The Dynamic Implication of Agricultural Research and Development Investment for Economic Development

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The Dynamic Implication of Agricultural Research and Development Investment for Economic Development

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Introduction

- FAO (2009) projects that by 2050, food production needs to increase by 70% to meet the world need.
- Demographic expansion and climate change put increasing pressure on land. Thus, the future increase in production is expected from productivity increase.
- Productivity increase requires increase in investment in research and development accompanied by a widespread adoption of new technologies, farming techniques and crop varieties in most countries.
- But beyond productivity increase, investment in R&D need to be translated into growth to be sustainable and to contribute to global poverty reduction.

Objective

We reexamine the role of agricultural investment in R&D in developing countries with focus on the dynamic impact on economic growth.

Model Specification

- We consider the following ARDL panel equation

\[ y_{it} = A_{it} + \mu_i + \sum_{j=1}^{p} a_j y_{i(t-j)} + \sum_{j=0}^{p} \beta_j R_{it-j} + \epsilon_{it} \]  

\[ y_{it} \] is the log of per capita output; \( R_{it} \) is the agriculture R&D; \( \mu_i \) is country-specific fixed effects in output

\[ A_{it} \] measures productivity is models as function R&D as follows \( \Delta A_{it} = y_{it} + \gamma_{it} R_{it} + \delta_{it} \) (2)  

- Differentiating (1) and combining with (2) gives

\[ \Delta y_{it} = \gamma_{it} + \gamma_{it} R_{it} + \sum_{j=1}^{p} a_j \Delta y_{i(t-j)} + \sum_{j=0}^{p} \beta_j \Delta R_{it-j} + \eta_{it} + \Delta \epsilon_{it} \]  

Estimation

- Taking the difference of equation (1) avoid relying on cointegration for the identification of equation (3)

- Use unit roots test to verify that he series are I(0)

- Use GMM-System estimation to address the potential endogeneity of current agriculture R&D investment and the presence of lags of growth in equation (3)

- Estimates and test the significance of the level and growth effect of R&D

Data and Descriptive Statistics

- Data on Agriculture R&D investment are from the Agricultural Science and Technology Indicators (ASTI).
- GDP data are from the World Development Indicators.
- Sample size is 57 countries over 1981-2010

<table>
<thead>
<tr>
<th>Table 1: Descriptive Statistics</th>
<th>Mean Std.Dev.</th>
<th>Min Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP growth</td>
<td>1.7</td>
<td>4.5-19.1</td>
</tr>
<tr>
<td>Ag public R&amp;D Investment ($ Million)</td>
<td>61.6</td>
<td>157.5</td>
</tr>
<tr>
<td>Ag public R&amp;D Investment per ag worker ($)</td>
<td>35.2</td>
<td>62.7</td>
</tr>
</tbody>
</table>

Results

- Log total Ag R&D Investment Log R&D Investment per Ag Worker

<table>
<thead>
<tr>
<th>OLS</th>
<th>GMM-SYS</th>
<th>OLS</th>
<th>GMM-SYS</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \Delta y_{it-1} )</td>
<td>0.209*** 0.211***</td>
<td>0.205*** 0.187***</td>
<td></td>
</tr>
<tr>
<td>( \Delta y_{it-2} )</td>
<td>0.049 (0.052) 0.103***</td>
<td>0.049 (0.051) 0.071***</td>
<td></td>
</tr>
<tr>
<td>( \Delta y_{it-3} )</td>
<td>0.034 (0.033) 0.143***</td>
<td>0.033 (0.033) 0.113***</td>
<td></td>
</tr>
<tr>
<td>( R_{it} )</td>
<td>0.207*** 0.343***</td>
<td>0.050 (0.114) 0.179</td>
<td></td>
</tr>
<tr>
<td>( \Delta R_{it-1} )</td>
<td>0.834 1.422</td>
<td>0.048 (0.991) 1.081* 1.218</td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>0.205*** 0.856</td>
<td>(0.967) 0.356 (0.580)</td>
<td></td>
</tr>
<tr>
<td>( \Delta \epsilon_{it} )</td>
<td>-0.445 -0.390</td>
<td>-0.173 -0.071</td>
<td></td>
</tr>
<tr>
<td>( \Delta \epsilon_{it-1} )</td>
<td>-0.512 -0.552</td>
<td>-0.477 (0.447) -0.118</td>
<td></td>
</tr>
<tr>
<td>( \Delta \epsilon_{it-2} )</td>
<td>-0.333 -0.328</td>
<td>-0.172 (0.463) -0.526</td>
<td></td>
</tr>
<tr>
<td>( \Delta \epsilon_{it-3} )</td>
<td>-0.473 (0.541) 0.463 (0.526) 5.122*** 4.320</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \Delta \epsilon_{it} )</td>
<td>-2.763 -1.117</td>
<td>5.122*** 4.320</td>
<td></td>
</tr>
<tr>
<td>Sargan</td>
<td>0.395*** 0.564***</td>
<td>0.013 (0.243) 0.283</td>
<td></td>
</tr>
</tbody>
</table>

In all regression the dependent variable is the annual growth rate of GDP per capita, \( y_{it} \). \( R_{it} \) stands for the variable in the columns uses as proxy for investment in R&D. Standard errors in parentheses; for OLS they are robust while for GMM-SYS they small sample bias corrected. The number of lags to include is chosen by the minimization of the Akaike Information Criteria. *** p<0.01, ** p<0.05, * p<0.1

Summary and Implications

- Using a simple dynamic model, we find that both the growth and the level effect of agriculture investment in R&D in developing countries are positive.

- Depending on the proxy used either one of these two effect is significant

- The result suggests that intensification of agriculture R&D investment could be an effective approach to increase income and growth in developing countries

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