations Critique. *Cambridge Journal of Economics.* 5 (4). pp. 311–26.

——. 1985. Uncertainty and Economic Analysis. *Economic Journal.* 95 (380). pp. 902–27.

Nelson, C. R. and C. I. Plosser. 1982. Trends and Random Walks in Macroeconomic Time Series: Some Evidence and Implications. *Journal of Monetary Economics.* 10 (2). pp. 139–62.

Perron, P. 1989. The Great Crash, the Oil Price Shock and the Unit Root Hypothesis. *Econometrica.* 57 (6). pp. 1361–1401.

Reserve Bank of India. 2002. *Report of the Working Group on Economic Indicators*. Mumbai.

——. 2014. *Handbook of Statistics on Indian Economy*. Mumbai.

Robinson, J. 1979. What Has Become of the Keynesian Revolution? In *Collected Economic Papers*, Volume 5. Oxford: Basil Blackwell.

Samuelson, P. 1939. A Synthesis of the Principle of Acceleration and the Multiplier. *Journal of Political Economy.* 47 (6). pp. 786–97.

Shleifer, A. 1986. Implementation Cycles. *Journal of Political Economy.* 94 (6). pp. 1163–90.

Stock, J. and M. Watson. 1999. Business Cycle Fluctuations in US Macroeconomic Time Series. In J. Taylor and M. Woodford, eds. *Handbook of Macroeconomics*. Amsterdam: Elsevier Science.

Weil, P. 1989. Increasing Returns and Animal Spirits. *The American Economic Review.* 79 (4). pp. 889–94.

Zivot, E. and D. W. K. Andrews. 1992. Further Evidence on the Great Crash, the Oil Price Shock, and the Unit Root Hypothesis. *Journal of Business and Economic Statistics.* 10 (3). pp. 251–70.