Motivation (1)

- Economic growth is volatile in small, emerging open economies
- The literature has identified two main candidates to explain this volatility:
  - Shocks to the trend of technological progress (Aguiar and Gopinath, 2007 - AG)
  - Shocks to the cost of external finance (García-Cicco, Pancrazi and Uribe, 2010 - GPU)
- Empirical evidence is mixed, but interest premium shocks seem to be important
Motivation (2)

- Visegrad countries (CZ,HU,PL,SK) good laboratory:
  - Highly open both to trade and finance, with relatively smooth convergence in the last 20 years
  - Convergence process broadly in line with neo-classical growth model

- Financial crisis
  - Both trend changes and financial shocks “make sense”
Growth in the CEE countries

Baksa - Kónya
Interest premium and economic growth: the case of CEE
EMBI spreads

Interest premium and economic growth: the case of CEE
What do we do?

- We estimate a simple stochastic neoclassical growth model
  - Relative importance of trend and interest premium shocks
- Estimation on a country panel: CZ, HU, PL, SK
  - Short time series, similar economic structure
  - Allow for common and country-specific shock components
- Methodological innovation
  - Working capital channel
  - Adjustment costs to consumption and investment
Main results

1. Trend shocks to productivity are the most important drivers of overall GDP growth.
2. Interest premium shocks are important for the composition of growth.
3. Transitory shocks to productivity are unimportant.
4. The common ("global") components of the trend and premium shocks are strongly linked to European Union developments.
5. Investment has a large idiosyncratic component, which co-moves well with the availability of EU structural funds.
The model

- A simple open economy RBC model
  - Investment with adjustment costs
  - Debt-dependent interest premium

- Why RBC?
  - Growth (not BC) horizon, annual data
  - Key shocks: productivity (growth + level) + premium
  - Residual shocks: investment + government + labor

- Two extensions
  - Working capital
  - Hours observed
Households solve

\[ E_0 \sum_{t=0}^{\infty} \beta^t \left[ \log \left( C_t - \chi \bar{C}_{t-1} \right) - \frac{\theta_t h_t \omega_t}{\omega} \right] \]

s.t. \[ C_t + D_t = W_t h_t + \frac{D_{t+1}}{R_t} + \Pi_t + \Xi_t \]

- \( \Xi_t \): fiscal shock
- \( \theta_t \): labor market shock
Firms

- Firms solve

\[
\Pi_t = \left[ \gamma e^{a_t} K_t^\alpha (X_t h_t)^{1-\alpha} \right]^{1-\mu} \left( M_t^\mu - R_t M_t - R_t W_t h_t - I_t \right)
\]

\[
K_{t+1} = (1 - \delta) K_t + \left[ 1 - \frac{\phi}{2} \left( \frac{e^\varepsilon_{i,t} I_t}{I_{t-1}} - \bar{g} \right) \right]^2 I_t
\]

- \( M_t \): intermediate inputs
- Working capital needed for labor, intermediates
• First, solve for intermediates

\[ R_t M_t = \mu Y_t^G \]

\[ Y_t^G = \left( \frac{\mu}{R_t} \right)^{\frac{1}{\mu}} \gamma Y_t \]

• Intertemporal problem with value added

\[
\max \Pi_0 = \mathbb{E}_0 \sum_{t=0}^{\infty} \beta_{t,0} \left[ R_t^{\mu-1} e^{at} K_t^\alpha (X_t h_t)^{1-\alpha} - R_t W_t h_t - I_t \right]
\]

s.t. \[ K_{t+1} = (1 - \delta) K_t + \left[ 1 - \frac{\phi}{2} \left( \frac{l_t e^{\tilde{\epsilon}_{i,t}}}{l_{t-1}^{1.6}} - \bar{g} \right)^2 \right] l_t \]
Two key equation

Production function

\[ Y_t = e^{a_t} K_t^\alpha (X_t L_t)^{1-\alpha} \]
\[ \frac{X_t}{X_{t-1}} = g_t \]
\[ g_t = \rho_g g_{t-1} + (1 - \rho_g)\bar{g} + \nu^g_t \]

Interest premium

\[ r_t = r^* + \psi \left( e^{d_t/y_t - \bar{d}_y} - 1 \right) + \nu^r_t \]

Risk premium
The labor market

- Our specification

\[
\theta_t \omega_t = \frac{1 - \alpha}{R_t^{1-\mu} \cdot (C_t/Y_t)}
\]

- W/o working capital, premium increase is expansionary 😊
- Need intermediates for strong WC
The labor market

Interest premium shock

Hours worked

Effective output

Trade balance (%GDP)

Without Working Capital

Working Capital on wages

Baseline

Baksa - Kónya

Interest premium and economic growth: the case of CEE
Estimation

- Growth rates of GDP, investment, consumption, employment; trade balance to GDP ratio
- Shocks: productivity, premium, fiscal, labor, investment
- Common and local innovations:

\[
\log g^j_t = \rho_g \log g^j_{t-1} + \nu_{g,t} + \nu^j_g,
\]

\[
\epsilon^j_{r,t} = \rho_r \log \epsilon^j_{r,t-1} + \nu_{r,t} + \nu^j_r,
\]

- Sample period 1996-2016
- Estimate shock processes

Interest premium and economic growth: the case of CEE
Calibrated parameters

<table>
<thead>
<tr>
<th>Parameter name</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discount factor ( \beta )</td>
<td>0.98</td>
</tr>
<tr>
<td>Depreciation rate ( \delta )</td>
<td>0.05</td>
</tr>
<tr>
<td>Consumption habit ( \chi )</td>
<td>0.5</td>
</tr>
<tr>
<td>Investment cost ( \phi )</td>
<td>2</td>
</tr>
<tr>
<td>Frisch elasticity ( \omega )</td>
<td>1.6</td>
</tr>
<tr>
<td>Debt elasticity of interest ( \psi )</td>
<td>0.05</td>
</tr>
<tr>
<td>Steady state debt/GDP ( d_y )</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Parameter name</th>
<th>CZ</th>
<th>HU</th>
<th>PL</th>
<th>SK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital share ( \alpha )</td>
<td>0.375</td>
<td>0.290</td>
<td>0.262</td>
<td>0.347</td>
</tr>
<tr>
<td>Share of intermediates ( \mu )</td>
<td>0.603</td>
<td>0.576</td>
<td>0.562</td>
<td>0.604</td>
</tr>
<tr>
<td>Value of leisure ( \theta )</td>
<td>12.25</td>
<td>12.78</td>
<td>12.95</td>
<td>12.40</td>
</tr>
</tbody>
</table>
## Estimation results

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Prior mean</th>
<th>Post. mean</th>
<th>90% conf. int.</th>
<th>Prior</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\rho_a$</td>
<td>0.495</td>
<td>0.9287</td>
<td>0.8652</td>
<td>0.99</td>
</tr>
<tr>
<td>$\rho_g$</td>
<td>0.495</td>
<td>0.1488</td>
<td>0.0489</td>
<td>0.2487</td>
</tr>
<tr>
<td>$\rho_r$</td>
<td>0.495</td>
<td>0.7972</td>
<td>0.7328</td>
<td>0.8671</td>
</tr>
<tr>
<td>$\rho_\xi$</td>
<td>0.495</td>
<td>0.7974</td>
<td>0.654</td>
<td>0.9819</td>
</tr>
<tr>
<td>$\rho_i$</td>
<td>0.495</td>
<td>0.6769</td>
<td>0.5314</td>
<td>0.8394</td>
</tr>
<tr>
<td>$\rho_h$</td>
<td>0.495</td>
<td>0.9761</td>
<td>0.952</td>
<td>0.99</td>
</tr>
</tbody>
</table>

### AR(1) parameters

**Baksa - Kónya**

Interest premium and economic growth: the case of CEE
Variance decomposition

- What is the role of each shock in explaining the volatility of the main variables?
  - Model-based exercise, using simulated data
  - Highlights the importance of various shocks in the long-run
- Alternatively, one can do a historical shock decomposition on the actual data
  - Some interesting results, but lots of details
  - Available upon request
## Variance decomposition

<table>
<thead>
<tr>
<th></th>
<th>$\nu_g$</th>
<th>$\nu_r$</th>
<th>$\nu_j$</th>
<th>$\nu_{g_j}$</th>
<th>$\nu_{r_j}$</th>
<th>$\nu_{j_\xi}$</th>
<th>$\nu_{j_i}$</th>
<th>$\nu_{j_h}$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>GDP growth</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CZ</td>
<td>23.14</td>
<td>1.12</td>
<td>5.76</td>
<td>50.84</td>
<td>1.5</td>
<td>0.67</td>
<td>3.24</td>
<td>13.73</td>
</tr>
<tr>
<td>HU</td>
<td>20.36</td>
<td>1.13</td>
<td>4.95</td>
<td>23.08</td>
<td>3.01</td>
<td>2.78</td>
<td>4.61</td>
<td>40.08</td>
</tr>
<tr>
<td>PL</td>
<td>27.19</td>
<td>1.75</td>
<td>13.63</td>
<td>12.57</td>
<td>2.54</td>
<td>2.31</td>
<td>3.52</td>
<td>36.48</td>
</tr>
<tr>
<td>SK</td>
<td>16.58</td>
<td>0.77</td>
<td>28.38</td>
<td>12.17</td>
<td>10.1</td>
<td>2.36</td>
<td>7.24</td>
<td>22.39</td>
</tr>
<tr>
<td><strong>Consumption growth</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CZ</td>
<td>15.66</td>
<td>15.29</td>
<td>1.65</td>
<td>34.41</td>
<td>20.39</td>
<td>0.7</td>
<td>4.42</td>
<td>7.48</td>
</tr>
<tr>
<td>HU</td>
<td>14.36</td>
<td>11.06</td>
<td>1.45</td>
<td>16.28</td>
<td>29.44</td>
<td>1.93</td>
<td>4.28</td>
<td>21.19</td>
</tr>
<tr>
<td>PL</td>
<td>21.65</td>
<td>15.41</td>
<td>4.5</td>
<td>10.01</td>
<td>22.36</td>
<td>1.55</td>
<td>3.19</td>
<td>21.33</td>
</tr>
<tr>
<td>SK</td>
<td>5.81</td>
<td>5.26</td>
<td>4.16</td>
<td>4.26</td>
<td>68.82</td>
<td>1.1</td>
<td>4.46</td>
<td>6.13</td>
</tr>
</tbody>
</table>
### Variance decomposition

<table>
<thead>
<tr>
<th></th>
<th>$\nu_g$</th>
<th>$\nu_r$</th>
<th>$\nu_a^j$</th>
<th>$\nu_g^j$</th>
<th>$\nu_r^j$</th>
<th>$\nu_\xi^j$</th>
<th>$\nu_i^j$</th>
<th>$\nu_h^j$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Investment growth</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CZ</td>
<td>8.29</td>
<td>9.67</td>
<td>0.9</td>
<td>18.21</td>
<td>12.9</td>
<td>0.35</td>
<td>47.88</td>
<td>1.81</td>
</tr>
<tr>
<td>HU</td>
<td>5.46</td>
<td>4.99</td>
<td>0.64</td>
<td>6.19</td>
<td>13.29</td>
<td>0.69</td>
<td>64.32</td>
<td>4.41</td>
</tr>
<tr>
<td>PL</td>
<td>8.49</td>
<td>6.96</td>
<td>2.09</td>
<td>3.92</td>
<td>10.1</td>
<td>0.55</td>
<td>63.12</td>
<td>4.78</td>
</tr>
<tr>
<td>SK</td>
<td>2.58</td>
<td>2.92</td>
<td>2.04</td>
<td>1.89</td>
<td>38.23</td>
<td>0.48</td>
<td>50.5</td>
<td>1.34</td>
</tr>
<tr>
<td><strong>Trade Balance to GDP</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CZ</td>
<td>0.72</td>
<td>31.16</td>
<td>0.82</td>
<td>1.59</td>
<td>41.57</td>
<td>1.33</td>
<td>21.29</td>
<td>1.51</td>
</tr>
<tr>
<td>HU</td>
<td>0.38</td>
<td>19.22</td>
<td>0.65</td>
<td>0.43</td>
<td>51.18</td>
<td>3.46</td>
<td>20.83</td>
<td>3.84</td>
</tr>
<tr>
<td>PL</td>
<td>0.55</td>
<td>29.3</td>
<td>2.19</td>
<td>0.26</td>
<td>42.52</td>
<td>3.11</td>
<td>17.85</td>
<td>4.22</td>
</tr>
<tr>
<td>SK</td>
<td>0.13</td>
<td>5.96</td>
<td>1.18</td>
<td>0.09</td>
<td>77.96</td>
<td>1.22</td>
<td>12.75</td>
<td>0.71</td>
</tr>
</tbody>
</table>
External validation

- **Global innovations** should “make sense”
  - Validate them against EU data *not used in the estimation*
  - **Global trend**: growth rate of the EU 15
  - **Global premium**: EU 15 real interest rate
  - Note that we recover an “implicit” interest rate from GDP and components

- **Investment shock**: EU structural funds
Global growth shock component and EU growth

Estimated global component (%, YoY) EU 15 growth rate (%, YoY)

Baksa - Kónya

Interest premium and economic growth: the case of CEE
Global interest rate and the observed EU 15 real interest rate

Implicit global interest rate
EU 15 real interest rate

Interest premium and economic growth: the case of CEE
Estimated implicit interest rates

-0.04 -0.03 -0.02 -0.01 0 0.01 0.02 0.03 0.04 0.05
Czech Republic
Hungary
Poland
Slovakia

Baksa - Kónya
Interest premium and economic growth: the case of CEE
EU funding and investment specific shocks

Czech Republic

Hungary

Poland

Slovakia

Investment shock
EU funds (% GNI)
Conclusion

- A fairly simple model of stochastic growth is useful to make sense of the Visegrad experience
  - Overall, mostly trend productivity (“income expectation”) shocks explain GDP growth
  - Premium shocks important for GDP components
- The EU as the source of external shocks
  - Growth environment
  - Interest rate environment (until the crisis)
  - Investment funds
Historical shock decomposition, CZ

GDP (%, YoY)

Consumption (%, YoY)

Investment (%, YoY)

Trade-Balance (% of GDP)

Interest premium and economic growth: the case of CEE
Historical shock decomposition, HU

- GDP (% YoY)
- Consumption (% YoY)
- Investment (% YoY)
- Trade Balance (% of GDP)

Trend: Global
Trend: Local
Premium: Global
Premium: Local
TFP
Labor
Government
Investment
Initial value

Interest premium and economic growth: the case of CEE
Historical shock decomposition, PL

### Historical Shock Decomposition

**GDP (%, YoY)**

- 1995: -0.06
- 2000: -0.04
- 2005: -0.02
- 2010: 0
- 2015: 0.02

**Consumption (%, YoY)**

- 1995: -0.04
- 2000: -0.02
- 2005: 0
- 2010: 0.02
- 2015: 0.04

**Investment (%, YoY)**

- 1995: -0.2
- 2000: -0.1
- 2005: 0
- 2010: 0.1
- 2015: 0.2

**Trade Balance (% of GDP)**

- 1995: -0.1
- 2000: -0.05
- 2005: 0
- 2010: 0.05
- 2015: 0.1

### Variables

- **Trend**: Global, Local
- **Premium**: Global, Local
- **TFP**, **Labor**, **Government**, **Investment**

**Initial value**

*Interest premium and economic growth: the case of CEE*
Historical shock decomposition, SK

**GDP (%, YoY)**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Value</td>
<td>-0.1</td>
<td>-0.05</td>
<td>0</td>
<td>0.05</td>
<td>0.1</td>
</tr>
</tbody>
</table>

**Consumption (%, YoY)**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Value</td>
<td>-0.15</td>
<td>-0.1</td>
<td>-0.05</td>
<td>0</td>
<td>0.05</td>
</tr>
</tbody>
</table>

**Investment (%, YoY)**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Value</td>
<td>-0.3</td>
<td>-0.2</td>
<td>-0.1</td>
<td>0</td>
<td>0.1</td>
</tr>
</tbody>
</table>

**Trade Balance (% of GDP)**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Value</td>
<td>-0.2</td>
<td>-0.1</td>
<td>0</td>
<td>0.1</td>
<td>0.2</td>
</tr>
</tbody>
</table>

**Trend: Global**

**Trend: Local**

**Premium: Global**

**Premium: Local**

**TFP**

**Labor**

**Government**

**Investment**

**Initial value**

---

Baksa - Kónya

Interest premium and economic growth: the case of CEE