

Cycle and reform: Stylised facts for India

Chetan Ghate, Radhika Pandey and Ila Patnaik

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Motivation I

- To present stylised facts for business cycles in India.
- A substantial literature exists on stylised facts for developed economies. Kydland and Prescott (1990), Stock and Watson (1999), King and Rebelo (1999).
- Recently a number of papers have focussed on stylised facts for developing economies. Agenor et al. (2000), Rand and Tarp (2002), Aguiar and Gopinath (2007), Male (2010).
- Contributes to the existing literature on the business cycle stylised facts for developing economies.
- To our knowledge, this is the first paper to exclusively deal with the Indian business cycle stylised facts.

Motivation II

- The Indian policy environment changed in 1991.
- The economy changed from a largely planned, agricultural, closed economy to a market determined, industrial and increasingly globalised economy.
- The question: How did the nature of Indian business cycles change after liberalisation?
- The existing literature does not document this change.
- Contribution: To provide evidence on the changing nature of Indian business cycles.

Part I

Data

The data set

- The analysis of stylised facts rely on long time series of quarterly data.
- We have only 11 years of quarterly data.
- To understand the changing nature of Indian business cycles, we examine both quarterly and annual data.
- Choice of key variables constrained by data availability.
- Following King and Rebelo (1999) we choose private consumption and investment.
- In addition, we examine exports, imports, consumer prices (CPI-IW) and government expenditure.
- We do not have data on hours worked, real wage rate and total factor productivity.

The data set: For quarterly data analysis

- Data is taken from 1999 Q2 to 2010 Q2.
- All the variables except consumer prices and government expenditure are expressed at constant prices with base 2004.
- Government expenditure is expressed in real terms by deflating with GDP deflator.
- GDP is considered as a proxy for the aggregate business cycle.
- Following the literature on developing economies, we also use GDP (excluding agriculture) and IIP as a measure of aggregate business cycle activity for the quarterly data analysis

Part II

Methodology

Growth cycle approach

- Seasonal adjustment using X-12-ARIMA seasonal adjustment program.
- The log transformed series is filtered through the Hodrick-Prescott filter to extract the cyclical (stationary) and trend (non-stationary) component.
- The cyclical component of the series is used to derive the business cycle characteristics of volatility, persistence and cross-correlation.

Developed and developing economies business cycles: Are they different?

Developed economies

Output is less volatile

Consumption is less volatile than output.

Investment is volatile

Government expenditure is counter-cyclical

Consumer prices are counter-cyclical

Investment is procyclical

Imports are procyclical

Developing economies

Output is more volatile.

Consumption is more volatile than output.

Investment is volatile.

No consistent relation

No consistent relation

Investment correlation is weak.

Imports correlation is weak.

Part III

The Indian business cycle

Business cycle statistics for the Indian economy using quarterly data (1999 Q2- 2010 Q2)

	Standard deviation	Relative standard deviation	Contemp. correlation	Persistence
Real GDP	1.18	1.00	1.00	0.73
Private Consumption	1.54	1.31	0.51	0.69
Investment	4.08	3.43	0.69	0.80
CPI	1.30	1.09	-0.29	0.70
Exports	8.79	7.40	0.31	0.77
Imports	8.93	7.52	0.45	0.54
Govt expenditure	6.69	5.53	-0.35	0.005

Features of Indian business cycle: Volatility

- Private consumption is more volatile than output similar to developing economies (Rand and Tarp, 2002, Neumeyer and Perry, 2005, Male, 2010).
- Consumer prices are more volatile than output similar to the findings for developing economies (Agenor et. al)
- These findings are sensitive to the choice of the de-trending procedure.
- Investment volatility is similar to that of developed and developing economies.
- Exports and imports exhibit significant volatilities similar to the findings for developed and developing economies.
- Government expenditure is highly volatile (Agenor et al.).

Features of Indian business cycle: Co-movement

- Investment is significantly procyclical. This feature makes the Indian business cycle closer to those of advanced economies.
- Imports are significantly procyclical, similar to the findings for developed economies.
- For developed economies, while the relation of exports with output is not significant; imports are found to be highly pro-cyclical (Stock and Watson, 1999).
- Negative correlation between consumer prices and output. This is similar to the findings on India by Agenor et al., 2000 and Male, 2010.
- The negative relation is consistent with the findings for developed economies (Stock and Watson, 1999).
- Government expenditure is counter-cyclical. This feature shows evidence of resemblance of Indian business cycles with those of developed economies.

Features of Indian business cycle: Persistence

- Persistence of GDP and non-agricultural GDP similar to those for developed economies and greater than those for developing economies (Male, 2010; Agenor et al.)
- Persistence of consumer prices are also comparable to those of developed economies (Male, 2010; Agenor et al.)

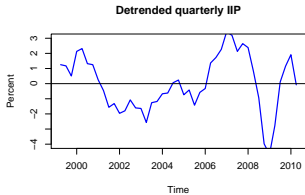
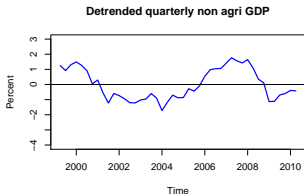
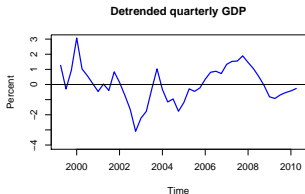
Part IV

Sensitivity analysis

Two sensitivity tests

- Redefining key variables: Do the business cycle stylised facts change when GDP (excl. agriculture) and IIP are taken as the reference variables?
- Different de-trending procedure: Are the features of Indian business cycle robust to the choice of de-trending procedure?

Three key variables: GDP, GDP (excl. agriculture) and IIP



Business cycle statistics with quarterly data (1999 Q2-2010 Q2) using non-agricultural GDP and IIP as the reference series

	GDP (excl.agriculture)		IIP	
	Rel. std. dev.	Cont. cor.	Rel. std. dev.	Cont. cor.
Pvt. Cons.	1.51	0.43	0.83	0.11
Investment	3.99	0.81	2.21	0.64
CPI	1.27	-0.38	0.70	-0.05
Exports	8.60	0.55	4.77	0.39
Imports	8.74	0.54	4.85	0.24
Govt expenditure	6.65	-0.35	3.63	-0.40

Business cycle features with GDP (excl. agriculture) as the reference variable

- GDP (excl.agriculture) is less volatile and more persistent than GDP.
- Investment is highly procyclical.
- The procyclicality of exports and imports is significant.
- Consumer prices and government expenditure are counter-cyclical.

Business cycle features with IIP as the reference variable

- Of the three reference variable, IIP is the most volatile.
- In contrast to the findings for the other two reference variables, the volatility of private consumption and consumer prices is lower than IIP.
- Consistent with the findings with GDP and GDP (excl.agriculture), investment, exports, imports and government expenditure have a relative volatility greater than 1.
- The contemporaneous correlation between private consumption and IIP is low.

De-trending methods

- Two different de-trending methods: Baxter-King and Christiano-Fitzgerald filter are used to check the robustness of results.
- Baxter and King (1999) have designed a band pass filter which eliminates very slow moving trend components and very high frequency components while retaining the intermediate business cycle fluctuations.
- The Christiano-Fitzgerald filter is another approximation to the band-pass filter.
- In line with the conventional definition, we define business cycle fluctuations as those ranging between eight to forty quarters.

Business cycle features for quarterly data using Baxter-King filter

	Standard deviation	Relative standard deviation	Contemp. correlation	Persistence
Real GDP	0.97	1.00	1.00	0.82
Private Consumption	0.72	0.74	0.55	0.70
Investment	2.93	3.01	0.81	0.84
CPI	0.6	0.61	-0.54	0.86
Exports	8.77	9.01	0.36	0.94
Imports	5.31	5.46	0.44	0.88
Govt expenditure	3.06	3.15	-0.89	0.83

Business cycle features using the Baxter-King filter

- On correlation results match: Consumption, investment and imports are pro-cyclical.
- Government expenditure and consumer prices are significantly counter-cyclical.
- On persistence also, the results match with the exception of government expenditure.
- The results differ on volatility. In contrast to the HP filter, the relative volatility of consumer prices and private consumption is less than 1.

Business cycle features for quarterly data using Christiano-Fitzgerald filter

	Standard deviation	Relative standard deviation	Contemp. correlation	Persistence
Real GDP	1.51	1.00	1.00	0.84
Private Consumption	0.99	0.66	0.81	0.73
Investment	3.84	2.53	0.91	0.85
CPI	0.34	0.22	-0.18	0.86
Exports	9.88	6.53	0.59	0.94
Imports	6.21	4.10	0.65	0.89
Govt expenditure	2.57	1.50	-0.91	0.82

Business cycle features using the Christiano-Fitzgerald filter

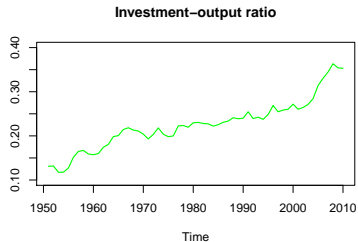
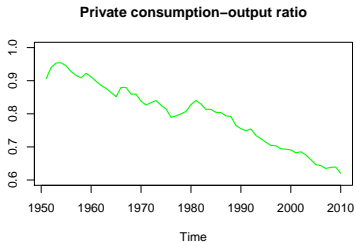
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Part V

How did the Indian economy change?

The background

Indian economy has changed over time.



Elements of change

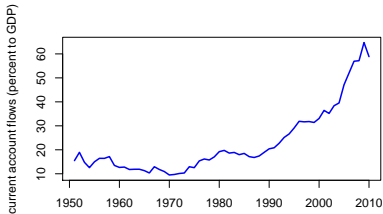
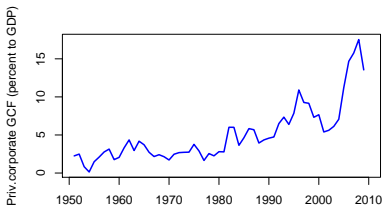
Declining share of agriculture: Agricultural performance used to define a good or bad year. The dependence on agriculture has now declined.

	Agriculture	Industry	Services
1951	53.15	16.5	30.2
1992	28.8	27.4	44
2009	14.6	28.4	57

Table: Changing composition of GDP (% to GDP)

Elements of change

- Emergence of conventional business cycle: With the dismantling of controls on capacity creation and trade, business cycle with an interplay of inventories and investment has evolved.
- Increased integration with the rest of the world: The dismantling of trade barriers has led to a surge in current account flows.



Part VI

Changes in stylised facts

Annual data analysis

- Pre-reform period: 1951-1991
- Post-reform period: 1992-2009

	Pre-reform period			Post-reform period		
	Std. dev.	Rel. std. dev.	Cont. cor.	Std. dev.	Rel. std. dev.	Cont. cor.
Real GDP	2.13	1.00	1.00	1.78	1.00	1.00
Pvt. Cons.	1.82	0.85	0.70	1.87	1.05	0.89
Investment	5.26	2.13	0.22	5.10	2.85	0.77
CPI	5.69	2.13	-0.21	3.49	1.95	0.29
Exports	7.14	3.34	0.07	7.71	4.33	0.33
Imports	11.23	5.26	-0.19	9.61	5.39	0.70
Govt expenditure	6.88	3.22	0.45	4.60	2.58	-0.26

Changes in stylised facts: volatility of macroeconomic variables

Some variables show a fall in volatility

- Volatility of aggregate GDP has fallen from 2.13 to 1.78.
- Volatility in agricultural GDP has fallen to half from 4.26 to 2.56.
- Volatility in investment has declined from 5.26 to 5.10.
- Volatility in government expenditure has declined from 6.88 to 4.60.
- Volatility in consumer prices has declined from 5.69 to 3.49.
- Volatility in imports has declined from 11.23 to 9.61.

While for some others, volatility has increased in the post-reform period.

- The volatility of non-agricultural GDP has increased from 1.69 to 1.81.
- The volatility of private consumption has marginally increased from 1.82 to 1.87.

Changes in stylised facts

- Increased pro-cyclicality of investment with output: The correlation increased from 0.22 to 0.77.
- Increased pro-cyclicality of imports with output: The correlation increased from -0.19 to 0.70 in the post-reform period.
- Counter-cyclical nature of government expenditure: From significantly pro-cyclical at 0.44 the correlation is -0.26 in post-reform period.

In summary, the features of Indian business cycle are moving closer to those of advanced economies.

Conclusion

- Documenting business cycle stylised facts forms the foundation for construction and validation of theoretical models.
- First exercise to exclusively deal with stylised facts for Indian business cycle.
- More relevant in the context of an economy like India that has undergone significant transformation.

Conclusion

- On correlation, the results are closer to those of advanced economies.
- The results on volatility for private consumption and price level are sensitive to the choice of the de-trending procedure.
- The application of Baxter-King and Chritiano-Fitzgerald filter removes high-frequency noise from these series, thus making them more smooth.
- This paper is a first exercise of this kind to provide an exhaustive set of stylised facts using both quarterly and annual data.

Thank you