GROWTH BEYOND IMBALANCES.

SUSTAINABLE GROWTH RATES AND OUTPUT GAP REASSESSMENT

E. Alberola, A. Estrada and D. Santabárbara

3rd WB-BE Research Conference. Financing growth: Levers, Boosters and Brakes

Madrid, 24 June 2014

INTERNATIONAL AFFAIRS
ROADMAP OF THE PRESENTATION

1. Motivation
2. Our methodology
3. Results
4. Conclusions and policy implications
The Great Recession was preceded by a long period of high and stable growth, with low and stable inflation (The Great Moderation).

- believed that growth close to potential but...

- ...large imbalances were built up

- How is potential growth measured?

  - Potential output growth is the most common measure to the growth rate that an economy can attain using their productive factors

  - Output gap (deviations from a level of potential output) is interpreted as a synthesis of the imbalances affecting an economy
MOTIVATION. INFLATION DID NOT WORK AS A SUFFICIENT INDICATOR OF IMBALANCES

- Potential growth just considers one imbalance/disequilibrium...
- Inflation allows calculating equilibrium unemployment (NAIRU)
- ...which was extremely misleading in the last crisis
- CPI inflation has been severely affected by the globalization process and the increased credibility of central banks
- Imbalances delinked from inflation developments (actually fostered)

**GDP vs inflation. Advanced economies**

![Graph showing GDP vs inflation for pre- and post-globalization periods.](image)

- Pre-globalization (1986-2000): $y = 0.4397x - 1.545$ with $R^2 = 0.3079$
- Post-globalization (2001-2007): $y = 0.0332x - 0.1579$ with $R^2 = 0.0055$

Source: IMF, WEO
MOTIVATION. POTENTIAL GROWTH AND CURRENT ACCOUNT

- As a result, potential growth estimates have tended to increase as imbalances built up

Real time potential output vs. current account balances
US, UK & Spain (%)

Sources: European Commission, US Congressional Budget Office
MOTIVATION. POTENTIAL GROWTH AND IMBALANCE INDICATORS

- More formally, it seems that (real time) potential growth is not correlated with inflation; but it is with the (ex-post) output gap...
- ...and with other imbalance indicators, especially during the last decade

Real time potential output and changes in selected macroeconomic indicators (8 year rolling regression, 95% confidence level)
MOTIVATION. OUR APPROACH

• **Sustainable growth**

• Output *growth that does not widen or generate macroeconomic imbalances* (widely defined)

• **Potential growth approach with some methodological improvements**

<table>
<thead>
<tr>
<th>Theoretical basis</th>
<th>Standard potential growth approach</th>
<th>Sustainable growth approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>Imbalances</td>
<td>Inflation</td>
<td>External and domestic</td>
</tr>
<tr>
<td>Production factors</td>
<td>K, L, TFP</td>
<td>(KP, KH)^e, L, TFP</td>
</tr>
<tr>
<td>Estimated equilibrium</td>
<td>Unemployment</td>
<td>All components</td>
</tr>
<tr>
<td>Estimation procedure</td>
<td>Biequational</td>
<td>(Sort of) Multiequational</td>
</tr>
</tbody>
</table>

• **Sample:** 1970-2011, three current account deficit countries: USA, UK & Spain and two current account surplus countries: China & Germany
ROADMAP OF THE PRESENTATION

1. Motivation

2. Our methodology

3. Results

4. Conclusions and policy implications
OUR METHODOLOGY. MACROECONOMIC IMBALANCE INDICATORS

- External and internal macroeconomic imbalances are proxied by indicators which the economic literature suggests associations with economic crises

<table>
<thead>
<tr>
<th></th>
<th>Prices</th>
<th>Flows</th>
<th>Stocks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>External sector</strong></td>
<td>REER</td>
<td>Current Account</td>
<td>IIP</td>
</tr>
<tr>
<td><strong>Private Sector</strong></td>
<td>CPI inflation</td>
<td>Private balance (private savings – private investment)</td>
<td>Private debt</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Housing investment</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Non-tradable sector</td>
<td></td>
</tr>
<tr>
<td><strong>Public Sector</strong></td>
<td></td>
<td>Public balance (public savings – public investment)</td>
<td>Public debt</td>
</tr>
</tbody>
</table>

**External Sector**
- REER
- Current Account
- IIP

**Private Sector**
- CPI inflation
- Private balance (private savings – private investment)
- Private debt
- Housing investment
- Non-tradable sector

**Public Sector**
- Public balance (public savings – public investment)
- Public debt
OUR METHODOLOGY. EXTENDED PRODUCTION FUNCTION APPROACH

• The basic approach is that of the production function, although with some extensions

\[ \Delta y = \alpha \Delta l + (1 - \alpha) \Delta k^e + \Delta tfp \]

- Effective labor (hours worked) is the result of combining (working age) population, participation and unemployment rates and hours per worker

\[ \Delta l = \Delta pop + \Delta a + \Delta (1 - u) + \Delta h \]

- Effective capital includes non residential, residential (productivity weighted) and the capacity utilization

\[ \Delta k^e = \Delta cu + (\Delta k^{nr} + \beta \Delta k^r) \]

- TFP is obtained as a residual but approximating the elasticity of output with respect to employment with the (time-varying) labor cost share
OUR METHODOLOGY. TECHNICAL DETAILS

• The extended bivariate system developed by Planas and Rossi (2010)

  \[ (1 - \rho_1 L - \rho_2 L) c_t^j = a_{ct}^j \]

  \[ \Delta p_t^j = \mu_{t-1}^j + a_{pt}^j \]

  \[ \mu_t^j = \mu_c^j (1 - \delta^j) + \delta^j \mu_{t-1}^j \]

• Every component of the production function is decomposed in a cyclical and permanent component

  \[ x_t^j = c_t^j + p_t^j \]

• The cyclical term can follow a second order autoregressive

• The permanent component has an unit root with drift

• The relation between the component of the production function and the imbalance is captured through a “Phillips curve style” equation

  \[ \text{imb}_t = \mu_{imb} + \gamma_{imb} (1 - L)^d x_{t-1}^j + \sum_{i=0}^r \lambda_i c_{t-i}^j + a_{imb}^j \]
OUR METHODOLOGY. SUMMING UP

• For each production function component, the optimal approach would be developing a multivariate approach to jointly incorporate all the imbalances

• This approach proved to be very cumbersome ➔ Working on it!

• Meanwhile, we developed a two step procedure that seems to perform well for each component

  1. We apply the bivariate methodology with all the imbalance indicators

     • we retain the permanent factor estimate (if the imbalance indicator is relevant)

  2. We extract a common element by weighting the estimated permanent factors according to their uncertainty surrounding the estimate ➔ sustainable factor

• Aggregate the estimates of the sustainable factor of each components to obtain sustainable output growth rates and the output gap
ROADMAP OF THE PRESENTATION

1. Motivation

2. Our methodology

3. Results

4. Conclusions and policy implications
RESULTS. RELEVANT IMBALANCES. US

**Labour**
- Activity rate
- Unemployment rate
- Hours worked per employee

**Capital**
- Productive investment
- Residential investment
- Capacity utilization

**Total Factor Productivity**
- Private balance
- Private savings
- Residential investment

- Current account balance
- Private balance
- Private savings
- Residential investment
- Non-tradable sector
RESULTS. POTENTIAL vs. SUSTAINABLE GROWTH.

US

- The differences between both estimates of potential growth are observed in the second part of the 90s and before and after the current crisis
- After 2009, there is still a negative gap as long as some of the imbalances indicators are still above historical averages
• According to our methodology, the last expansionary period was larger and slightly more intense

• The current less negative output gap suggest higher permanent output losses during the recession

**Output Gaps. US. 1981-2011**
## RESULTS. RELEVANT IMBALANCES. SPAIN

<table>
<thead>
<tr>
<th>Labour</th>
<th>Capital</th>
<th>Total Factor Productivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activity rate</td>
<td>Unemployment rate</td>
<td>Hours worked per employee</td>
</tr>
<tr>
<td>Productive investment</td>
<td>Residential investment</td>
<td>Capacity utilization</td>
</tr>
</tbody>
</table>

- Current account balance
- Public balance
- Productive investment
- Domestic investment
- Private savings
- Public savings
- Current account balance
- Private balance
- Public balance
- Residential investment
- Private balance
- Public balance
- Residential investment
- Current account balance
- Public balance
- Private balance
- Private investment
- Public investment
- Residential investment
RESULTS. POTENTIAL vs. SUSTAINABLE GROWTH. SPAIN

- The differences between both approaches are large, especially in the period 2000-2007
- On the contrary, after the crisis the imbalances adjustment has slowed the reduction of sustainable growth
• The differences in the last expansionary period are substantial
• During the recession, the profile is totally different, with a continuous deepening in the case of sustainable growth
RESULTS. REVISIONS TO SUSTAINABLE GROWTH. 2007-2011. SPAIN

- What would be the real time, sustainable growth? Similar results
- 2007: Identification of imbalances → lower trend growth, larger cyclical component
- Lower revisions

Potential and Sustainable Growth Rates (%)

<table>
<thead>
<tr>
<th>Year</th>
<th>EC: Ex post potential growth</th>
<th>EC: Real time potential growth</th>
<th>Sustainable growth</th>
<th>Sustainable growth 2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2001</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2003</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2005</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2007</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2011</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Ex post vs 2007 Output Gaps

Sources: European Commission and Alberola, Estrada and Santabárbara (2014)
• Sustainable growth is uncorrelated with the imbalance indicators, apart from residential investment

Sustainable output growth rates and changes in selected macroeconomic indicators (8 year rolling regression, 95% confidence level)
ROADMAP OF THE PRESENTATION

1. Motivation

2. Our methodology

3. Results

4. Conclusions and policy implications
CONCLUSIONS AND FURTHER STEPS

• The methodologies most commonly used to estimate potential growth are designed to filter one particular imbalance: inflation ...

• ... but, they forget the behavior of other macro-economic imbalances

• Inflation has not been the most relevant imbalance in the last decade

• This paper is a (statistical) step in the direction of filling that gap

• However...

  • …we still have to integrate the analysis in a real multiequational framework

  • …we should separate the impact of refinements in production function and imbalances in the sustainable growth estimates

  • …we should exploit the policy implications of the new estimates
THANK YOU FOR YOUR ATTENTION
MOTIVATION. REVISIONS OF POTENTIAL GROWTH ESTIMATES

- With hindsight, there is a recognition that such estimates were wrong... ...and got us wrong
- Demand for an alternative approach to assess sustainable growth paths

Official sources: Real time and ex-post potential growth (%)
MOTIVATION. POTENTIAL GROWTH AND IMBALANCE INDICATORS (REVISITED)

- However, even although ex-post estimates of potential growth are revised in the expected direction...
- ...still significant correlation with the indicators of imbalances remains

Ex-post potential output and changes in selected macroeconomic indicators (8 year rolling regression, 95% confidence level)
This problem of revisions seems to be related to the procedure, not to the institution estimating potential growth.

OECD: Real time and ex-post potential growth (%)
ROBUSTNESS CHECK OF THE RESULTS

Output gaps: extended sample
In per cent of potential output

Source: Borio et al, (2013)
MOTIVATION. RELATED LITERATURE ON THIS IDEA

• **Early Warning Indicators**
  - Frenkel and Saravelos (2012),
  - Scoreboard MIB (EU), Broad Guidelines (G 20)

• **Financial and Business Cycles**
  - Claessens, Kose and Terrones (2011)
  - Borio and Disyatat (2011); Borio, Disyayat and Juselius (2013)

• **Financial Crisis Causes**
  - Leaven and Valencia (2012)
  - Claessens and Kose (2013)

• **Literature in Spain**
  - Campa and Gavilán (2006); Estrada, Jimeno and Malo de Molina (2009)
  - Doménech and Gómez (2006)
  - Dolado and Lamo (1993)
Ex-post potential growth and changes in selected macroeconomic indicators (8 year rolling regression, 95% confidence level)

Sources: European Commission, US Congressional Budget Office
OUR METHODOLOGY. DIFFERENCES IN THE IDENTIFICATION OF EQUILIBRIUM COMPONENTS

• Identification of equilibrium components using information on imbalances indicators is applied to all the production function components

<table>
<thead>
<tr>
<th>Differences in methodology</th>
<th>Traditional</th>
<th>This paper</th>
</tr>
</thead>
<tbody>
<tr>
<td>Permanent effective labor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Working age population</td>
<td>Observed</td>
<td>Filtered</td>
</tr>
<tr>
<td>Participation rate</td>
<td>Filtered</td>
<td>Adj. by imbal.</td>
</tr>
<tr>
<td>Unemployment rate</td>
<td>Adj. by inflation (Phillips curve)</td>
<td>Adj. by imbal.</td>
</tr>
<tr>
<td>Hours per worker</td>
<td>Filtered</td>
<td>Adj. by imbal.</td>
</tr>
<tr>
<td>Non-residential</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residential</td>
<td>Observed</td>
<td>Adj. by imbal.</td>
</tr>
<tr>
<td>Capacity utilization</td>
<td>×</td>
<td>Adj. by imbal.</td>
</tr>
<tr>
<td>TFP</td>
<td>Filtered</td>
<td>Adj. by imbal.</td>
</tr>
</tbody>
</table>
OUR METHODOLOGY. SOME DETAILS ON THE SECOND STEP

- The extracted common factor for every component would not change substantially if the correlation among (the growth rates of) estimated permanent factors with every relevant imbalance indicator was high...

<table>
<thead>
<tr>
<th>TABLE 2. CORRELATION AMONG ESTIMATED PERMANENT FACTORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
</tr>
<tr>
<td>Working age population</td>
</tr>
<tr>
<td>Participation rate</td>
</tr>
<tr>
<td>Unemployment rate</td>
</tr>
<tr>
<td>Hours per worker</td>
</tr>
<tr>
<td>Productive investment</td>
</tr>
<tr>
<td>Residential investment</td>
</tr>
<tr>
<td>Capacity utilization</td>
</tr>
<tr>
<td>Total factor productivity</td>
</tr>
</tbody>
</table>

Source: Own calculations; * These variables are not available in the case of China.

- In any case, we have tried some other weighting procedures (principal components to obtain a synthetic imbalance indicator, principal components on the permanent factor estimates of the production function components) obtaining very similar results
### Correlation among Imbalance Indicators

<table>
<thead>
<tr>
<th></th>
<th>Current Account</th>
<th>Private Balance</th>
<th>Public Balance</th>
<th>Residential Investment</th>
<th>Non-tradable Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current Account</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Private Balance</td>
<td>(0.21, 0.71)</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Public Balance</td>
<td>(-0.17, 0.37)</td>
<td>(-0.76, 0.58)</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Residential</td>
<td>(-0.10, -0.76)</td>
<td>(-0.91, 0.46)</td>
<td>(0.19, 0.82)</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>Investment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-tradable Share</td>
<td>(-0.71, 0.70)</td>
<td>(-0.28, 0.67)</td>
<td>(-0.64, 0.14)</td>
<td>(-0.72, 0.90)</td>
<td>1</td>
</tr>
</tbody>
</table>
In the final period, the sources of lower sustainable growth are the contribution of labor and TFP.

**Contributions to Sustainable Growth Rates. US. 1981-2011**

- **Labor contribution**
- **Capital contribution**
- **TFP**
- **Observed GDP growth**

<table>
<thead>
<tr>
<th>Period</th>
<th>Labor</th>
<th>Capital</th>
<th>TFP</th>
<th>GDP Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>1981-1982</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1983-1989</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1990-1991</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1992-2000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2001-2003</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2004-2005</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2006-2011</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
CBO estimates a natural rate of unemployment, so the concept is not exactly the same.
RESULTS. RELEVANT IMBALANCES. UK

<table>
<thead>
<tr>
<th>Labour</th>
<th>Capital</th>
<th>Total Factor Productivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activity rate</td>
<td>Unemployment rate</td>
<td>Hours worked per employee</td>
</tr>
</tbody>
</table>

- Current account balance
- Residential investment
- Public savings

- Current account balance
- Private balance
- Private investment
- Public balance

- Private savings
- Public balance
- Current account balance
- Residential investment
- Non-tradable sector
RESULTS. POTENTIAL vs. SUSTAINABLE GROWTH. UK

- In this case, the differences are more widespread, although it seems especially relevant the overestimate since the beginning of the millennium.

- After the crisis, most of the imbalances indicators have been corrected, explaining the higher sustainable growth.

Potential and Sustainable Growth Rates. UK. 1981-2011
RESULTS. OUTPUT GAPS. UK

- These estimates show that the last expansionary period was somewhat more intense with this methodology.
- The current negative output gap is more reduced; however, data for 2012 suggest a convergence of both estimates.

Output Gaps. UK. 1981-2011
RESULTS. CONTRIBUTIONS FROM THE PRODUCTION FUNCTION. UK

- The differences in the composition of potential and sustainable growth are notorious in the most recent period.
- A non-negative contribution of labor and a negative one of TFP seems more compatible with observed data.

Contributions to Sustainable Growth Rates. UK. 1981-2011

- Labor contribution
- Capital contribution
- TFP
- Observed GDP growth
RESULTS. PRODUCTION FUNCTION COMPONENTS. UK

- In the case of labor, it is not the NAIRU the source of differences. The differences are in hours per worker and in the participation rates.
- Sustainable TFP growth is more volatile, but, more importantly, the growth rate is permanently lower, due to the capital stock used.

[Graphs showing NAIRU and Capital Growth for UK, 1981-2011]
RESULTS. CONTRIBUTIONS FROM THE PRODUCTION FUNCTION. SPAIN

- In the last two sub-periods main differences correspond to labor

Contributions to Sustainable Growth Rates. SPAIN. 1981-2011
These differences are basically due to the estimate of equilibrium unemployment, much more stable in our case.

**NAIRU. SPAIN. 1981-2011**

![Graph showing NAIRU for Spain from 1981 to 2011 with two lines representing different scenarios.]
RESULTS. RELEVANT IMBALANCES. GERMANY

**Labour**
- Activity rate
- Unemployment rate
- Hours worked per employee

**Capital**
- Productive investment
- Residential investment
- Capacity utilization

**Total Factor Productivity**
- Private balance
- Public balance
- Public savings
- Non-tradable sector

- Current account balance
- Private balance
- Public balance
- Public savings
- Non-tradable sector
- Private balance
- Private savings
- Public savings
- Current account balance
- Private balance
- Public balance
- Public savings
RESULTS. POTENTIAL vs. SUSTAINABLE GROWTH. GERMANY

- Major differences arise after 2007
- However, potential estimates seem to be highly correlated with observed growth

Potential and Sustainable Growth Rates. GERMANY. 1981-2011
• These two output gap estimates are basically the same
• The last year positive output gap estimate has reversed in 2012

Output Gaps. GERMANY. 1981-2011
As can be seen, the lower sustainable growth is due to the insignificant contribution of labor
The difference lies in equilibrium unemployment, that diminishes by 2 percentage points in the EC case (9%-7%), compared to ½ (8%-7.5%)
### Results: Relevant Imbalances. China

<table>
<thead>
<tr>
<th>Labour</th>
<th>Capital</th>
<th>Total Factor Productivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activity rate</td>
<td>Productive investment</td>
<td>- Private balance</td>
</tr>
<tr>
<td>Unemployment rate</td>
<td>Residential investment</td>
<td>- Private savings</td>
</tr>
<tr>
<td>- Current account balance</td>
<td>- Public balance</td>
<td>- Public balance</td>
</tr>
<tr>
<td>- Public balance</td>
<td>- Residential investment</td>
<td>- Public balance</td>
</tr>
<tr>
<td></td>
<td>- Current account balance</td>
<td>- Private investment</td>
</tr>
</tbody>
</table>
RESULTS. POTENTIAL vs. SUSTAINABLE GROWTH. CHINA

- As in the case of Germany, the differences between both methods are moderated and located at the end of the sample
- Again, the rebound in IMF estimates seems highly correlated with observed growth
• As expected, differences are not very relevant
The IMF does not provide the factor contributions to GDP growth. From our estimates it is remarkable the contribution of capital and TFP, as it corresponds to a catching-up economy.

Contributions to sustainable Growth. CHINA. 1981-2011

- Labor contribution
- Capital contribution
- TFP
- Observed GDP growth
Despite the low levels, the crisis has increased equilibrium unemployment.