Filling the gap: open economy considerations for more reliable potential output estimates

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UN DESA Expert Group Meeting on the World Economy (LINK Project)
October 21-23, 2015, New York

* Based on a joint work with András Simon
Potential output is an important unobserved variable for macroeconomic modelling, policy analysis and policy making

- Macro models
- Monetary and fiscal policies
- EU fiscal rules and sanctions depend on structural budget balance, hence on estimated potential output

Empirical methods

- Univariate methods, e.g. Hodrick-Prescott filter
- Structural methods, e.g. Phillips curve and NAIRU/NAWRU (non-accelerating inflation/wage rate of unemployment)
- Production-function
• **Major handicaps of existing methodologies (EU, IMF, OECD, structural models, univariate filters)**

  • **Key conceptual handicaps:**
    - Disregarding open economy considerations
    - Use of smoothing algorithms

  • **Weaknesses in empirics:**
    - Sometimes implausible estimated potential output developments (e.g. potential output estimates follow an inverted U-shape, with potential output continuing to increase during crisis years, then gradually turning into a decline)
    - Large revisions
Aims of this paper

- Incorporate open economy considerations
- Estimate the model for 45 countries
- Use real-time data available in each year between 2004-15

Related literature

- Darvas and Simon (2000): use info from exports and imports; estimate for Hungary, Mexico and Poland
- Dobrescu (2006): trade balance/GDP should be constant; estimate for Romania
- Alberola, Estrada and Santabárbara (2014): adjust labour, capital and TFP in production function for imbalances; estimate for Spain
- Borio, Disyatat and Juselius (2013, 2014): ”finance-neutral sustainable output”; estimate for US, UK and Spain
1. Standard concepts
2. Our alternative approach
3. The real-time dataset
4. Empirical results
   • The current account model
   • The sustainable output model
   • Real-time output gap estimates: comparison with estimates of the European Commission, IMF, OECD and Hodrick-Prescott filter
5. Summary
1. Standard concepts

- **Atheoretical models**

  smooth supply $\Leftrightarrow$ fluctuating demand?

- **Problems:**
  - Is supply really smooth?
  - New-Keynesian definition: output corresponding to flexible price level $\rightarrow$ more volatile than actual output
1. Standard concepts, cont.

- **Standard structural model:**
  - Non-inflationary level of output: aggregate supply = demand
  - Excess demand $\rightarrow$ employment tension $\rightarrow$ inflation $\rightarrow$ demand correction

- **Problems:**
  1. Only inflation is measurable directly (NAIRU is a latent variable)
  2. High share of tradable goods blurs the relationship between excess demand and employment/inflation. Price explosion may be postponed by exchange rate developments or a favourable market sentiment
2. Our alternative approach for sustainable output

- **Phillips-curve/NAIRU not sufficient:** effect of excess demand is not symmetric across tradable and non-tradable sectors:
  - Non-tradeable sector: excess demand creates excess employment and inflation via the Phillips-curve
  - Tradeable sector: much of the excess demand absorbed by the trade balance, parallel to, or even without, the increase of inflation
  - Excess demand of the rest of the world has implications for domestic inflation and trade balance

- **These effects are supported by several theories and models**

- **We offer a new concept:** ”sustainable output” to incorporate these effects
2. Our alternative approach for sustainable output, cont.

• **Model set-up:**
  • Separation of the tradeable/non-tradeable sectors is not intended (and difficult) \(\Rightarrow\) build a model that uses total output and let the data determine the relative importance of the Phillips curve and current account balance

• **Open economy considerations:**
  • In the short-run, foreign output-gap matters for both inflation and the current account balance
  • In the short-run, real exchange rate disequilibrium matters for both inflation and the current account balance
2. Sketch of our sustainable output model

Observation equations

• The two behavioural equations:
  • Phillips curve augmented with global variables:

\[
\pi_t = \beta_0 + \beta_\pi \pi_{t-1} + \beta_{\text{gap}} (y_t - \bar{y}_t) + \beta_{\pi w} \pi_t^{(w)} + \beta_{\text{gap } w} \left( y_t^{(w)} - \bar{y}_t^{(w)} \right) + \beta_r (r_t - \bar{r}_t) + \varepsilon_t^{(\pi)}
\]

• Current account gap equation:

\[
\tau_t - \bar{\tau}_t = \gamma_0 + \gamma_{\text{gap}} (y_t - \bar{y}_t) + \gamma_{\text{gap } w} \left( y_t^{(w)} - \bar{y}_t^{(w)} \right) + \gamma_{r0} (r_t - \bar{r}_t) + \gamma_{r1} (r_{t-1} - \bar{r}_{t-1}) + \varepsilon_t^{(\tau)}
\]

Where: \( \pi_t \) inflation rate; \( \tau_t \) current account balance/GDP; \( \bar{\tau}_t \) its intertemporal optimum; \( y_t \) log of GDP; \( \bar{y}_t \) sustainable output; \( r_t \) log of real exchange rate; \( \bar{r}_t \) equilibrium real exchange rate; superscript \( w \): rest of the world.
2. Our alternative approach for sustainable output, cont.

- **Which measure of external balance?**
  - Even when there is no excess demand, the current account balance should not be necessarily zero.
  - In theory, there is balance corresponding to the equilibrium intertemporal allocation of resources → deviation from this balance.
  - Problem: theory does not pin down an empirical method.
  - Empirical estimates can be *ad hoc*.
  - We use the deviation from an estimated medium-term equilibrium current account balance, based on the model of Lane and Milesi-Ferretti 2012 Journal of International Economics (which is similar to many other models used in the literature).
• Panel model for 65 advanced and emerging countries, not including major oil exporters, poor and small countries
• Sample: 4-year non-overlapping averages (to smooth the business cycle) from early 1970s to the year of the data vintage
• Explanatory variables:
  1. Fiscal balance
  2. GDP growth rate
  3. GDP per capita at PPP
  4. The old-age dependency ratio
  5. The aging rate
  6. Oil rents
  7. Lagged Net Foreign Assets (NFA) position
3. The real-time dataset for each spring in 2004-2015

Sample includes 45 countries

- **Main data sources:**
  - Spring versions of IMF World Economic Outlook databases for each year between 2004-15, typically published in April
  - Spring versions of the European Commission’s AMECO dataset (available vintages published in 2009-2015)
  - Other sources, like IMF’s historical dataset on budget balances, ...

- **Current account gap:** deviation from estimates in Darvas (2015), which in turn largely follows Lane and Milesi-Ferretti (2012)

- **Foreign output-gap:** currently Hodrick-Prescott; could be the weighted average of the gap calculated by us

- **Real exchange rate equilibrium:** currently Hodrick-Prescott; could be a structural estimate
4. Empirical results: the current account model

- Parameter estimates have correct signs and are statistically significant
- Estimated parameters change little when different vintages of the data is used
Full sample: Actual and estimated equilibrium current account balances (% GDP)
Real-time data: Estimated annual current account gaps (% GDP) using different data vintages

Note: the years in the legend indicate the vintage of the data used
In contrast: Large revisions to European Commission NAWRU estimates

- European Commission NAWRU estimates follow the actual trend of the unemployment rate, and were revised significantly for the past when the trend changed.

**NAWRU estimates and forecasts by the European Commission at different dates and the actual unemployment rate, 1995-2016**

NAWRU = non-accelerating wage rate of unemployment
A conclusion

• **NARWU**: was not (and probably cannot) be estimated reliably real-time

• **Current account gap**: can be estimated reliably real-time
4. Empirical results: the sustainable output model

- State-space representation
- Kalman–filter for inference on latent variables and parameters (ML/QML estimation)
- Key results:
  - The current account equation is more important in determining the sustainable level of output than the Phillips curve
  - Output gap parameter in the current account equation has the correct estimated sign for all 45 countries and is statistically significant for almost all of them
  - Output gap parameter in the Phillips curve has an incorrect sign for one-third of the countries and is hardly significant
  - Foreign output gap matters for both inflation and the current account
  - Real exchange rate matters for both inflation and the current account
Our estimates suggest:
- Unsustainable pre-crisis boom
- Recent fall in output just brought it back to sustainable, but no negative gap
Our estimates suggest:
- Reunification boom
- Recently output gap is negative
Our estimates suggest:

- Fall of sustainable output preceded (not followed) the fall of actual output
- Output gap is small

Note: for Greece, the IMF estimate is identical to the Hodrick-Prescott filter
For 2015, IMF suggests practically zero output gap, while our estimate suggests a -3.2% gap.
Brazil

For 2015, HP suggests small negative output gap, while our estimate suggests a 4.2% positive gap with sustainable output falling recent years.
Real-time estimates for the 2007 output gap

Ireland

Based on April/May data of the year indicated on the horizontal axis
Real-time estimates for the 2007 output gap

Spain

Based on April/May data of the year indicated on the horizontal axis.
Real-time estimates for the 2007 output gap

Portugal

Based on April/May data of the year indicated on the horizontal axis.
Real-time estimates for the 2007 output gap

Italy

Based on April/May data of the year indicated on the horizontal axis.
Real-time estimates for the 2007 output gap

Germany

Based on April/May data of the year indicated on the horizontal axis.
Real-time estimates for the 2007 output gap

Based on April/May data of the year indicated on the horizontal axis.

This paper EC IMF OECD HP

Output gap in 2007

Date of estimation

Netherlands
Annual revisions in previous year output gap estimates

12 EU countries (% of potential GDP, absolute value, unweighted average)

- Big revision in IMF/EC/OECD/HP estimates at the time of the crisis, but not in our estimates
- Revisions a year later typically 0.5%-1.0% of GDP for all three estimates, which is "large"

The 12 countries: Austria, Belgium, France, Finland, Germany, Ireland, Italy, Netherlands, Portugal, Spain, Sweden and the United Kingdom

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Revision of previous year output gap one year later

E.g. the difference between the estimate made in spring 2011 and spring 2012 for 2010
Annual revisions in previous year output gap estimates

5 non-EU countries (% of potential GDP, absolute value, unweighted average)

Revision of previous year output gap one year later

➢ Same conclusion as for the EU countries

The 5 countries: Australia, Canada, Japan, New Zealand and the United States of America

E.g. the difference between the estimate made in spring 2011 and spring 2012 for 2010
Output gap revisions vs current account volatility

European Commission output gap estimates for 25 countries

Revision in EC output gap vs. CA volatility, 2004-13

- More volatile current account leads to larger revisions in European Commission’s output gap estimates.
### Output gap revisions vs current account volatility

Correlation coefficient between output gap revisions and the variability of the current account balance (twelve EU countries, 2004-13)

<table>
<thead>
<tr>
<th>Source</th>
<th>Correlation coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>This paper</td>
<td>0.13</td>
</tr>
<tr>
<td>EC</td>
<td>0.59</td>
</tr>
<tr>
<td>IMF</td>
<td>0.69</td>
</tr>
<tr>
<td>OECD</td>
<td>0.54</td>
</tr>
<tr>
<td>HP (without forecasts)</td>
<td>0.57</td>
</tr>
<tr>
<td>HP (with forecasts)</td>
<td>0.50</td>
</tr>
</tbody>
</table>

Close to zero correlation for our model, high correlation for all others: important information is missing from EC/IMF/OECD/HP estimates.
• **Our alternative approach for estimating sustainable output:**
  - Recognise the importance of open economy factors:
    - Foreign supply can fill the gap between demand and supply in the tradable sector, but not in the non-tradable sector
    - Foreign output gap has implications for domestic inflation and trade balance
  - We use an unobserved components model incorporating both a Phillips curve and a current account equation
  - *(We do not use a production function)*
• **Empirical results:**
  - 45 countries
  - Real-time dataset available in each year between 2004-15
  - Sensible parameter and sustainable output estimates, which for several countries differ significantly from the estimates of the 3 institutions and the HP filter
  - Better identifying the sign of output gap in real time
  - Annual revisions in output gap estimates:
    - Much smaller revisions than IMF/EC/OECD/HP during the crisis years
    - Similar in normal years, about 0.5-1.0% GDP
  - IMF/EC/OECD/HP revisions related to CA variability

• **Policy implications**
Future work

• **Possible extensions of our work:**
  • More sophisticated state equations
  • Calculate foreign output gap as the weighted average of our output gap estimates for other countries (iterative estimation)
  • Incorporate the Balassa-Samuelson effect
  • Estimate equilibrium real exchange rates
  • Refine the current account equilibrium model
  • Panel estimation of the sustainable output model
  • Set up a model that jointly estimates all unobserved variables
Thank you for your attention

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