Growth and Convergence. Some Empirical Analysis

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Contents

1. The theoretical background
2. From theoretical to empirical models
3. Some empirical analysis
4. Comments
The Theoretical Background
We focus on the following issues:

- Convergence
- Economic Policies
Convergence Issue

Closed Economy
- Absolute Convergence
- Conditional Convergence (depending on saving rate and population growth rate)
- Club Convergence (for group of countries with a minimum of HK and Institutions)

Open Economy
- Theory: Faster Convergence
- Empirics: Slower Convergence

Neoclassical Approach
Convergence Issue

Endogenous Growth Approach

Closed Economy
- Divergence

Open Economy
- Divergence
  (mitigated by Trade and Knowledge Spillovers)
### Economic Behaviours & Policies

<table>
<thead>
<tr>
<th>Behaviour</th>
<th>Influence of Policies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absolute Convergence</td>
<td>None</td>
</tr>
<tr>
<td>Conditional Convergence</td>
<td>Saving Rates and Population Growth</td>
</tr>
<tr>
<td>Club Convergence</td>
<td>Minimum Endowment of HK and Institutions</td>
</tr>
<tr>
<td>Divergence</td>
<td>Endogenous Elements (as Innovation)</td>
</tr>
</tbody>
</table>
From Theoretical to Empirical Models
Static Solow Model (Barro & Sala-i-Martin 1992)

\[
\frac{1}{T} \log \left( \frac{z_{i,t_0+T}}{z_{i,t_0}} \right) = B - \frac{(1 - e^{-\beta})}{T} \log(z_{i,t_0}) + \varepsilon_{it}
\]

Where

\( T \) = period of time
\( z_{i,t_0} \) = PILpc at time 0
\( z_{i,t_0+T} \) = PILpc at time \( T \)

\[
B = g_A + \frac{(1 - e^{-\beta})}{T} [\log(\hat{z}^*) + g_A t_0]
\]

and homogeneous hypothesis holds \( g_{Ai} = g_A \quad \hat{y}_i^* = \hat{y}^* \)
Dynamic Model (Amable 2000)

\[
\ln(z_{i,t}) = a_i + b \ln(z_{i,t-\tau}) + \gamma W_{i,t} + \varepsilon_{i,t}
\]

Where
- \(\tau\) = period of time
- \(z_{i,t_0}\) = PILpc at time 0
- \(z_{i,t_0+T}\) = PILpc at time \(T\)
- \(W_{i,t}\) = row of determinants of economic growth
**Smulders Model (Smulders 1992)**

\[
\begin{bmatrix}
\tilde{h}_t^R \\
\tilde{L}_t^R \\
\tilde{L}_t^W
\end{bmatrix} = \hat{I} \begin{bmatrix}
\tilde{h}_{t-1}^R \\
\tilde{L}_{t-1}^R \\
\tilde{L}_{t-1}^W
\end{bmatrix} + \gamma_1 \begin{bmatrix}
W_1 \\
0 \\
0
\end{bmatrix} + \gamma_2 \begin{bmatrix}
W_2 \\
0 \\
0
\end{bmatrix} + \begin{bmatrix}
\varepsilon_1 \\
\varepsilon_2 \\
\varepsilon_3
\end{bmatrix}
\]

Where:

- \( \tilde{h}^R = \tilde{h}^A - \tilde{h}^B \) is the log of the productivity gap between advanced and backward countries.

- \( \tilde{L}^R = \tilde{L}^A - \tilde{L}^B \) is the log of the ratio of labour employed in production between advanced and backward countries.

- \( \tilde{L}^W = s^A \tilde{L}^A + s^B \tilde{L}^B \) is the sum, weighted by GDP, of labour in production for advanced and backward countries.

- \( \hat{I} \) is a matrix containing structural technological and spillovers parameters.
Estimate Methods and Techniques

- Static Solow Model: OLS
- Dynamic Model: GMM
- Smulders Model: VARX
Some Empirical Analysis
Analysis and Variables

• Descriptive Analysis (GDPpc, R&D, Openness)

• Static Solow Model OLS (GDPpc, UE27)

• Dynamic Model GMM (GDPpc, R&D, Openness, UE21)

Input

- Public Expenditure on Education
- Number of Scientific Graduates

Output

- Number of Patent Applications
- Trade and HighTech Exports
- FDI

GDP

- GDPpc
- GDP Growth Rate

R&D

Openness
GDPpc Descriptive Analysis

Graphs by Country
GDPpc Growth Descriptive Analysis
Public Expenditure on Education Descriptive Analysis
Trade (%GDP) Descriptive Analysis
HighTech Exports Descriptive Analysis
### Static Solow Model - Estimates Results

<table>
<thead>
<tr>
<th>Source</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>Number of obs = 27</th>
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<tbody>
<tr>
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<td>1</td>
<td>0.001082918</td>
<td>F( 1, 25) = 6.27</td>
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<tr>
<td>Residual</td>
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<td>25</td>
<td>0.000172685</td>
<td>Prob &gt; F = 0.0192</td>
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<tr>
<td>Total</td>
<td>0.005400044</td>
<td>26</td>
<td>0.000207694</td>
<td>R-squared = 0.2005</td>
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</tbody>
</table>

| GrowthAR | Coef.         | Std. Err. | t     | P>|t|   | [95% Conf. Interval] |
|----------|---------------|-----------|-------|-------|---------------------|
| lnGDPpc_T92 | -0.12077     | 0.048227  | -2.50 | 0.019 | -0.220095 to -0.021445 |
| _cons    | 0.144661     | 0.0461943 | 3.13  | 0.004 | 0.0493272 to 0.239605 |

Regression coefficient < 0, then $\beta > 0$
Static Solow Model - Estimates Plot

UE27 Solow Model- average growth rate vs ln_gdp_92
### Dynamic Model - Estimates Results

<table>
<thead>
<tr>
<th>Variables</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
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<td>eso</td>
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<td>97</td>
<td>105</td>
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<table>
<thead>
<tr>
<th>Variables</th>
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<th>H</th>
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<td>N. observations</td>
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Comments

- Dynamic model seems to confirm divergence but this result doesn’t consider the investment variable.

- Trade has a crucial role in determining growth.

- Other variables are not significant in these specifications.

- Specification 1 of the dynamic model highlights the role for growth of both openness and patent applications.