Productivity Growth in the Global Agricultural Economy

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The 20th Century decline in food prices

Grillis & Yang Global Agricultural Price Index (Updated)
Adjusted for Inflation by the U.S. GDP Price Deflator

-1.0% per year
-1.6% per year
Is the recent agricultural price rise because productivity growth has been slowing down?

Source: World Bank Development Report 2008  (figure refers to developing countries only)
Toward a more complete assessment of productivity growth

Yield growth

Input intensification

TFP growth
- technical change
- allocative efficiency

Area growth

Research & extension
Rural education
Resource quality
Infrastructure
Institutions

Resource endowments
Prices & costs
Input policies
Infrastructure
Exchange rates
Institutions
Measuring TFP growth

- Previous studies: Malmquist Distance function
  - Arnade (1998), Coelli et al. (2005), Ludena et al. (2007)
  - Uses only Input-Output quantity data
  - Results sensitive to data quality & dimensionality issue

- This study: use Solow-type growth accounting method
  - TFP growth is difference between output growth and input growth

\[
\dot{TFP}_{tc} = \sum_i R_{ic} \dot{Y}_{ite} - \sum_j S_{je} \dot{X}_{jtc}
\]

- Only compare TFP growth, not TFP levels, among countries
Empirical approach

- Output: Add up FAO crop & livestock outputs
  - Valued using fixed global prices measured in constant 2005 US$ (FAO’s gross value of output measure)
- Input: Add up FAO input quantities using cost shares or production elasticities published from previous studies
  - Cost shares vary over time (if observed)
  - Where not available, assign fixed cost share from “similar” country
Constructing an input index

Growth rate of aggregate input is weighted average of growth in Land, Labor, Capital and Materials, where weights are their (fixed or varying) cost shares.
Constructing an input index
Average input cost shares for 9 countries

- India
- Indonesia
- China
- Mexico
- Brazil
- Japan
- South Africa
- UK
- USA

Categories:
- Labor
- Land & Structures
- Livestock & Feed
- Machinery & Energy
- Chemicals & Seed
Application of cost shares to regions

(source of estimates in parentheses)
Growth decomposition

- Cobb-Douglas CRS production function

\[ Y = A \prod_{i=1}^{n} X^\beta_i \]

- Growth decomposition by input costs

\[ \dot{Y} = \dot{A} + \sum_{i=1}^{n} \beta_i \dot{X}_i \]

- Growth decomposition by resources \((X_1 = \text{land})\)

\[ \dot{Y} = \dot{X}_1 + \frac{Y}{X_1} \]

\[ \dot{Y} = \dot{X}_1 + \dot{A} + \sum_{i=2}^{n} \beta_i \left( \frac{\dot{X}_i}{X_1} \right) \]
Agricultural growth decomposition shows declining input intensification and rising TFP.

Annual growth rate by decade, global average.
Agricultural TFP growth rates converging among major global regions
Long-run average agricultural TFP growth, 1971-2008 (% per year)

Average annual TFP growth
- > 2%
- 1-2%
- < 1%

Circled regions show persistently low TFP growth