Growth, Employment, and Business Cycles

Chetan Ghate\textsuperscript{1}

Indian Statistical Institute, Delhi Centre.

ICRIER G20 Conference, 2013

\textsuperscript{1}This presentation draws on joint work with Pawan Gopalakrishnan (ISI, Delhi) and Suchismita Tarafdar (SNU).
Jobs and Growth have been a top priority for the Russian presidency.

In the G20 Leader’s declaration (September 2013):
- Unemployment and underemployment in many countries, particularly among young people, remains one of the key challenges confronting the global economy and a top priority for the G20.

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- Job creation through sound monetary and fiscal policies, structural policies to foster innovation and promotion of smaller enterprises;
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India: some facts

- Labor force roughly 600 million
- Work force is roughly 470 million
- Formal sector: (10%); informal sector (90%)
- A lot of self employment in the 90% category
- 47 million (20 million - public sector - including PSUs; 10 million - quasi-public sector; 17 million "corporate sector")
Key policy questions

- How can we think about employment, business cycles, and fiscal policy in EMEs?
- What are the labor market implications of interest rate shocks?
- Some recent examples:
  - Tapering of QE3 $\rightarrow R \uparrow$
  - European sovereign debt crisis $\rightarrow R \uparrow$
  - Current EME currency crisis $\rightarrow R \uparrow$

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A large empirical literature (Agénor et al. (2000), Male (2010), Rand and Tarp (2002), and Ghate et al. (2013)) has identified the key stylized facts in EME business cycles.

Compared to Advanced Economies (AEs), in Emerging Market Economies (EMEs)

- output \((Y)\) is more volatile
- interest rates \((R)\) are counter-cyclical
- consumption \((C)\) is pro-cyclical and more volatile
- net exports \((NX)\) are more volatile than output and are more counter-cyclical than in AEs
- and there is no consensus on the cyclical property of government expenditures \((G)\).

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### Business cycle statistics for developed and emerging economies using quarterly data.

<table>
<thead>
<tr>
<th></th>
<th>Developed economies</th>
<th>Emerging economies</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Std. dev.</td>
<td>Rel. std. dev.</td>
</tr>
<tr>
<td>Real GDP</td>
<td>1.34</td>
<td>1.00</td>
</tr>
<tr>
<td>Private consumption</td>
<td>0.94</td>
<td>0.66</td>
</tr>
<tr>
<td>Investment</td>
<td>3.41</td>
<td>0.67</td>
</tr>
<tr>
<td>Trade balance</td>
<td>1.02</td>
<td>-0.17</td>
</tr>
</tbody>
</table>

*Source: Aguiar and Gopinath, 2007.*
The Indian business cycle

Ghate et al. (2013)

<table>
<thead>
<tr>
<th></th>
<th>Std. dev.</th>
<th>Rel. std. dev.</th>
<th>Cont. corr.</th>
<th>First ord. auto corr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real GDP</td>
<td>1.18</td>
<td>1.00</td>
<td>1.00</td>
<td>0.73</td>
</tr>
<tr>
<td>Private consumption</td>
<td>1.54</td>
<td>1.31</td>
<td>0.51</td>
<td>0.67</td>
</tr>
<tr>
<td>Investment</td>
<td>4.08</td>
<td>3.43</td>
<td>0.69</td>
<td>0.80</td>
</tr>
<tr>
<td>CPI</td>
<td>1.30</td>
<td>1.09</td>
<td>-0.29</td>
<td>0.70</td>
</tr>
<tr>
<td>Exports</td>
<td>8.79</td>
<td>7.40</td>
<td>0.31</td>
<td>0.77</td>
</tr>
<tr>
<td>Imports</td>
<td>8.93</td>
<td>7.52</td>
<td>0.45</td>
<td>0.54</td>
</tr>
<tr>
<td>Govt expenditure</td>
<td>6.69</td>
<td>5.53</td>
<td>-0.35</td>
<td>0.005</td>
</tr>
<tr>
<td>Net exports</td>
<td>1.24</td>
<td>1.04</td>
<td>-0.15</td>
<td>0.45</td>
</tr>
<tr>
<td>Real interest rate</td>
<td>2.11</td>
<td>1.77</td>
<td>0.38</td>
<td>0.372</td>
</tr>
<tr>
<td>Nominal exchange rate</td>
<td>4.61</td>
<td>3.88</td>
<td>-0.54</td>
<td>0.82</td>
</tr>
<tr>
<td>M1 (narrow money)</td>
<td>3.13</td>
<td>2.64</td>
<td>0.5</td>
<td>0.105</td>
</tr>
<tr>
<td>M3 (broad money)</td>
<td>1.79</td>
<td>1.50</td>
<td>0.06</td>
<td>0.40</td>
</tr>
<tr>
<td>Reserve money</td>
<td>4.53</td>
<td>3.82</td>
<td>0.47</td>
<td>0.50</td>
</tr>
<tr>
<td>CPI inflation</td>
<td>0.88</td>
<td>0.74</td>
<td>0.05</td>
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The Neumeyer and Perri model

- Firms face a working capital constraint + preferences are GHH.
  \[ R \uparrow \Rightarrow L^D \downarrow \]
- Because GHH utility \( L^S \) remain unchanged \( \Rightarrow \) equilibrium labor falls, \( Y \) falls \( \Rightarrow \rho (R, Y)^{EME} < 0 \)
- Intertemporal substitution effect \( \Rightarrow C \downarrow \) instantaneously, \( S \uparrow \)
  \[ R \uparrow \Rightarrow X \downarrow \]
- \( (S - X) \uparrow \Rightarrow \rho (NX, Y) < 0 \)
- Does not explain government expenditure counter-cyclicality and pro/a-cyclicality of interest rates
A single model for EMEs?

- We need to explain the following stylized facts:
  1. \( \sigma(X) > \sigma(C) > \sigma(Y) \)
  2. \( \rho(NX, Y) < 0 \)
  3. \( \rho(G, Y) \leq 0 \) (in India, \( \rho(G, Y) < 0 \Rightarrow \) Govt exp. are stabilizing)
  4. \( \rho(R, Y) \leq 0 \) (in India, \( \rho(R, Y) > 0 \), puzzling but true in many EMEs, see Male (2010))

- We need a better understanding of fiscal policy and labor market dynamics

- To answer this we extend Neumeyer and Perri (2005)
  - We add fiscal policy
  - We make preferences Cobb-Douglas - enables \( \rho(R, Y) \leq 0 \)

- We then calibrate the model to qualitatively match EME business cycles using
  - TFP shocks
  - interest rate and country spread shocks.
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The Model: Firms

- The firm maximizes

\[ \pi_t = A_t k_{t-1}^\alpha [(1 + \gamma)^t t_t]^{1-\alpha} - w_t l_t - r_t k_{t-1} \]

\[ - \left( R_{t-1}^G - 1 \right) \theta_G w_t l_t - \left( R_{t-1}^P - 1 \right) (\theta - \theta_G) w_t l_t. \] (1)

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

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

- We obtain \( w_t \) and \( r_t \).
The Model: Households

- A stand-in representative agent maximizes

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

where \( \forall t \ c^*_t = c_t + \Theta G_t, 0 < \Theta < 1 \)

- subject to

\[
(1 + \tau_c) c_t + x_t + b_t + \kappa(b_t) \leq (1 - \tau_w) w_t l_t
\]

\[+(1 - \tau_k) r_t k_{t-1} + R_{t-1}^P b_{t-1}.\]

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

\[
x_t = k_t - (1 - \delta) k_{t-1} + \Phi(k_t, k_{t-1}).
\]

- \( \Phi(k_t, k_{t-1}) \) is the investment adjustment cost.
The Model: Government

- The government balances its 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

\[
TR_t = \tau_c c_t + \tau_w w_t l_t + \tau_k r_t k_{t-1}.
\] (6)

- $S_t$ is the loan extended to firms

\[
S_t = \theta_G w_t l_t.
\]

- Therefore

\[
G_t = \tau_c c_t + \left\{ \left[ R^P_{t-1}(1 - s) - 1 \right] \theta_G + \tau_w \right\} w_t l_t + \tau_k r_t k_{t-1}.
\] (7)
The Labor Market Equilibrium

- We get $l^s_t$ from the representative agent’s FOC

\[(1 - l^s_t) = \frac{(1 - \mu)}{\mu} \left( \frac{1 + \tau_c}{1 - \tau_w} \right) \frac{\tilde{c}^*_t}{\tilde{w}_t} \]  \hspace{1cm} \text{(8)}

- Magnitude of shift depends on the tax wedge: \( \left( \frac{1 + \tau_c}{1 - \tau_w} \right) \)

- We get $l^d_t$ from the firm’s FOC

\[l^D_t = \left[ \frac{(1 - \alpha)A_t}{\tilde{w}_t \left[ (1 - \theta) + R^P_{t-1} (\theta - s \theta_G) \right]} \right]^{\frac{1}{\alpha}} \frac{\tilde{k}_{t-1}}{(1 + \gamma)} \]

- Magnitude of shift depends on: $\theta_G$ and $s$
Labor market dynamics with interest rate shocks

From a one period shock in $R$ at time period $t$

$L^s_t \uparrow$ and $L^d_t$ remains unchanged because $\tilde{c}_t$ instantaneously falls due to the intertemporal substitution effect, whereas $L^d_t$ depends on $R^P_{t-1}$. 
Labor market dynamics with interest rate shocks

At time period $t + 1$

$I_{t+1}^d \downarrow$ because it depends on $R_t^P$
Labor market dynamics with interest rate shocks

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

- Annual HP-filtered de-trended series from 1980 - 2008. All shocks are assumed to be uncorrelated.

- TFP (Bhattacharya et al. (2013))

\[ \hat{A}_t = \rho_A \hat{A}_{t-1} + \varepsilon_{At}. \]
\[ \rho_A = 0.485^{***} (0.0147) \]

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

\[ R^P_t = R^*_t D_t. \] (9)

- \( R^P_t \) is the Indian real interest rate, \( R^*_t \) is the US real interest rate and \( D_t \) is the country spread over \( R^*_t \) such that

\[ D_t = \frac{R^P_t}{R^*_t}. \]

- Therefore,

\[ \hat{R}^P_t = \hat{R}^*_t + \hat{D}_t. \]
Interest rates and country spreads

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

$$\hat{R}_t^* = \rho_R \hat{R}_{t-1}^* + \epsilon_{Rt}.$$  

$$\rho_R = 0.455^{***} (0.0105)$$

- We conduct two sets of experiments
  - the *exogenous country risk case* (not statistically significant)
    
    $$\hat{D}_t = \rho_D \hat{D}_{t-1} + \epsilon_t$$  
    
    $$\rho_D = 0.143 \ (0.0167)$$
  
  - the *induced country risk case*
    
    $$\hat{D}_t = -\eta \hat{E}_t \hat{A}_{t+1} + u_t.$$  
    
    $$\eta = 0.9268^{***} \ (0.0146)$$
    
    $u_t$ is a random shock
Interest rates and country spreads

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    \]
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    \( u_t \) is a random shock
## Table 1: Parameters

<table>
<thead>
<tr>
<th>Parameter Name</th>
<th>Symbol</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coefficient of risk aversion (calibrated)</td>
<td>$\sigma$</td>
<td>3</td>
</tr>
<tr>
<td>Share of consumption in utility function</td>
<td>$\mu$</td>
<td>0.82</td>
</tr>
<tr>
<td>(Chakraborty, (2008))</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depreciation rate*</td>
<td>$\delta$</td>
<td>0.025</td>
</tr>
<tr>
<td>Rate of technical progress</td>
<td>$\gamma$</td>
<td>0.047</td>
</tr>
<tr>
<td>(Bhattacharya et al. (2013))</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ratio of wage bill to be paid in advance*</td>
<td>$\theta$</td>
<td>0.6, 1</td>
</tr>
<tr>
<td>Discount rate (calibrated)</td>
<td>$\beta$</td>
<td>0.99</td>
</tr>
<tr>
<td>Effective discount rate (calibrated)</td>
<td>$\tilde{\beta}$</td>
<td>$\beta(1 + \gamma)(1 - \sigma)$</td>
</tr>
<tr>
<td>Real interest rate (calibrated)</td>
<td>$\bar{R}$</td>
<td>$(1 + \gamma)^{\beta(1 - \sigma)}$</td>
</tr>
<tr>
<td>Share of capital in production</td>
<td>$\alpha$</td>
<td>0.4</td>
</tr>
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<td>(Ghate et al. (2012))</td>
<td></td>
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<tr>
<td>Bond holding costs (Tiryaki (2012))</td>
<td>$\kappa$</td>
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</tr>
<tr>
<td>Capital adjustment costs*</td>
<td>$\phi$</td>
<td>50</td>
</tr>
<tr>
<td>Subsidized portion of the advance wage bill ratio*</td>
<td>$\theta_s$</td>
<td>0.5*</td>
</tr>
<tr>
<td>Subsidy on working capital loans*</td>
<td>$s$</td>
<td>0.5*</td>
</tr>
<tr>
<td>Tax on consumption*</td>
<td>$\tau_c$</td>
<td>0.12</td>
</tr>
<tr>
<td>Tax on labor income*</td>
<td>$\tau_w$</td>
<td>0.15</td>
</tr>
<tr>
<td>Tax on capital income*</td>
<td>$\tau_k$</td>
<td>0.15</td>
</tr>
<tr>
<td>Edgeworth substitutability of government consumption*</td>
<td>$\Theta$</td>
<td>0.5*</td>
</tr>
<tr>
<td>Steady state TFP*</td>
<td>$\overline{\lambda}$</td>
<td>1</td>
</tr>
</tbody>
</table>

(* indicates that values for these parameters have been assumed)
Single period interest rate shock - Exogenous case
Transmission of the interest rate shock

- On impact,
  - $R_t^* \uparrow \Rightarrow R_t^P \uparrow \Rightarrow C_t \downarrow \Rightarrow I_t \uparrow \Rightarrow Y_t \uparrow$ since $Y_t = Y(k_{t-1}, I_t)$ and $k_{t-1}$ is pre-determined
  - $C_t \downarrow \Rightarrow S_t \uparrow ; R_t^P \uparrow \Rightarrow X_t \downarrow \Rightarrow (S_t - X_t) \uparrow$
  - $R_t^P \uparrow \Rightarrow G_t \uparrow$ and $TR_t \downarrow$ because $C_t \downarrow$ dominates $\Rightarrow (TR_t - G_t) \downarrow$
  - $|S_t - X_t| > |TR_t - G_t| \Rightarrow NX_t \uparrow$

- A single period interest rate shock leads to a worsening public sector imbalance.
- Output does not return to the steady state value even after 40 quarters!
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Calibration Results - Exogenous case (with multi period shocks)

With all three shocks ($\hat{A}$, $\hat{R}^*$ and $\hat{D}$)

We observe:

- $\rho (C, Y) > 0$ (rising interest income makes $C$ pro-cyclical)
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Observation: IRFs similar to the exogenous case, except that the magnitudes are dampened.

This is because TFP shocks offset interest rate shocks (which changes the policy functions).
Calibration Results - Induced case (with multi period shocks)

- With all three shocks ($\hat{A}$, $\hat{R}^*$ and $u$)
- The transmission of shocks on impact are identical. However, we observe:
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Observation 1: We recover the standard EME business cycle stylized facts

Observation 2: The magnitudes of $\rho(G, Y)$ and $\rho(R, Y)$ crucially depend on $s$ and $\theta_G$. 

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Comparison

<table>
<thead>
<tr>
<th>Correlations</th>
<th>Exogenous</th>
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</tr>
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<tbody>
<tr>
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<td>$&gt; 0$</td>
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Unlike in the exogenous case

- A positive and persistent productivity shock $E_t \hat{A}_{t+1}$ causes a reduction in interest rates
- At the same time positive productivity shock causes positive income effects
- Private investments become pro-cyclical because of TFP shocks, and due to dampened interest rates.
- This reinforces $\rho (R, Y) < 0$.

The positive income effects due to TFP causes $\rho (NX, Y) < 0$
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- A positive shock in $R^P$ or $D$ increases $G$ on impact
- However, $\rho(G, Y) < 0$ because
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Takeaway for G20

- Interest rate shocks have implications for labor market dynamics and EME business cycles
- TFP shocks can moderate the negative effects of interest rate shocks
- Fiscal policy matters for the transmission of interest rate shocks to labor market dynamics
- Our framework allows us to quantify this mechanism
- These issues are relevant to the G20
Thank you!