Leading indicators of the business cycle: dynamic probit models for OECD countries and Russia

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Literature review

2 directions of research on leading indicators

- Continuous dependent variable
  - Nonmodel based LI - OECD (2008)
- Discrete dependent variable
  - Binary models - Estrella, Mishkin (1998), Stock, Watson (1992), Kauppi, Saikkonen (2008), Ng (2012), etc.

Contribution

- Dynamic panel data models (previous studies – time series data)
- Credit market variables as leading indicators
- Longer forecasting horizon (up to 1 year vs several months in existing studies)
Methodology and data

- *Panel quarterly data* on ~30 OECD countries and peers (including Russia) over the period 1q1980 – 2q2013*. Data sources – IFS, OECD, WB, ECB
- Dependent variable – state of the economy / business cycle phase (binary)
- Methodology: *dynamic panel probit model*
  - in Dueker (1997), Moneta (2003), Kauppi, Saikkonen (2008), Ng (2012) – dynamic probit model on time series data

\[
y_{it}^* = \gamma y_{it-k} + x_{it-k}' \beta + \alpha_i + u_{it}
\]

\[
y_{it} = \begin{cases} 
1 & \text{if } y_{it}^* < 0 \\
0 & \text{else} 
\end{cases}
\]

- $y_{it}^*$ latent dependent variable
- $y_{it}$ observed binary variable
- $x_{it-k}$ vector of explanatory variables
- $k$ number of quarter lag (1, 2 and 4 quarter)

According to the data, initial condition $y_{it}$ is exogenous with respect to individual effects $\alpha_i$ : no «initial condition problem» - standard RE probit estimator is used

* GDP contraction during transitional period in post socialist countries was deleted from the sample
Dating business cycle phases

3 approaches

- Classical business cycle – Peaks_{bc} and Troughs_{bc}
- Deviation (growth) cycle - P_{gc} and T_{gc}

**Growth rate cycle**

- \( P_{grc} \) and \( T_{grc} \) are non-informative (noisy)
- instead – «negative/positive growth rates periods»

\[
y_{it} = \begin{cases} 
1 & \text{if } GDPgr < 0 \quad (recession) \\
0 & \text{if } GDPgr > 0 \quad (expansion) 
\end{cases}
\]

**Target variable** – GDP growth rates over corresponding quarter of the previous year

(other options - IIP, CCI, etc.)

BC dates following the **classical approach** should coincide with dating on **growth rate cycle** approach «negative/positive growth rates periods». Deviation cycle dates should diverge.
Explanatory variables selection

1. Macroeconomic variables
   lagged GDP growth, inflation, unemployment, consumption and investment expenditures, inventories, housing market dynamics

2. Consumer and business expectations

3. External sector variables
   US business cycle phase, oil prices.

4. Financial sector variables
   government bond and interbank market interest rates, stock market indices, monetary aggregates, NEER

5. Credit market variables – proposed in the paper
   lending rates
   credit boom indicators

## Estimation results

<table>
<thead>
<tr>
<th>Dependent variable (lag = $k$ quarters)</th>
<th>Lag = 1 quarter</th>
<th>Lag = 2 quarters</th>
<th>Lag = 4 quarters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Macroeconomic variables</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Investment in fixed capital, growth rates per year</td>
<td>-0.063***</td>
<td>-0.057***</td>
<td>0.034***</td>
</tr>
<tr>
<td>CPI inflation, per year</td>
<td></td>
<td></td>
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<tr>
<td>Expectations</td>
<td></td>
<td></td>
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<tr>
<td>Consumer confidence indicator, in OECD methodology, growth rate per quarter</td>
<td>-0.267***</td>
<td>-0.372***</td>
<td>-0.357***</td>
</tr>
<tr>
<td>External sector variables</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>US GDP leading indicator, in OECD methodology, in annual terms</td>
<td>-0.215***</td>
<td>-0.231***</td>
<td>-0.112***</td>
</tr>
<tr>
<td>Current account balance to GDP ratio</td>
<td></td>
<td>-0.019*</td>
<td>-0.036***</td>
</tr>
<tr>
<td>REER index, 2005=100</td>
<td>0.009**</td>
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<tr>
<td>Financial sector variables</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Stock price index, growth rates per quarter</td>
<td>-0.014***</td>
<td>-0.023***</td>
<td>-0.032***</td>
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<tr>
<td>Credit market variables</td>
<td></td>
<td></td>
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<tr>
<td>Loans to deposits ratio</td>
<td>0.002***</td>
<td>0.002*</td>
<td>0.006***</td>
</tr>
<tr>
<td>Constant</td>
<td>-2.269***</td>
<td>-1.218***</td>
<td>-1.856***</td>
</tr>
<tr>
<td>Number of observations (countries )</td>
<td>2260 (25)</td>
<td>2250 (28)</td>
<td>2171(28)</td>
</tr>
<tr>
<td>LR-test, absence of random effects (P-value)</td>
<td>0.399</td>
<td>0.001</td>
<td>0.000</td>
</tr>
<tr>
<td>Threshold (unconditional probability of recession)</td>
<td>0.16</td>
<td>0.16</td>
<td>0.17</td>
</tr>
<tr>
<td>Recessions, correctly classified</td>
<td>86%</td>
<td>81%</td>
<td>70%</td>
</tr>
<tr>
<td>Absence of recessions, correctly classified</td>
<td>90%</td>
<td>85%</td>
<td>79%</td>
</tr>
<tr>
<td>Noise-to-signal ratio</td>
<td>12%</td>
<td>19%</td>
<td>31%</td>
</tr>
</tbody>
</table>
Estimation results
Model probabilities of recession (4Q lag models)
Estimation results

Probabilities of recession for Russia

State of the business cycle
Model with 1q lead
Model with 2q lead
Model with 4q lead
Threshold