The Indian Business Cycle

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Statistics Day – RBI

July 3, 2017

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EME Business Cycles

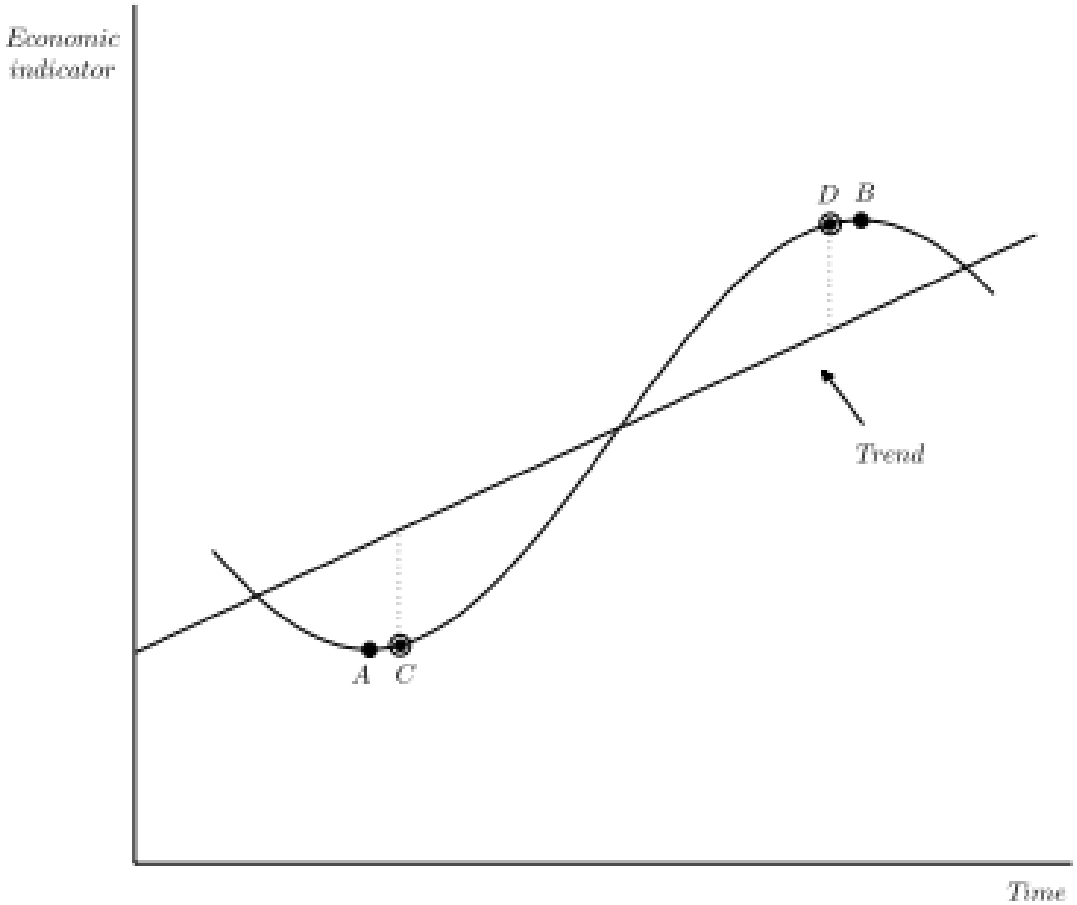
- A substantial literature exists on business cycle stylized facts for developed economies (Kydland and Prescott, 1990; Stock and Watson, 1999; King and Rebelo, 1999; Rebelo, 2005).
- A number of papers have recently focused on the empirical regularities of EMDE business cycles (Agenor et al., 2000; Rand and Tarp, 2002; Male, 2010; Vegh, 2016)
- In the Indian context, we need
  - Better measurement of the Indian business cycle
  - Research agenda on building, calibrating, and estimating DSGE models for India
  - An understanding how to stabilize business cycles as a key objective of macroeconomic stability.
- I will draw heavily on Ghate, Pandey, and Patnaik (2013, *SCED*); Ghate, Gopalakrishnan, and Tarafdar (2016, *Journal of Economic Asymmetries*); and Dave, Ghate, Gopalakrishnan, and Tarafdar (2017, work in progress).

Overview of Talk

- Preliminaries
- EME business cycles
  - India evidence and other EME evidence
- What ingredients should go into the theory ?
  - Aguiar and Gopinath (2007) introduce a stochastic productivity trend in addition to temporary productivity shocks
  - Criticisms (Garcia-Cicco et al, 2010) and implications from encompassing models (Chang and Fernandez, 2013)
  - Neumeyer and Perri (2005); introduce foreign interest rate shocks with financial frictions
  - Ghate, Gopalakrishnan and Tarafdar (2016, *JEA*); Dave, Ghate, Gopalakrishnan, and Tarafdar (2017); add fiscal policy and public debt to Neumeyer and Perri (2005)
  - Treatment of labor markets (search and matching frictions, see Ghate and Mazumder, 2017, work in progress)
- Implications for macroeconomic stability
- Conclude

Preliminaries - Classical business cycles versus growth cycles

Growth cycles: measured by a deviation from its long run trend
Classical cycles: based on the absolute downturn of the level of output



Preliminaries - Some definitions

- Expansion
  - movement from trough to peak
- Recession
  - movement from peak to trough
- Duration
  - length of time the economy spends between two troughs or peaks
- Amplitude
  - deviation from trend

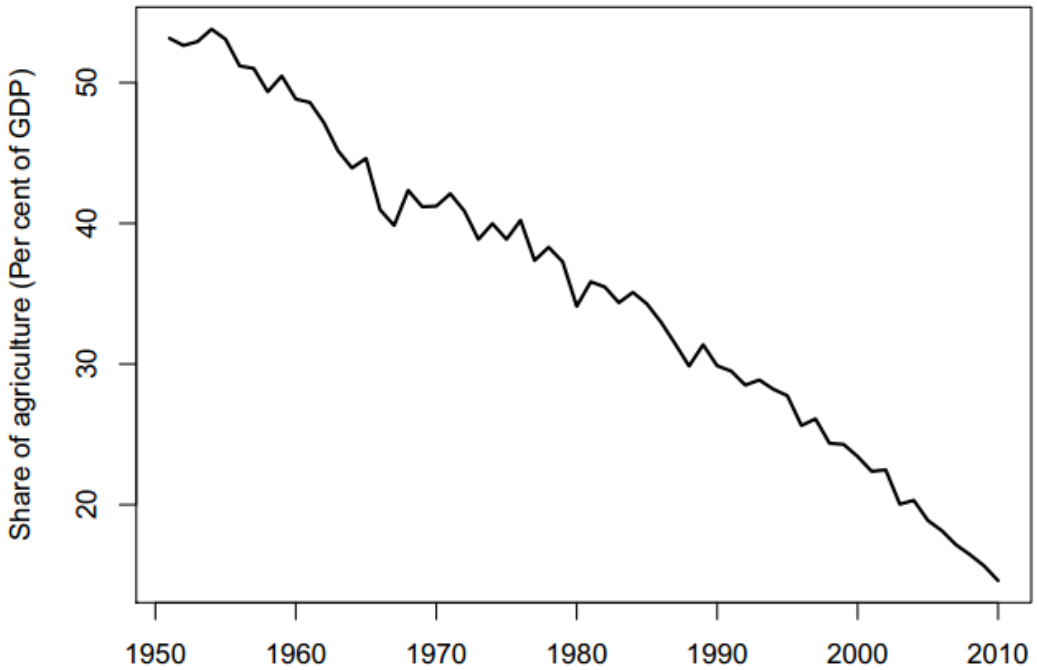
Literature review

- Three existing approaches
  - Classical business cycles (Dua and Banerji, 2012)
  - Growth cycle approach (Mall, 1999; Chitre, 2004) with the former based primarily on turning points in IIP
  - Growth rate cycle approach (Dua and Banerji, 2012)
- Several Issues
  - These papers work with pre 1991 data.
  - Classical approach may not be relevant because we have not seen in actual fall in output, as we did in the pre-1991 years.
  - Some papers do work with post 1991 data (Dua and Banerji, 2006; Mohanty et al. 2003), but the growth cycle approach is better than a *growth-rate* cycle approach when identification of business cycle dates is desired.
- Fourth approach: need to incorporate structural transformation and need for a theory - i.e., pre-post 1991 comparisons (Ghate, Pandey, and Patnaik, 2013; Ghate, Gopalakrishnan and Tarafdar, 2016)

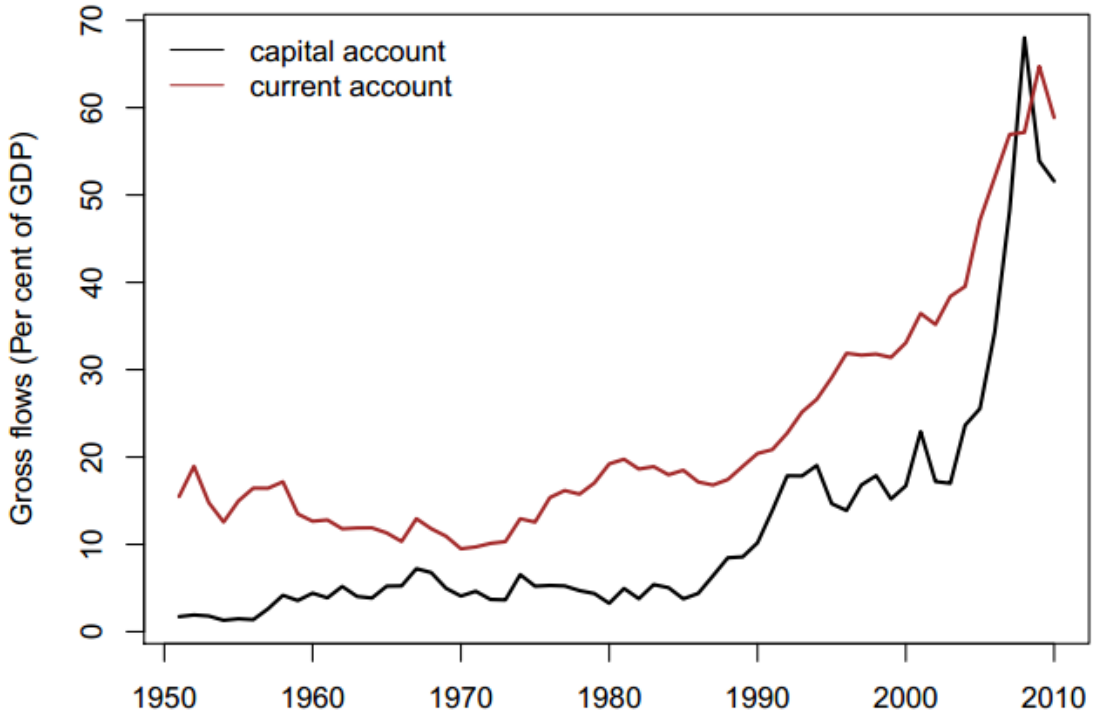
Why is structural transformation important ?

- India provides an interesting example because of the changing nature of stylized facts
- The Indian policy environment changed after the liberalization reforms of 1991
- The economy changed from a largely planned, closed, and agricultural dependent economy to a market determined, more industrial, and increasingly globalized economy
- Three transitions: away from socialism, away from autarky, and away from agriculture.
- How did this change the properties of the Indian business cycle?

Transition away from Agriculture



Transition away from Autarky -1

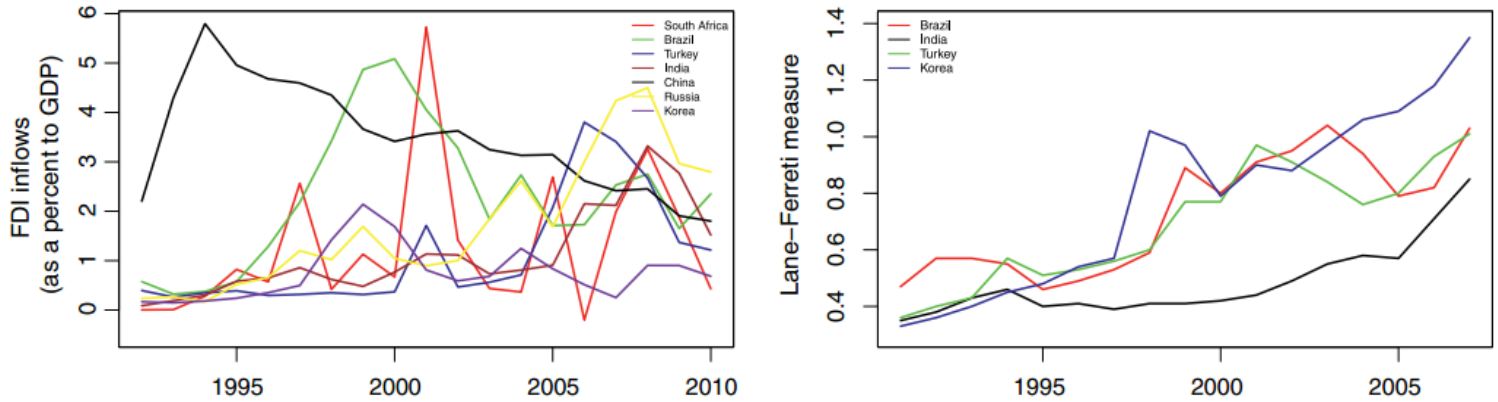


$$NI = \Delta L - \Delta A$$

$\Delta L =$ increase of foreign holdings of domestic assets; $\Delta A =$ increase in domestic holdings of foreign assets

Gross inflows: $\Delta L, \Delta A$

Transition away from Autarky - 2



An issue that arises with referees!

- What is the relevance of the SOE assumption in India?
  - RHS panel is the Lane-Milessi-Feretti (2007) measure of financial openness
  - De facto measure of financial integration (stock of all external assets and liabilities of a country / GDP)

Extracting cycles

- Default approach is to use the HP filter, and do robustness with a BK filter
  - Several criticisms of the HP filter (Stock and Watson, 1999; Cogley and Nason, 1995)
  - Hamilton (2016) argues that the HP filter produces spurious dynamic relations
  - Hamilton proposes a simple and robust estimator of the cyclical component
- Band pass filters
  - Baxter and King (1999) belongs to the category of band pass filters that filter out slow moving components and high frequency movements in given time series while retaining periodicities of typical business cycle durations (between 6 quarters and 8 years)
  - Christiano and Fitzgerald (2003); application of CF filter to Indian data (Pandey, Patnaik, and Shah, 2017)
- OECD (2016)

India evidence: growth cycle approach

- The log transformed series is filtered 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-correlations
- We use the HP Filter to extract the cyclical component of the series
- Robustness check done with respect to the BK Filter
  - approach followed by other papers (see Rand and Tarp, 2002).

Annual data analysis: Ghate et al. (2013)

Business cycle statistics for the Indian economy using annual data: Pre and post reform period.

	Pre-reform period (1950–1991)				Post-reform period (1992–2010)			
	Std. dev.	Rel. std. dev.	Cont. cor.	First ord. auto corr.	Std. dev.	Rel. std. dev.	Cont. cor.	First ord. auto corr.
Real GDP	2.13	1.00	1.00	0.045	1.78	1.00	1.00	0.716
Non-agri GDP	1.69	1.00	1.00	0.553	1.81	1.00	1.00	0.735
Pvt. cons.	1.82	0.85	0.69	0.026	1.87	1.05	0.89	0.578
Investment	5.26	2.46	0.22	0.511	5.10	2.85	0.77	0.593
CPI	5.69	2.66	0.07	0.511	3.49	1.95	0.29	0.624
Exports	7.14	3.34	0.07	0.205	7.71	4.31	0.33	0.226
Imports	11.23	5.26	−0.19	0.204	9.61	5.38	0.70	0.470
Govt expenditure	6.88	3.22	−0.35	0.230	4.60	2.58	−0.26	0.474
Net exports	0.9	0.4	0.24	0.245	1.1	0.65	−0.69	0.504
Nominal exchange rate	6.74	3.15	0.10	0.632	5.35	3.00	−0.48	0.492
M1 (narrow money)	3.43	1.57	−0.03	0.413	3.27	1.83	0.54	0.546
M3 (broad money)	2.12	0.97	−0.01	0.593	2.64	1.47	0.65	0.710
Reserve money	3.02	1.38	0.06	0.42	4.85	2.71	0.70	0.542
CPI inflation	5.78	2.48	−0.29	0.228	2.94	1.64	0.55	0.378

Takeaways

- Volatility of key macro variables have fallen
  - Output volatility – 2.13 vs 1.78 (consistent with other other Asian economies)
- Increases in consumption volatility
  - 0.85 vs 1.05 ($\frac{\sigma_c}{\sigma_y}$ driven largely by decreases in σ_y)
- Increased pro-cyclicality of investment
  - 0.22 vs 0.77
- Increased pro-cyclicality of imports
  - -0.19 vs 0.70 (imports fluctuating more with BC activity which is a feature of AEs)
- Counter-cyclical net exports
  - 0.24 vs -0.69 (X not pro-cyclical, M significantly pro-cyclical)
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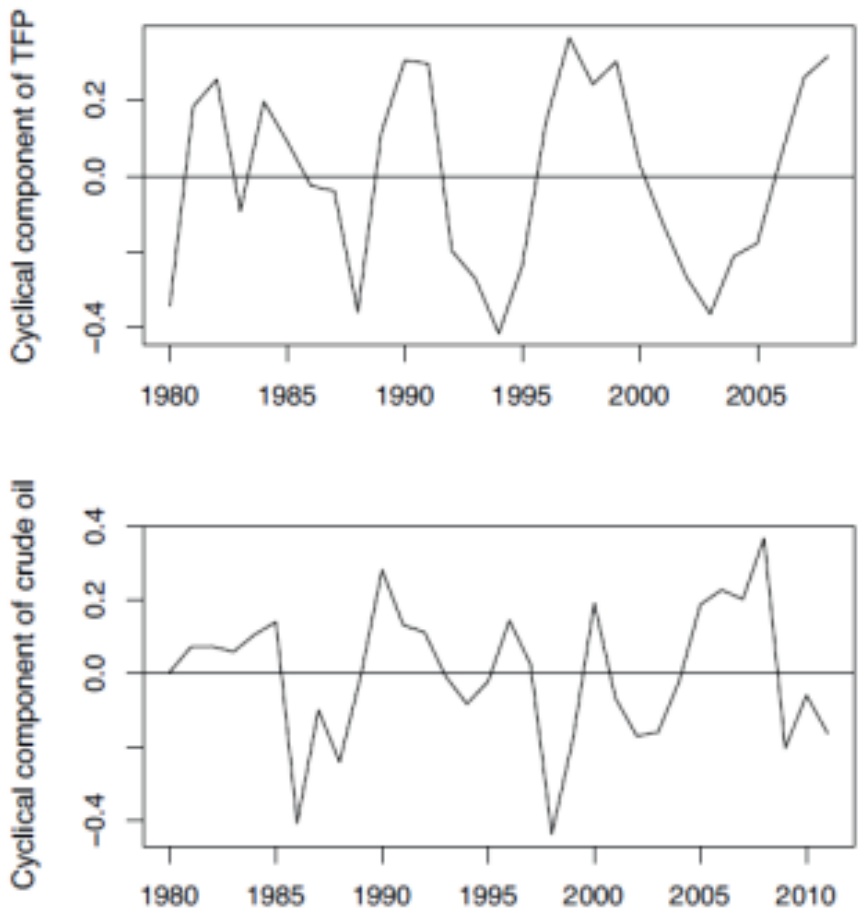
Statistical significance of difference in correlation

Variables	Difference in correlation (z)	p-Value
Private consumption	−1.92	0.054
Investment	−2.61	0.0089*
CPI	−0.77	0.44
Exports	−0.88	0.37
Imports	−3.49	0.0004*
Government expenditure	−1.15	0.25
Nominal exchange rate	2.08	0.037*
Net exports	3.63	0.000278*
Narrow money (M1)	−2.11	0.03*
Broad money (M3)	−2.61	0.0088*
Reserve money	−2.65	0.0079*
CPI inflation	−2.87	0.0004*

* Indicates significance at the 5% level.

- Procedure : see footnote 28–29 (Ghate et al. (2013))

Lower volatility not driven by good luck but better policies



- Good Luck Hypothesis: Variance of exogenous shocks is smaller (s.d. for TFP ↑ from 0.21 to 0.27; s.d. for crude ↑ from 2.29 to 4.83)

India's Transition

Pre-reform period

Output is more volatile
Investment is weakly correlated with output
Imports are acyclical
Net exports are acyclical
Nominal exchange rate is acyclical

Post-reform period

Output becomes less volatile
Investment is strongly correlated with output
Imports become pro-cyclical
Net exports become counter-cyclical
Nominal exchange rate is counter-cyclical.

Sensitivity tests: Quarterly data (HP filter)

Business cycle stylized facts using quarterly data (1999 Q2–2010 Q2).

	Std. dev.	Rel. std. dev.	Cont. corr.	First ord. auto corr.
Real GDP	1.18	1.00	1.00	0.73
Private consumption	1.54	1.31	0.51	0.67
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
Net exports	1.24	1.04	−0.15	0.45
Real interest rate	2.11	1.77	0.38	0.372
Nominal exchange rate	4.61	3.88	−0.54	0.82
M1 (narrow money)	3.13	2.64	0.5	0.105
M3 (broad money)	1.79	1.50	0.06	0.40
Reserve money	4.53	3.82	0.47	0.50
CPI inflation	0.88	0.74	0.05	0.66

Sensitivity tests: Annual data (BK filter)

Business cycle statistics for the Indian economy using annual data: Pre and post reform period (with Baxter–King filter).

	Pre-reform period (1950–1991)				Post-reform period (1992–2010)			
	Std. dev.	Rel. std. dev.	Cont. cor.	First ord. auto corr.	Std. dev.	Rel. std. dev.	Cont. cor.	First ord. auto corr
Real GDP	1.94	1.00	1.00	−0.171	0.95	1.00	1.00	0.234
Non-agri GDP	1.09	1.00	1.00	0.249	0.89	1.00	1.00	0.550
Pvt. cons.	1.59	0.81	0.86	−0.308	1.05	1.10	0.84	−0.041
Investment	3.49	1.79	0.22	0.325	3.12	3.26	0.60	0.243
CPI	4.29	2.20	0.28	0.297	1.51	1.58	0.28	0.189
Exports	5.99	3.07	−0.03	−0.133	6.08	6.35	0.36	0.180
Imports	8.76	4.49	−0.06	0.037	6.15	6.42	0.47	0.215
Govt expenditure	6.39	3.10	−0.17	0.010	3.73	3.90	−0.44	0.358
Net exports	0.68	0.34	0.08	0.013	0.81	0.84	−0.26	0.029
Nominal exchange rate	4.34	2.23	0.05	0.312	2.17	2.27	−0.17	0.124
M1 (narrow money)	2.47	1.23	−0.10	−0.08	1.42	1.48	0.43	0.49
M3 (broad money)	1.40	0.70	0.02	0.265	1.44	1.51	0.31	0.515
Reserve money	2.43	1.21	0.02	0.2	2.33	2.47	0.40	0.08
CPI inflation	5.78	2.65	−0.21	0.228	2.94	3.07	0.43	0.378

Sensitivity tests: redefining the sample period

Business cycle statistics for the Indian economy using annual data: pre reform period (1971–1991).

	Pre-reform period (1971–1991)			
	Std. dev.	Rel. std. dev.	Cont. cor.	First order auto corr.
Real GDP	2.24	1.00	1.00	−0.008
Pvt. cons.	1.94	0.86	0.69	−0.03
Investment	3.55	1.57	0.50	0.41
CPI	5.96	2.64	−0.16	0.481
Exports	6.00	2.66	0.10	0.501
Imports	8.71	3.87	−0.10	0.312
Govt expenditure	5.62	2.62	0.50	0.245
Net exports	0.8	0.3	0.12	0.279
Nominal exchange rate	5.54	2.46	0.40	0.564
M1 (narrow money)	3.86	1.67	−0.133	0.233
M3 (broad money)	1.80	0.78	0.25	0.515
Reserve money	4.15	1.79	0.11	0.458
CPI inflation	5.96	2.58	−0.43	0.212

Other EME Experience

- Rand and Tarp (2002) question whether the length of business cycles in EMDEs is comparable to the duration in industrialized countries.
- Use a sample of 15 developing countries (Table 2)
- Average length of the business cycle for developing countries is only between 7 and 18 quarters ($\approx$ 4.5 years)
  - Fewer co-movements in terms of common peaks and troughs
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Other EME Experience

Region	Country	Period (Q = quarter)	Average expansion length	Average contraction length	Average length of the business cycle
Sub-Saharan Africa	South Africa	61,Q1–99,Q4	5.8	5.9	11.8
	Malawi	70,Q1–99,Q4	5.9	5.4	12.0
	Nigeria	70,Q1–99,Q4	4.0	5.5	9.5
	Côte d'Ivoire	68,Q1–99,Q4	4.8	4.8	9.7
	Zimbabwe	78,Q1–98,Q3	5.1	5.3	10.4
Latin America	Uruguay	79,Q1–99,Q4	4.9	4.3	9.1
	Columbia	80,Q1–98,Q4	5.0	4.7	9.7
	Peru	79,Q1–99,Q4	4.6	4.3	9.4
	Chile	60,Q1–99,Q4	3.7	3.8	7.8
	Mexico	60,Q1–99,Q3	4.8	4.7	9.5
Asia and N. Africa	India	60,Q1–99,Q4	3.1	4.7	8.1
	Korea	60,Q1–99,Q4	6.3	10.4	18.1
	Morocco	60,Q1–99,Q4	3.7	4.0	7.7
	Pakistan	70,Q3–99,Q4	5.4	5.8	11.2
	Malaysia	70,Q1–99,Q4	4.2	4.9	9.6
All Countries	All		4.8	5.2	10.2

- See Rand and Tarp (2002). Truncation lag parameter of $k = 20$

Other EME Experience

- Volatility
  - Output in their sample is a little more volatile than in the OECD region (but by no more than $15 - 20\%$)
  - Consumption is generally more volatile than output
  - No significant volatility between DEs and EMDEs in imports, exports, terms of trade, and the REER
- Cross Correlations
  - Foreign trade (in general) counter-cyclical
  - Consumption and investment strongly pro-cyclical
  - Inflation negatively correlated with output (supply side models for EMDEs appropriate)

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In sum, stylized facts for EME vs DEs

Developed economies	Developing economies
Output is less volatile	Output is more volatile.
Consumption is less volatile than output	Consumption is more volatile than output
Investment is volatile: 3 times relative to output- U.S	Investment is highly volatile
Government expenditure is counter-cyclical	No consistent relation
Consumer prices are counter-cyclical	No consistent relation
Investment is procyclical	Investment correlation is weak
Imports are procyclical	Imports correlation is weak
Weakly counter-cyclical net exports	Strongly counter-cyclical net exports

Towards a theory of EME business cycles

	Developed economies			Emerging economies		
	Std dev.	Rel std. dev.	Cont. cor.	Std dev.	Rel. std. dev.	Cont. cor.
Real GDP	1.34	1.00	1.00	2.74	1.00	1.00
Private Consumption		0.94	0.66		1.45	0.72
Investment		3.41	0.67		3.91	0.77
Trade balance		1.02	-0.17		3.22	-0.51

Source: Aguiar and Gopinath, 2007.

Towards a Theory - AG 2007

- Agiuar and Gopinath (2007) is essentially Mendoza (1991) + Trend productivity shocks
  - See also Garcia-Cicco et al. (2010), Correia et al. (1995), Kydland and Zargaza (2002), Chang and Fernandez (2013)
- In their view,EMEs are characterized by frequent changes in economic policy, hence shocks to trend growth are the primary source of fluctuations as opposed to transitory fluctuations around the trend
- In contrast, developed economies typically face stable political and economic policy regimes so that changes to productivity are transitory.
- AG examine a version of a small open economy RBC model with permanent and transitory shocks to productivity to account for emerging versus developed economy experiences.

Identification in AG 2007

- After $\varepsilon_t^g \uparrow$ productivity $\uparrow$ permanently
- $\uparrow$ in permanent income $\Rightarrow$ consumption can $\uparrow$ more than current income $\Rightarrow \frac{\sigma_c}{\sigma_y} > 1$
- The representative agent may want to issue debt in the world market to finance consumption in excess of current income
- This leads to a counter-cyclical current account

AG 2007 - Description of the Model

- Production function

$$Y_t = \exp^{z_t} K_t^{1-\alpha} (\Gamma_t L_t)^{\alpha}, \qquad 0 < \alpha < 1$$

where $\{z_t\}$ and $\{\Gamma_t\}$ represent two alternative productivity processes

- The shock, z_t, represents the transitory component of productivity, and evolves as a stationary $AR(1)$ process

$$z_t = \rho_z z_{t-1} + \varepsilon_t^z, \qquad |\rho_z| < 1$$

where $\{\varepsilon_t^z\}_{t=0}^{\infty}$ is distributed $i.i.d$ with $E(\varepsilon_t^z) = 0$, $Var(\varepsilon_t^z) = \sigma_z^2$.

- In the standard model, ε_t^z is the only source of uncertainty

AG 2007 - Description of the Model

- The permanent shock to productivity evolves according to

$$\Gamma_t = g_t \Gamma_{t-1} = \prod_{s=0}^{t} g_s$$

$$\ln(g_t) = (1-\rho_g)\ln(\mu_g) + \rho_g \ln(g_{t-1}) + \varepsilon_t^g, \qquad \left|\rho_g\right| < 1$$

here $\{\varepsilon_t^g\}_{t=0}^{\infty}$ is distributed $i.i.d$ with $E(\varepsilon_t^g) = 0$, $Var(\varepsilon_t^g) = \sigma_g^2$.

- Γ_t allows for labor augmenting tech. progress. In a standard model Γ_t assumes a deterministic path
- Thus, g_t, denotes shocks to the growth rate of productivity and μ_g denotes average long run productivity growth.

AG 2007 - Description of the Model

- See Jaimovich and Rebelo (2009) who embed GHH and KPR preferences as special cases
- Cobb Douglas preferences

$$u_t = \frac{\left(C_t^{\gamma}(1-L_t)^{1-\gamma}\right)^{1-\sigma}}{1-\sigma} \qquad 0 < \gamma < 1, \sigma \geq 0$$

- Reduces the extent to which BCs can be driven by interest rate shocks
- Robustness check done with Grossman, Hercowitz, and Huffman (GHH) preferences

$$u_t = \frac{\left(C_t - \tau \Gamma_{t-1} L_t^{v}\right)^{1-\sigma}}{1-\sigma}, \qquad v > 1, \tau > 0$$

- Allows labor supply to be independent of consumption levels.
- Technically if $u(c, l) = v(c - h(1-l)) \Rightarrow MRS_{cl} = \frac{1}{h'(1-l)} \Rightarrow$ MRS only depends on the real wage, not consumption

AG 2007 - Description of the Model

- Economy wide resource constraint given by:

$$C_t + K_{t+1} = Y_t + (1-\delta)K_t - \underbrace{\frac{\phi}{2}K_t\left(\frac{K_{t+1}}{K_t} - \mu_g\right)^2}_{\text{Adjustment cost of Capital}} - B_t + q_t B_{t+1}$$

- Adjustment costs $\Rightarrow$ if you want change your capital stock $\Rightarrow$ quadratic adjustment costs.
- Price of debt for the country is sensitive to the quantity of debt outstanding. This is usually modelled according to a debt-elastic interest rate rule

$$\frac{1}{q_t} = 1 + r_t = 1 + r^* + \underbrace{\psi\left[\exp\left(\frac{B_{t+1}}{\Gamma_t} - b\right) - 1\right]}_{\text{Country spread risk due to indebtedness}}$$

where r^* is the world interest rate, b is the steady state normalized debt, and $\psi > 0$ governs the elasticity of interest rate to changes in indebtedness

AG 2007 - Description of the Model

- Need a well defined steady state (see Schmidt-Grohe and Uribe (2003)). Therefore assume

$$r_t = r^* + p\left(\widetilde{d}_t\right), \text{ where } p'(.) > 0$$

- In the steady state,

$$1 = \beta\left[1 + r + \psi\left\{\exp\left(d - \widetilde{d}\right) - 1\right\}\right]$$

- $\Longrightarrow$ interest rate premium is nil

AG 2007 - Calibration results

- AG (2007) calibrate their model to match Mexico (EME) and Canada (AE) for the period 1980-2003
- Important findings:
  - The relative importance of trend productivity shocks over transitory shocks for Canada and Mexico depend on the specification for preferences
  - For Canada: $\frac{\sigma_g}{\sigma_z} = \{0.25 \text{ or } 0.41\}$; for Mexico: $\frac{\sigma_g}{\sigma_z} = \{2.5 \text{ or } 5.4\}$
  - The auto-correlations of transitory shocks and ϕ are roughly similar for both countries
- Main finding: volatility of innovations much stronger in the permanent technology process than in the transient one. Major role of trend shock
  - presence of more persistent trade deficits in EMEs than in AEs.
  - $\frac{\sigma_c}{\sigma_y} > 1$ for EMEs unlike in AEs

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Criticisms of AG 2007

- Garcia-Cicco et al. (2010) challenge AG's results and argue that trend shocks perform poorly among several dimensions.
- Results in AG are driven due to the choice of a short sample to estimate low-frequency movements in productivity.
  - The show that output fluctuations in post WWII are as large as the pre WWII period
  - Similar results were not obtained when Garcia-Cicco et al. worked with long-run Argentine data (1913-2005).
  - They estimate that consumption smoothing in response to transitory shocks are more important than in response to permanent shocks.
  - In their estimated model,
    $\sigma\left(\text{consumption growth}\right) < \sigma\left(\text{output growth}\right)$.
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Criticisms of AG 2007

- They also show that
  - Investments are insufficiently volatile
  - Auto-correlations of output growth and $\frac{NX}{Y}$ do not match the data. In fact $\frac{NX}{Y}$ actually tends to follow a random-walk
- Therefore Garcia-Cicco et al. (2010) argue that EME-RBC models are not purely driven by the influence of permanent/transitory shocks, other sources of shocks matter.

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Implications from encompassing models

- Chang and Fernandez (2013) allow for stochastic productivity trends, temporary shocks, interest rate shocks, and financial frictions (working capital requirements and endogenous spreads)
- Conduct a Bayesian estimation of the posterior distribution of parameters to generate IRFs and variance decompositions
- They find that trend shocks play a small role in explaining the variance in output (estimated posterior ratio of volatilities, $\frac{\sigma_z}{\sigma_g} = 5.5$)
- In Chang and Fernandez (2013), relative importance of trend shocks increases when they shut off interest rate shocks and financial frictions.
  - Main Result: In Mexican data, fluctuations are chiefly generated by *transitory* technology shocks, *and* interest rate shocks which are *amplified* by financial frictions.
  - Trend shocks become quantitatively relevant only when financial frictions are assumed away.

What does this mean for an India business cycle model?

- Need a theory (possibly) without trend shocks
- Need a broader look at the data
  - Interest rate shocks and financial frictions
  - But we also require a description of fiscal policy since we are writing down BC models of EMEs
  - How can fiscal policy serve as a tool for macroeconomic stabilization in EMEs?
    - Automatic stabilizers versus discretionary fiscal policy ?
- Policy implications

Lets go back...

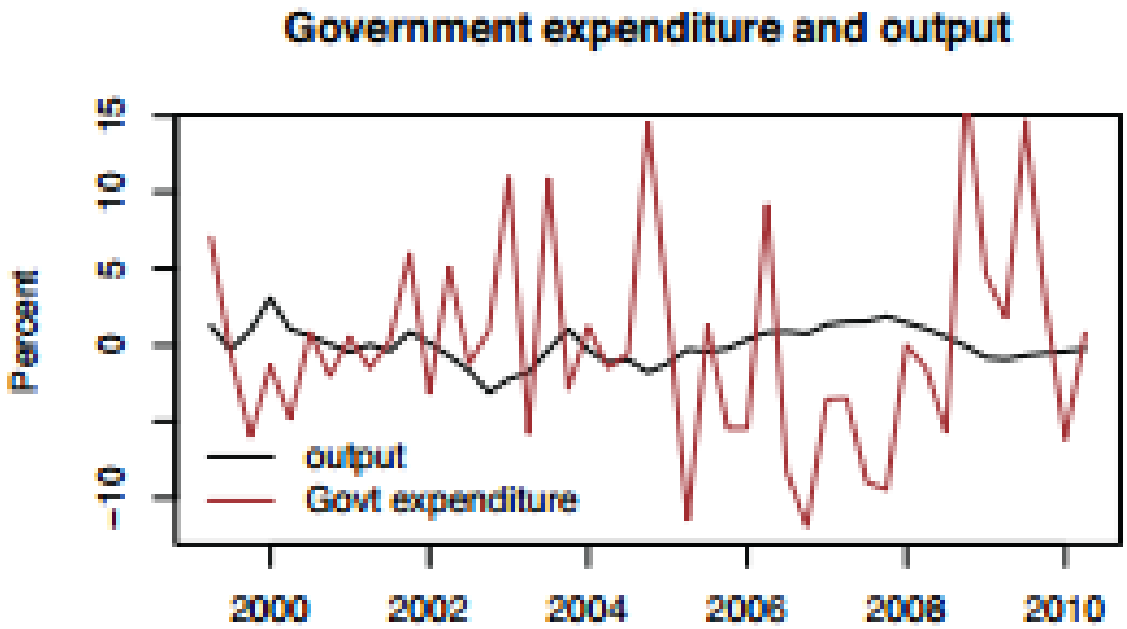
Ghate et al. (2013)

Business cycle stylized facts using quarterly data (1999 Q2–2010 Q2).

	Std. dev.	Rel. std. dev.	Cont. corr.	First ord. auto corr.
Real GDP	1.18	1.00	1.00	0.73
Private consumption	1.54	1.31	0.51	0.67
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
Net exports	1.24	1.04	−0.15	0.45
Real interest rate	2.11	1.77	0.38	0.372
Nominal exchange rate	4.61	3.88	−0.54	0.82
M1 (narrow money)	3.13	2.64	0.5	0.105
M3 (broad money)	1.79	1.50	0.06	0.40
Reserve money	4.53	3.82	0.47	0.50
CPI inflation	0.88	0.74	0.05	0.66

G and Y

Ghate et al. (2013)



- Evidence suggests government expenditures are counter-cyclical in India, in the 2000s. Contrary to popular belief!

Other country facts suggest a mixed experience (Male, 2010)

Country	Sample	$\frac{\sigma(G)}{\sigma(Y)}$	$\frac{\sigma(R)}{\sigma(Y)}$	$\rho(G, Y)$	$\rho(R, Y)$
Chile	1980:1-2004:4	11.3	1.7	–	−0.22
Colombia	1980:1-2004:4	2.2	3.7	0.35	0.27
Hong Kong	1980:1-2004:4	2.5	3.1	−0.21	0.33
Hungary	1980:1-2004:4	1.7	2.6	−0.63	−0.01
Israel	1980:1-2004:4	20.7	8.7	–	−0.02
Korea	1980:1-2004:4	2.4	2.1	−0.04	−0.36
Mexico	1980:1-2004:4	4.0	8.5	−0.11	−0.48
Slovak Rep.	1980:1-2004:4	2.3	5.1	–	0.45
Slovenia	1980:1-2004:4	1.5	11.1	0.27	0.25
South Africa	1980:1-2004:4	1.9	3.9	0.04	0.13
Turkey	1980:1-2004:4	8.3	–	0.74	–
India	1999:2-2010:2	5.53	1.77	−0.35	0.38

What should a theoretical model for India try to explain?

- In EMEs, R is more volatile than output, but there is mixed evidence on $\rho(R, Y)_{EME}$
- $\rho(R, Y) < 0$ in Latin American economies, but $\rho(R, Y) > 0$ in Eastern Europe, Africa and Asia (Male (2010)).
  - Also in India (Ghate et al. (2013)).
- So we need a theory of counter-cyclical government expenditures, pro-cyclical interest rates, counter-cyclical current account, and higher relative consumption volatility!
  - Government expenditure has been counter-cyclical in India post reforms (Ghate et al. (2013)).

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NP 2005 - Description of the model

- Neumeyer and Perri (2005) build a SOE-RBC model where interest rate shocks play a crucial role (see also Uribe and Yue (2006))
  - Motivated by the observation that cost of foreign credit is counter-cyclical in EME data
- They highlight that compared to AEs, in EMEs
  - output (Y) is more volatile
  - consumption (C) is pro-cyclical and more volatile
  - net exports (NX) are more volatile than output and are more counter-cyclical than in AEs
- In addition
  - Interest rates (R) are also counter-cyclical. Why?
  - Make a crucial assumption – households face GHH preferences
  - Shuts income effect channel due to interest rate shocks on the labor supply
  - Makes interest rates strongly counter-cyclical

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NP 2005 - Description of the model

- Firms face a working capital constraint + preferences are GHH.
- $R \uparrow \Rightarrow L^D \downarrow$
- Agents face GHH preferences $\Rightarrow L^S$ remain unchanged $\Rightarrow$ equilibrium labor falls, Y falls $\Rightarrow \rho\left(R, Y\right)_{EME} < 0$
- Intertemporal substitution effect $\Rightarrow C \downarrow$ instantaneously, $S \uparrow$
- $R \uparrow \Rightarrow X \downarrow$
- $(S - X) \uparrow \Rightarrow \rho\left(NX, Y\right) < 0$

NP 2005 - Description of the model

- In their model, real interest rates are decomposed into two components

$$R_t = R_t^* D_t$$

  where R is the domestic real interest rate, R^* is the international real interest rate (US real interest rate), and D is the country specific spread component
- R_t^* is random and fluctuates around its LR value
- NP model D in two ways – the exogenous case, and the induced case (country risk depends inversely on expected productivity).
- They calibrate their model to match the Argentine data and they show that lowering the country spread risk shocks can lower output volatility by around 27%.

Extending NP 2005 for a business cycle model for India

- Ghate, Gopalakrishnan, and Tarafdar (2016) extend NP (2005) with fiscal policy and Cobb-Douglas preferences
  - fiscal policy affects labor market channels through the supply and demand side
  - Cobb-Douglas - enables $\rho(R, Y) \lessgtr 0$ since evidence on this is mixed across EMEs
- We then calibrate the model to qualitatively match Indian business cycles documented in Ghate et al. (2013) using
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Main result of GGT 2016

- By adding fiscal policy, we are able to explain the disparity in $\rho(R, Y)_{EME}$ and in $\rho(G, Y)_{EME}$
- **Key Feature** : Fiscal policy acts as a stabilizer in our framework, which makes real interest rates a-cyclical/pro-cyclical in our framework. This is because
  - a time varying tax wedge affects the labor supply and,
  - a subsidy on the interest rate on a portion of the firm's total borrowings affects the labor demand.
- Why is a variant of NP 2005 a good framework for the Indian case?

Because it highlights a reasonable causal mechanism:

$$\textit{Interest rate shocks} \longrightarrow \textit{amplified/stabilized by fiscal policy} \longrightarrow \underbrace{\textit{labor market outcomes}}_{\textit{Search Frictions}} \longrightarrow \textit{real economy outcomes}$$

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GGT 2016 - Description of the model

t^- : firm issues bonds in the international capital markets at R_{t-1} to finance its working capital requirement

t: interest rate shocks and TFP shocks are realized; actual production occurs

t^+: firm makes all factor payments and repays the loans

GGT 2016 - Description of the model

- The firm maximizes

$$\begin{aligned}\pi_t &= A_t k_{t-1}^{\alpha}\left[(1+\gamma)^t l_t\right]^{1-\alpha} - w_t l_t - r_t k_{t-1} \\ &\quad - \left(R_{t-1}^{G} - 1\right)\theta_G w_t l_t - \left(R_{t-1}^{P} - 1\right)(\theta - \theta_G) w_t l_t.\end{aligned} \tag{1}$$

- The government lends $\theta_G < \theta$ portion of the working capital at

$$R_{t-1}^{G} = R_{t-1}^{P}(1-s) > 1, \quad 0 < s < 1. \tag{2}$$

- We obtain w_t and r_t.

GGT 2016 - Description of the model

- A stand-in representative agent maximizes

$$E_0 \sum_{t=0}^{\infty} \beta^t \frac{\left[(c_t^*)^{\mu} (1 - l_t)^{(1-\mu)} \right]^{(1-\sigma)}}{(1-\sigma)}, \tag{3}$$

$$\text{where } \forall t \; c_t^* = c_t + \Theta G_t, \text{ such that } \Theta > 1$$

- subject to

$$\begin{aligned} (1+\tau_c)c_t + x_t + b_t + \kappa(b_t) \leq & (1-\tau_w) w_t l_t \\ & + (1-\tau_k) r_t k_{t-1} + R_{t-1}^P b_{t-1}. \end{aligned} \tag{4}$$

- $\kappa(b_t)$ is the bond holding cost, x_t is private investment such that;

$$x_t = k_t - (1-\delta) k_{t-1} + \Phi(k_t, k_{t-1}). \tag{5}$$

- $\Phi(k_t, k_{t-1})$ is the investment adjustment cost.

GGT 2016 - Description of the model

- $\kappa(b_t)$ is the bond holding cost such that

$$\kappa(b_t) = \frac{\kappa}{2} y_t \left[\left(\frac{b_t}{y_t} \right) - \left(\frac{b}{y} \right) \right]^2 \tag{6}$$

  which is required for ensuring stationarity

- x_t is private investment such that;

$$x_t = k_t - (1-\delta) k_{t-1} + \Phi(k_t, k_{t-1}), \tag{7}$$

- where $\Phi(k_t, k_{t-1})$ is the investment adjustment cost.

$$\Phi(k_t, k_{t-1}) = \frac{\phi}{2} k_{t-1} \left[\left(\frac{k_t}{k_{t-1}} \right) - (1+\gamma) \right]^2. \tag{8}$$

  which is required for keeping the relative volatility of x_t under check.

GGT 2016 - Description of the model

- The government balances it's budget $\forall t$

$$\underbrace{TR_t}_{\text{After Prod.}} + \underbrace{R^G_{t-1}\theta_G w_t l_t}_{\text{After Prod}} = \underbrace{G_t}_{\text{After Prod.}} + \underbrace{S_t}_{\text{Before Prod.}}$$

- where TR_t is

$$TR_t = \tau_c c_t + \tau_w w_t l_t + \tau_k r_t k_{t-1}. \tag{9}$$

- S_t is the loan extended to firms

$$S_t = \theta_G w_t l_t.$$

- Therefore

$$G_t = \tau_c c_t + \left\{ \left[R^P_{t-1}(1-s) - 1 \right] \theta_G + \tau_w \right\} w_t l_t + \tau_k r_t k_{t-1}. \tag{10}$$

GGT 2016 - Description of the model

- We transform all variables to their stationary values. For any variable x_t, we define it's stationary transformation as $\widetilde{x}_t$ such that,

$$\widetilde{x}_t = \frac{x_t}{(1+\gamma)^t}.$$

  All variables in our model grow at the same exogenous rate $(1+\gamma)$. All variables are therefore transformed to their corresponding stationary values except l_t, which is assumed to be at the stationary.

- Further, as in Uhlig (1997), any stationary variable $\widetilde{x}_t$ can be log-linearized as

$$\begin{aligned} \widetilde{x}_t &= \overline{x} e^{\widehat{x}_t} \\ &\simeq \overline{x}(1+\widehat{x}_t). \end{aligned}$$

The Labor Market – Supply side

Proposition

Labor supply, l_t^S ,is given by:

$$l_t^S = 1 - \frac{\widetilde{c}_t}{\widetilde{w}_t}\left(\frac{1-\mu}{\mu}\right)\Gamma_t \tag{11}$$

where

$$\Gamma_t = \left(\frac{1+\tau_c}{1-\tau_w}\right)\frac{\Psi_t}{D_{t-1}} \tag{12}$$

And $\tau_c > \tau_w$, $\tau_c > \left[R_{t-1}^P(1-s)-1\right]\theta_G$, *and* $\mu > 0.5 \Longrightarrow \Gamma_t > 1$.

The Labor Market – Supply side

- Γ_t is the "fiscal policy wedge" where

$$\Gamma_t = \left(\frac{1+\tau_c}{1-\tau_w}\right)\frac{\Psi_t}{D_{t-1}}$$

such that

$$D_{t-1} = 1 + \Theta\left(\frac{1-\mu}{\mu}\right)\left(\frac{1+\tau_c}{1-\tau_w}\right)\left\{\left[R^P_{t-1}(1-s)-1\right]\theta_G + \tau_w\right\}$$

and

$$\Psi_t = \left[1 + \Theta\tau_c + \frac{\Theta\tau_k r_t \widetilde{k}_{t-1}}{(1+\gamma)\widetilde{c}_t} + \frac{\Theta\left\{\left[R^P_{t-1}(1-s)-1\right]\theta_G+\tau_w\right\}\widetilde{w}_t}{\widetilde{c}_t}\right]$$

- Clearly, when $\Theta = 0$,

$$\Gamma_t = \overline{\Gamma} = \left(\frac{1+\tau_c}{1-\tau_w}\right).$$

The Labor Market – Supply side

- Note that

$$
\begin{aligned}
D_{t-1} &= D\left(\overset{+}{R}{}^{P}_{t-1};\ \text{parameters}\right) \\
\Psi_t &= \Psi\left(\overset{+}{r}_t, \overset{-}{\widetilde{c}}_t, \overset{+}{\widetilde{k}}_{t-1}, \overset{+}{R}{}^{P}_{t-1}, \overset{+}{\widetilde{w}}_t;\ \text{parameters}\right).
\end{aligned}
$$

The Labor Market – Supply side

- D_{t-1}, does not change on impact. $\Psi_t \uparrow$ in time period t because $\widetilde{c}_t \downarrow$ and $r_t \uparrow$ (no-arbitrage condition).
- Therefore $\Gamma_t \uparrow$ on impact due to a positive interest rate shock.
- Hence the outward shift of I_t^S due to a positive interest rate shock is dampened by an increase in Γ_t.

The Labor Market – Supply side

Proposition

For a positive shock to R_t^P

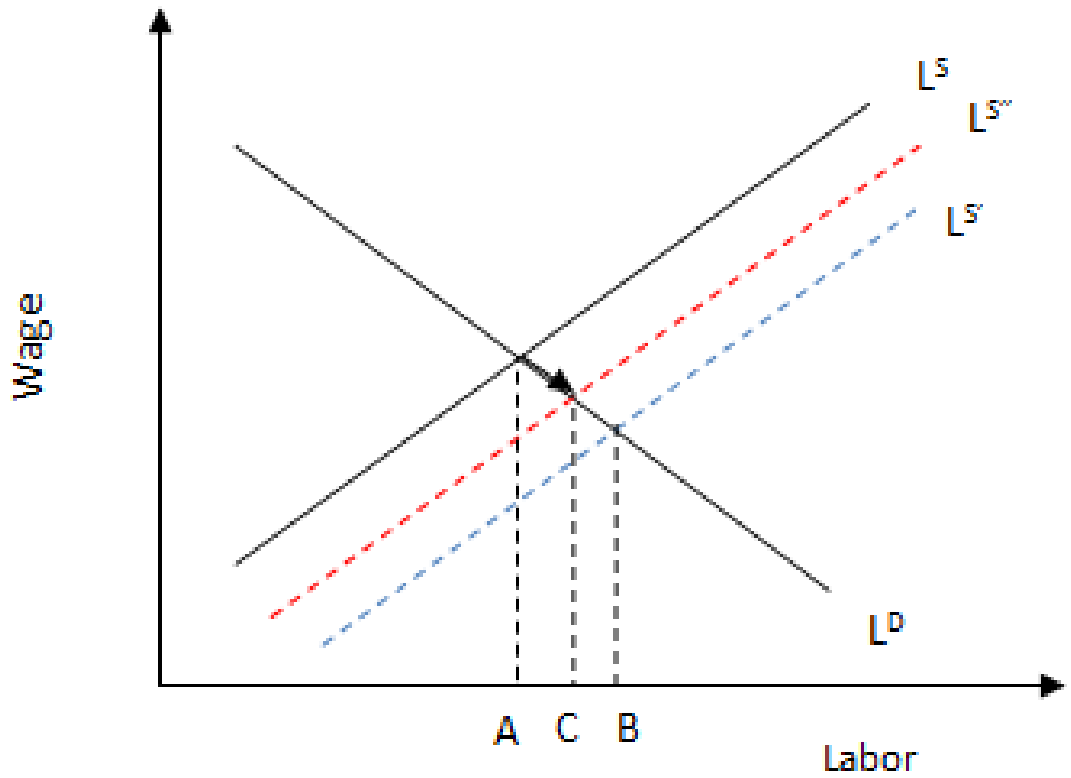
$$\frac{\partial \widetilde{c}_t}{\partial R_t^P} < 0 \Longrightarrow \frac{\partial l_t^S}{\partial R_t^P} > 0$$

Further, a positive interest rate shock always increases the fiscal policy wedge,i.e., $\frac{\partial \Gamma_t}{\partial R_t^P} > 0$ *An increase in* Γ_t *therefore dampens the outward shift of the labor supply:*

$$\left|\frac{\partial l_t^S}{\partial R_t^P}\right|_{\Gamma_t=0} > \left|\frac{\partial l_t^S}{\partial R_t^P}\right|_{\Gamma_t\neq 0} > 0.$$

Labor supply – interest rate shocks

From a one period shock in R at time period t



$L_t^s \uparrow$ to $L_t^{s'}$ because $\widetilde{c}_t$ instantaneously falls due to the intertemporal substitution effect. However, L_t^s shifts to $L_t^{s''}$ with $\Gamma_t \uparrow$.

The Labor Market Equilibrium – Demand side

- We get I_t^d from the firm's FOC

$$I_t^D = \left[\frac{(1-\alpha)A_t}{\widetilde{w}_t\left[(1-\theta)+R_{t-1}^P(\theta - s\theta_G)\right]}\right]^{\frac{1}{\alpha}} \frac{\widetilde{k}_{t-1}}{(1+\gamma)}.$$

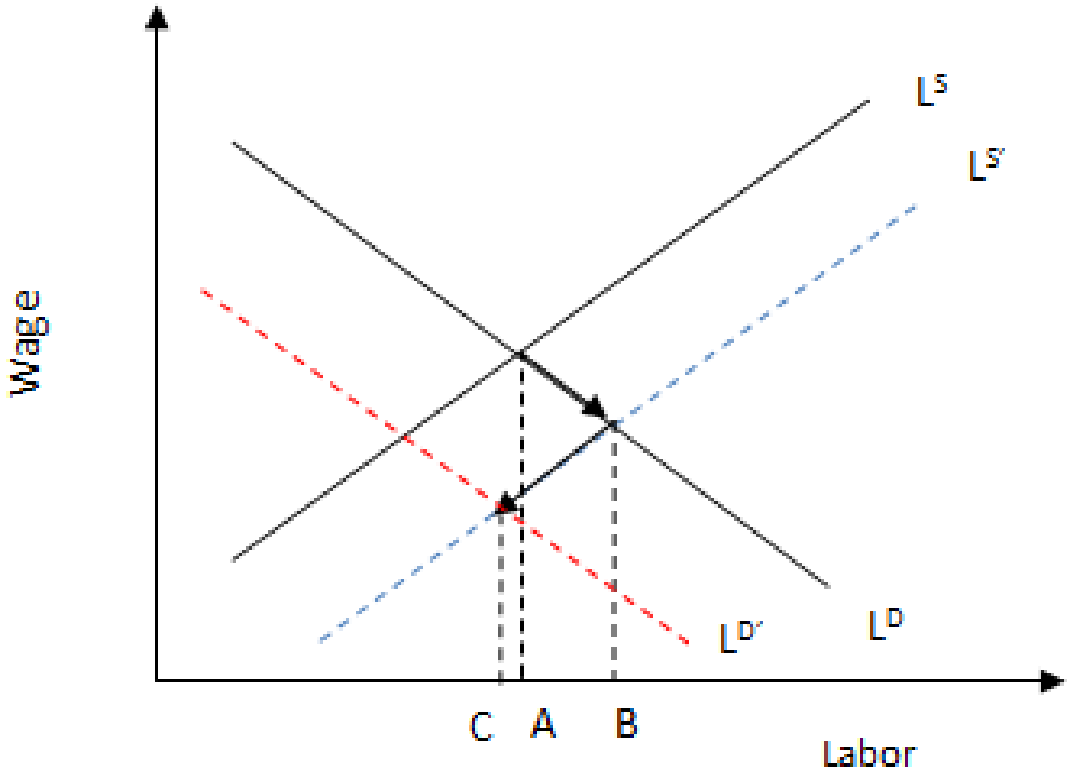
Proposition

A positive shock to interest rate R_t^P lowers labor demand only in time period $t+1$. However, the presence of θ_G and s, dampens the reduction in I_{t+1}^D. That is

$$\left|\frac{\partial I_{t+1}^D}{\partial R_t^P}\right|_{s\neq 0,\theta_G\neq 0} < \left|\frac{\partial I_{t+1}^D}{\partial R_t^P}\right|_{s=0,\theta_G=0}.$$

Labor Demand – interest rate shocks

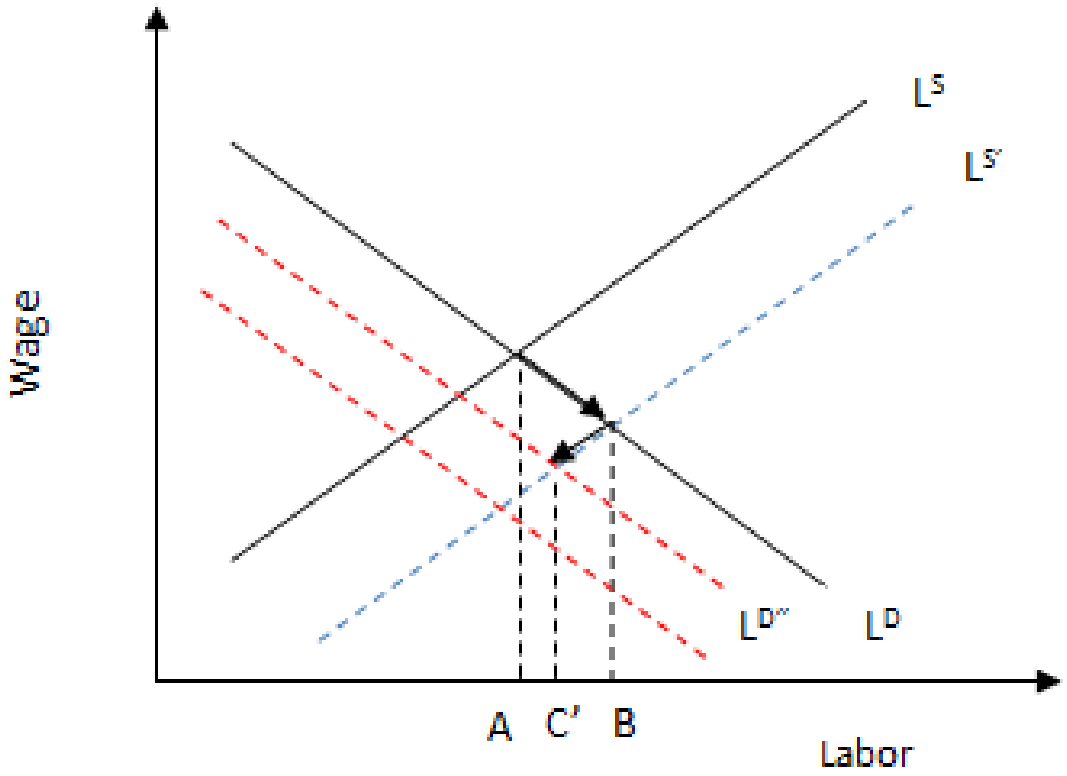
At time period $t+1$



$I^d_{t+1} \downarrow$ because it depends on R^P_t

Labor Demand – interest rate shocks

At time period $t+1$ - with a working capital loan subsidy



Shocks

- TFP

$$\widehat{A}_t = \rho_A \widehat{A}_{t-1} + \varepsilon_{At}. \tag{13}$$

- For interest rates,

$$R_t = R_t^* D_t. \tag{14}$$

- R_t^* is the US real interest rate. Therefore,

$$\widehat{R}_t = \widehat{R}_t^* + \widehat{D}_t. \tag{15}$$

Interest rates and country spreads

- $\widehat{R}_t^*$ is estimated as

$$\widehat{R}_t^* = \rho_R \widehat{R}_{t-1}^* + \varepsilon_{Rt}. \tag{16}$$

- There are two different models for country spreads
  - The Exogenous Case

$$\widehat{D}_t = \rho_D \widehat{D}_{t-1} + \varepsilon_{Dt}. \tag{17}$$

  - The Induced Case

$$\widehat{D}_t = -\eta E_t \widehat{A}_{t+1} + u_t. \tag{18}$$

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Calibration

- We estimate the DGP for India assuming annual HP-filtered de-trended series from 1980 - 2008. All shocks are for the moment assumed to be uncorrelated.
- TFP (Penn World Tables Version 8.0 (2014))

$$\begin{aligned} \widehat{A}_t &= \rho_A \widehat{A}_{t-1} + \varepsilon_{At}. \\ \rho_A &= 0.42 \ (0.012) \end{aligned}$$

- We use annual World Bank data on real lending rates, i.e.,

$$R_t^P = R_t^* D_t. \tag{19}$$

- R_t^* is the US real interest rate. Therefore,

$$\widehat{R}_t^P = \widehat{R}_t^* + \widehat{D}_t.$$

Interest rates and country spreads

- $\widehat{R}_t^*$ is estimated as

$$\begin{aligned} \widehat{R}_t^* &= \rho_R \widehat{R}_{t-1}^* + \varepsilon_{Rt}. \\ \rho_R &= 0.462 \ (0.004) \end{aligned}$$

- Country spreads are modelled as

$$\begin{aligned} \widehat{D}_t &= -\eta E_t \widehat{A}_{t+1} + u_t. \\ \eta &= 0.4425 \ (0.006) \\ & \quad u_t \text{ is a random shock} \end{aligned}$$

- This is the "*Induced Case*" as in Neumeyer and Perri (2005), which is the relevant case for India.

Parameters

Summary of parameter values.

Parameter name	Symbol	Value
Coefficient of risk aversion (calibrated)	σ	3.5
Share of consumption in utility function (calibrated)	μ	0.75
Depreciation rate	δ	0.0375
Rate of technical progress (Quarterly) (Penn World Tables)	γ	0.004275
Ratio of wage bill to be paid in advance	θ	1
Real Interest Rate (World Bank Lending Rates)	R^P	1.0623
Effective discount rate (calibrated)	$\tilde{\beta}$	$\frac{(1+\gamma)}{R^P}$
Discount rate (calibrated)	β	$\frac{\tilde{\beta}}{(1+\gamma)^{\mu(1-\sigma)}}$
Share of capital in production (Ghate et al., 2012)	α	0.4
Bond holding costs (Tiryaki, 2012)	κ	0.01
Capital adjustment costs	ϕ	200
Subsidized portion of the advance wage bill ratio	θ_C	$\leq\theta$
Subsidy on working capital loans	s	$1-\frac{1}{R^P}$
Tax on consumption (VAT rate in India)	τ_c	0.12
Tax on labor income (Poirson, 2006)	τ_w	0.01
Tax on capital income	τ_k	$=\tau_w$
Weight of government consumption in c_t^*	Θ	≥ 1
Steady state TFP	$\bar{A}$	1

Experiment 1: Single period TFP shock

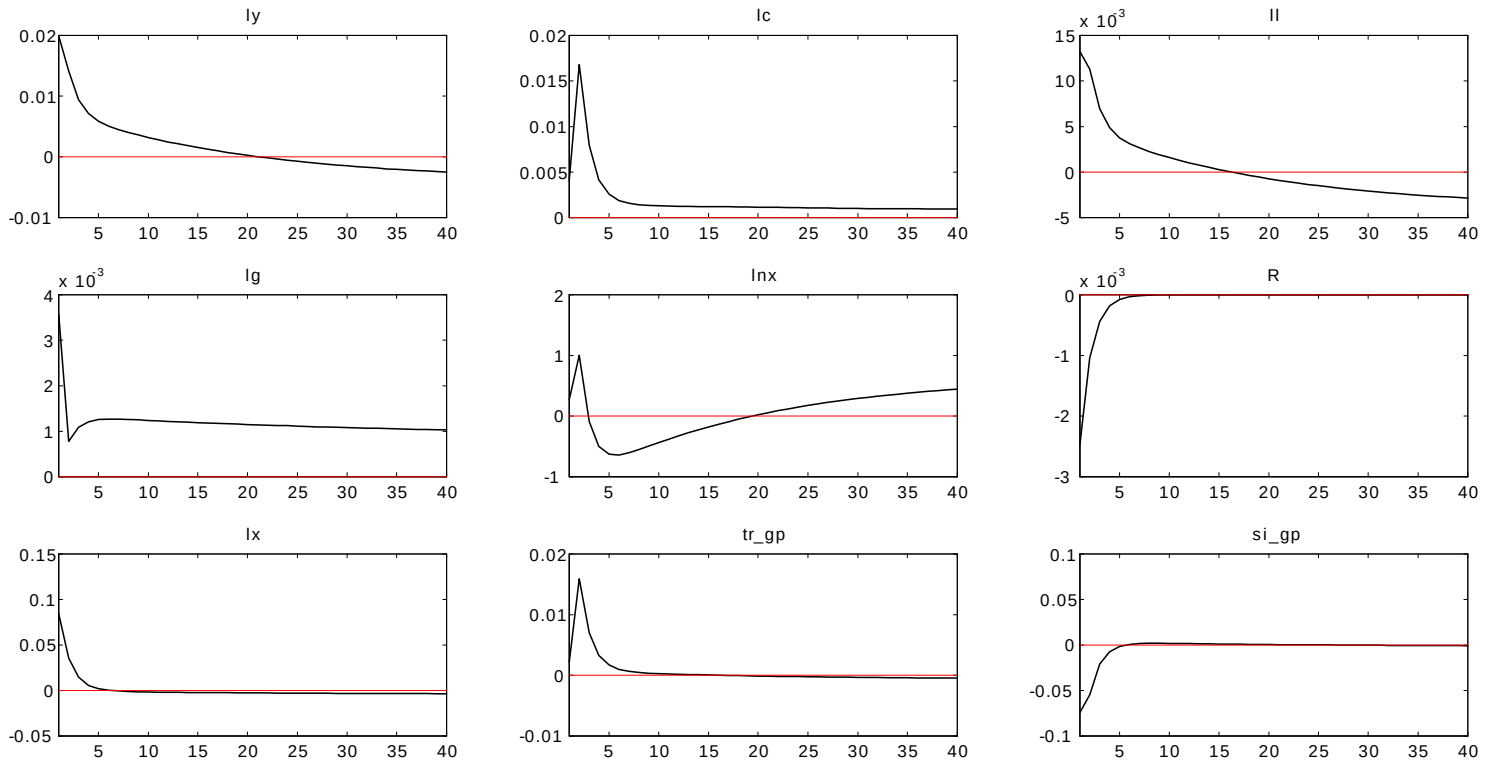

Figure: Single period TFP ($\widehat{A}$) shock

Experiment 2: Single period interest rate shock

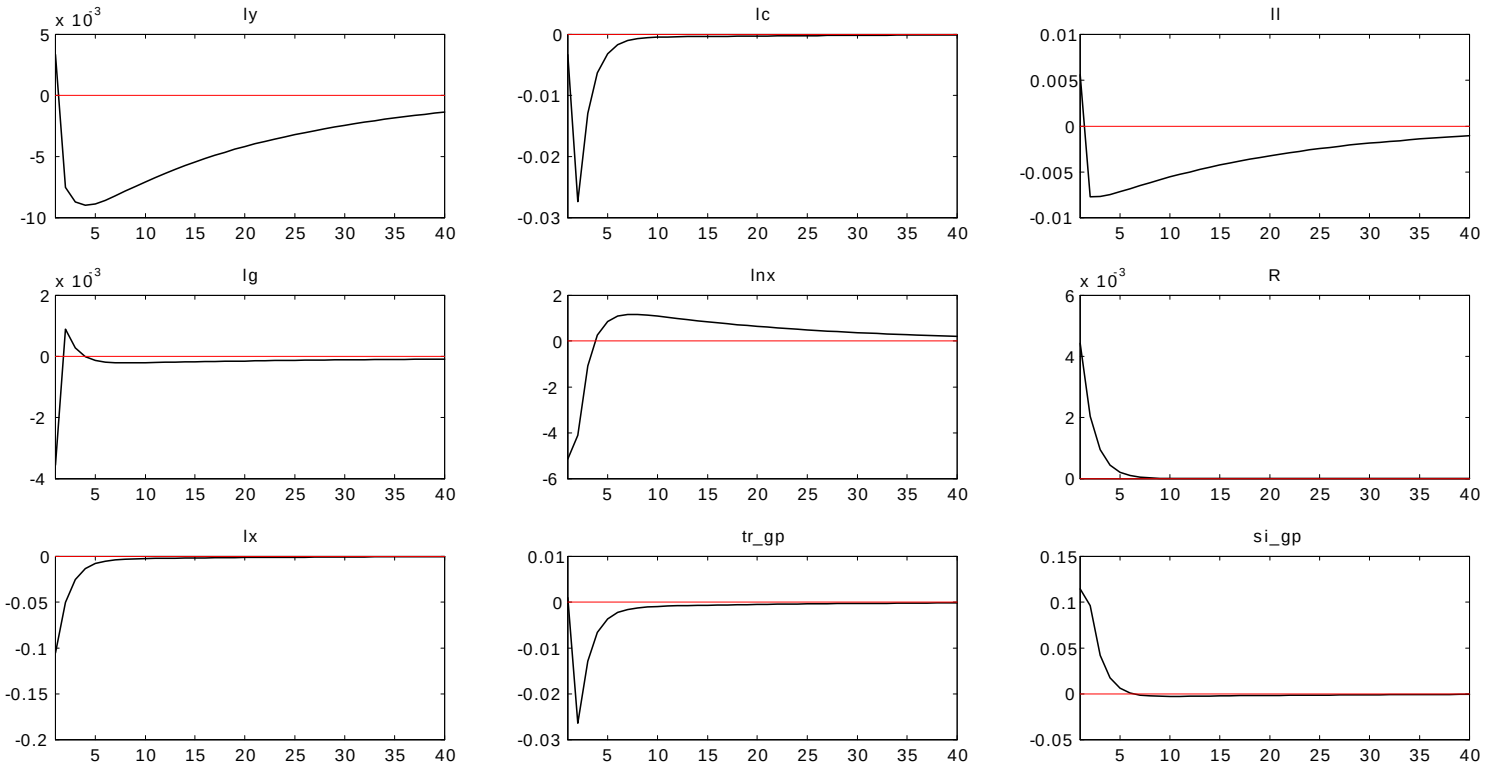

Figure: Single period TFP ($\widehat{R}^*$) shock

Experiment 3: Single period u-shock

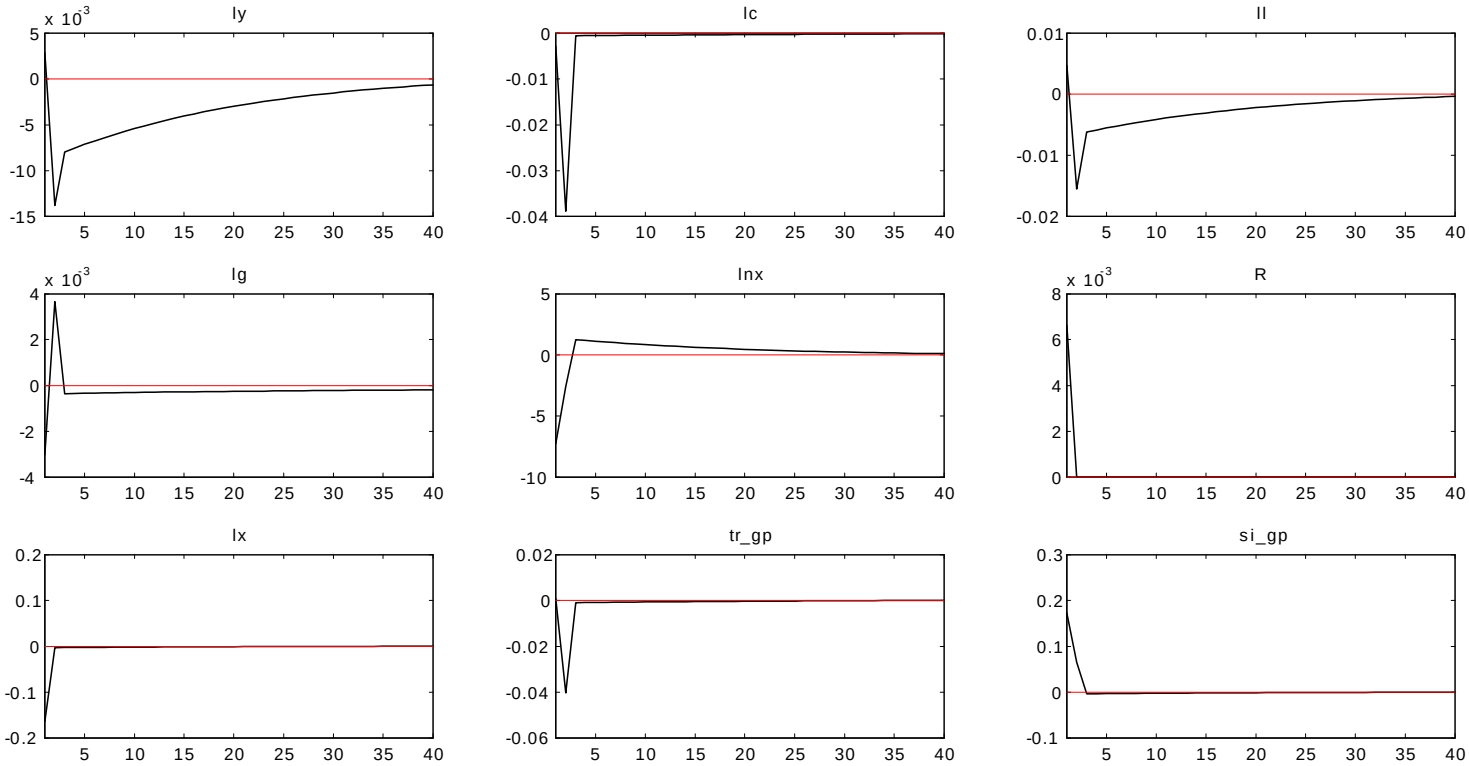

Figure: Single period TFP ($\widehat{D}$) shock

Calibration Results

Moments	No Fiscal Policy	Only G	G and S	Actual Data
(1)	(2)	(3)	(4)	(5)
$\rho(C, Y)$	0.6033	0.4586	0.5126	0.51
$\rho(X, Y)$	0.1330	0.1022	0.1103	0.69
$\rho(R, Y)$	-0.0832	-0.0458	-0.0546	0.38
$\rho(\frac{NX}{Y}, Y)$	0.1912	0.2562	-0.1505	-0.15
$\rho(G, Y)$	–	0.6882	-0.32	-0.35
$\sigma(C)/\sigma(Y)$	0.3548	0.3236	1.20	1.31
$\sigma(X)/\sigma(Y)$	10.9	10.11	10.23	3.43
$\sigma(R)/\sigma(Y)$	0.48	0.439	0.44	1.77
$\sigma(NX)/\sigma(Y)$	11.13	10.57	10.64	1.04
$\sigma(G)/\sigma(Y)$	–	0.358	1.55	5.53

Calibration Results: Goodness of fit improves when we add government expenditures with subsidies.

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Moments	G and S	G and S (with high Θ)	Actual Data
(1)	(2)	(3)	(4)
$\rho(C, Y)$	0.5126	0.5045	0.51
$\rho(X, Y)$	0.1103	0.0247	0.69
$\rho(R, Y)$	-0.0546	0.0754	0.38
$\rho(\frac{NX}{Y}, Y)$	-0.1505	-0.1792	-0.15
$\rho(G, Y)$	-0.32	-0.0229	-0.35
$\sigma(C)/\sigma(Y)$	1.20	1.69	1.31
$\sigma(X)/\sigma(Y)$	10.23	7.23	3.43
$\sigma(R)/\sigma(Y)$	0.44	0.28	1.77
$\sigma(NX)/\sigma(Y)$	10.64	7.82	1.04
$\sigma(G)/\sigma(Y)$	1.55	0.23	5.53

Implications for macroeconomic stability

- See IMF (2015, Chapter 2): Little agreement on whether governments should use discretionary fiscal policy beyond automatic stabilizers to limit fluctuations of macro conditions
- We show that fiscal policy dampens overall volatility, but there is a *trade-off*
  - A rise in Θ results in lesser volatility in X, R, NX, and G even though these outcomes obtain at the expense of consumption volatility.
- In addition, higher values of Θ make consumption more volatile. Big reduction in current consumption dominates the dampening effect of an increase in Γ on labor supply.
  - This makes the real interest rate mildly pro-cyclical because the productivity shock has also exerted a simultaneous contemporaneous positive income effect
- A rise in Θ also makes government consumption more counter-cyclical – primarily because of a reduction in tax revenues (which are mainly on account of τ_c due to more volatile reductions on private consumption) $\Rightarrow$ feedback effects

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Adding public debt to GGT 2016 - DGGT 2017

- Can we link country spreads over world interest rates to government debt to improve quantitative matching in GGT?
- In an extension to GGT 2016, Dave, Ghate, Gopalakrishnan, and Tarafdar (2017) exploit the risk premium channel to 1) improve goodness of fit in GGT 2016, and 2) understand when a contraction in fiscal policy is expansionary.
- While fiscal consolidation on the one hand lowers government spending, it also reduces the risk premium of the country thereby resulting in lower real interest rates. The net effect is therefore unclear.
- We estimate a DSGE model by adding government debt, along the lines of the standard literature (see Arellano (2008), Cicco et al. (2010), and Cuadra et al. (2010)) to GGT 2016. The risk premium is modelled as deviations of government debt / GDP ratio from a steady state level.

Some data on net interest payments and public debt

	General government net interest earning (+) / expense (-)	General government gross debt
	Percent of GDP	Percent of GDP
Brazil	-5.9	65.8
Chile	-0.2	15.4
Colombia	-2.4	44.3
Hong Kong SAR	2.0	0.2
Hungary	-3.9	76.5
Israel	-3.5	67.2
Jordan	-3.4	88.6
Korea	0.8	36.2
Malaysia	-1.8	55.5
Mexico	-2.7	49.4
Nigeria	-1.0	11.0
Slovak Republic	-1.6	53.8
Slovenia	-2.7	77.7
South Africa	-3.1	45.9
Turkey	-2.4	34.0
Uruguay	-3.0	61.8
India	-4.5	65.7
Source: IMF WEO. Note: All figures are simple averages for years 2013-2015.		

DGGT 2017 - Brief description

- Households derive utility from effective consumption (C^*), leisure $(1-H)$, and government debt (D)
- A representative household maximizes utility:

$$\max_{\{C_t,H_t,D_t,K_t\}} E_0 \sum_{t=0}^{\infty} \beta^t \left[\mu \ln\left(C_t^*\right) + (1-\mu)\ln\left(1-H_t\right) + \varphi \ln\left(D_t\right)\right], \tag{20}$$

subject to,

$$C_t^* = C_t + \Theta G_t,$$

$$C_t + K_t - (1-\delta)K_{t-1} + \frac{\phi}{2}K_{t-1}\left[\frac{K_t}{K_{t-1}} - 1\right]^2 + D_t + \frac{\kappa}{2}Y_t\left[\frac{D_t}{Y_t} - \frac{\bar{D}}{\bar{Y}}\right]^2 + b_t + \frac{\kappa}{2}Y_t\left[\frac{b_t}{Y_t} - \frac{b}{\bar{Y}}\right]^2$$

$$= (1-\tau_w)W_tH_t + (1-\tau_k)R_tK_{t-1} + R_{t-1}^G D_{t-1} + R_{t-1}^P b_{t-1} + T_t$$

- Government spending is exogenous, i.e., $G_t \sim CSSP$; the government also extends (imposes) a lump-sum transfer (tax) T_t to (on) households

DGGT 2017 - Brief description

- The government budget constraint is given by

$$G_t + R^G_{t-1} D_{t-1} + T_t = \tau_w W_t H_t + \tau_k R_t K_t + D_t, \quad (21)$$

$$R^G_t = R^*_t \eta_t \quad (22)$$

- We analyze two cases

$$\eta_t = \eta \left(\frac{G_t}{Y_t} - \frac{G}{Y} \right) + \varepsilon_t \quad \text{(Case 1)}$$

$$\eta_t = \eta \left(\frac{D_t}{Y_t} - \frac{D}{Y} \right) + \varepsilon_t \quad \text{(Case 2)}$$

- Case 1: Government balances budget
- Case 2: Government issues debt

DGGT 2017 - Brief description

- The firm seeks to maximize it's profits given by,

$$\max_{\{K_t, H_t\}} \; Y_t - R_t K_{t-1} - (1-\theta) W_t H_t - \theta W_t H_t R^P_{t-1}, \tag{23}$$

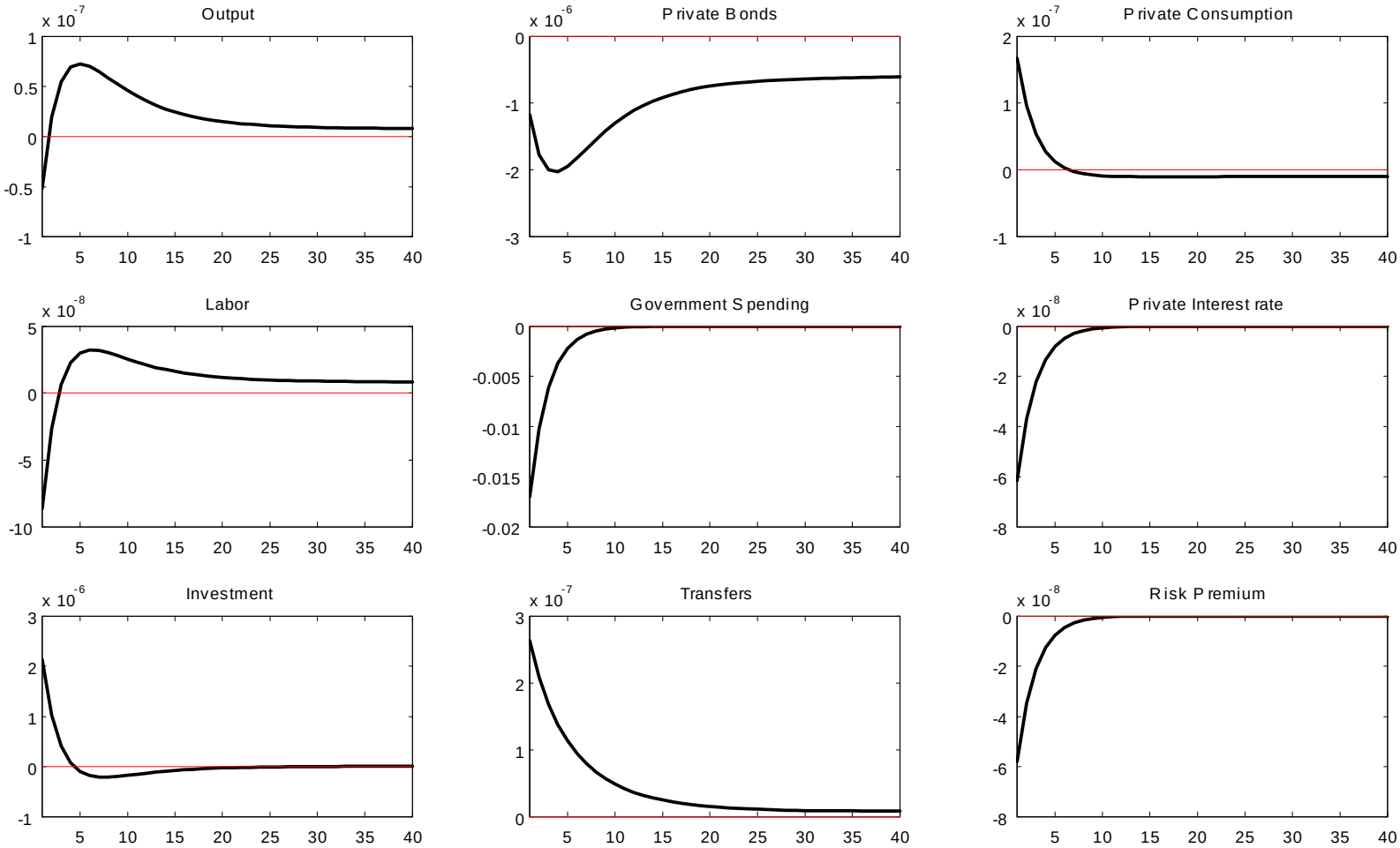
subject to

$$Y_t = A_t K^{\alpha}_{t-1} H^{1-\alpha}_t \tag{24}$$

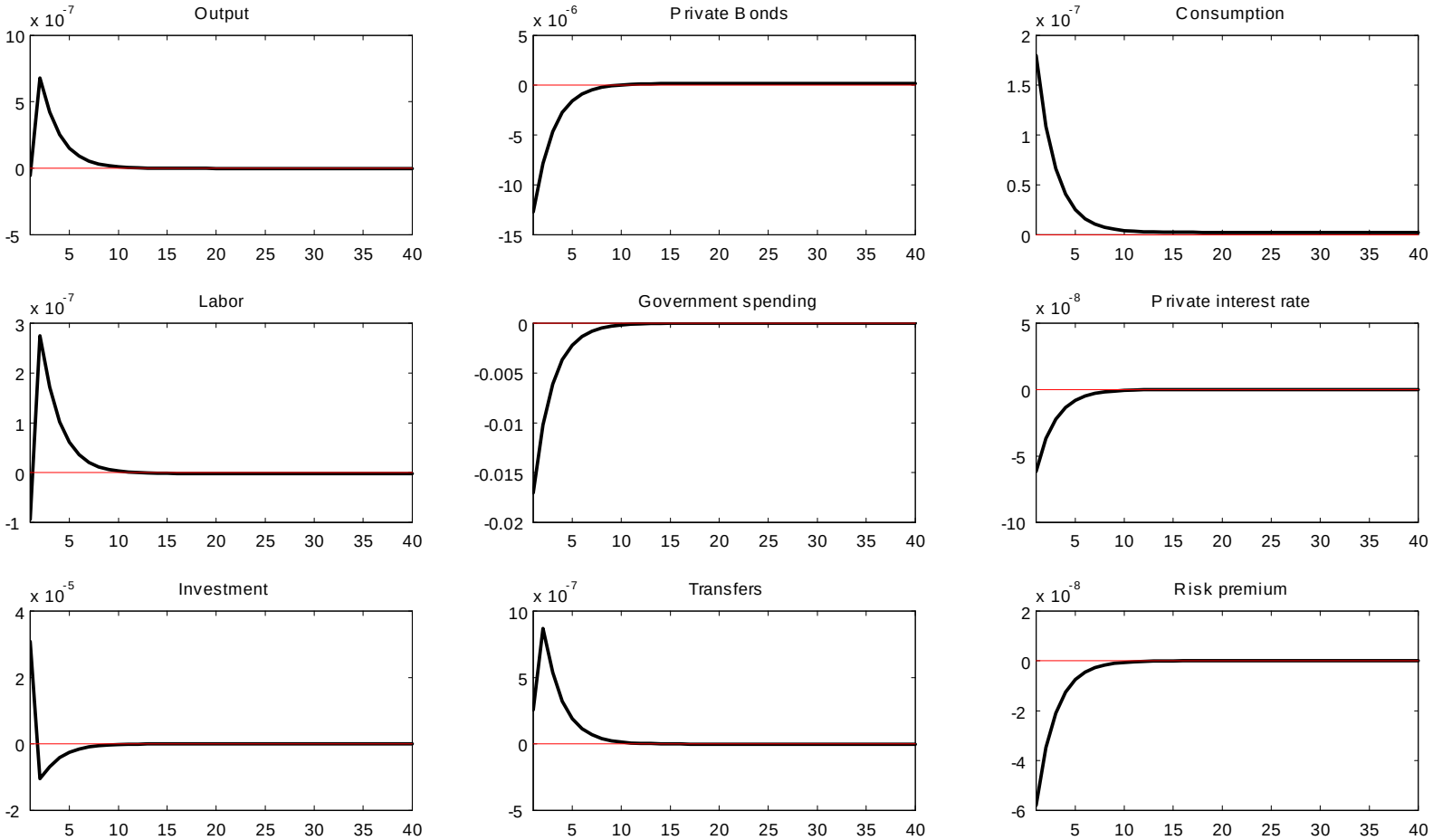
$$A_t \sim CSSP \tag{25}$$

$$R^P_t = R^G_t \exp(\bar{A} - A_t) \tag{26}$$

Case 1: Balanced Budget: High adjustment cost of capital



Case 1: Balanced Budget: Low adjustment cost of capital



Case 2: Public debt

- Ongoing

Concluding Remarks

- Need a rigorous model to understand the Indian business cycle to provide a framework for macro-stability
- Extensions to NP 2005 provide a suitable avenue for future research on the Indian business cycle
  - Needs to be augmented with a better description of labor markets (with search)
- Asymmetric effects of monetary policy.
- Calibration versus estimation ?

Thank you