

Productivity Growth in the Global Agricultural Economy

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Forum on Food Price Increases: Causes Impacts and Response

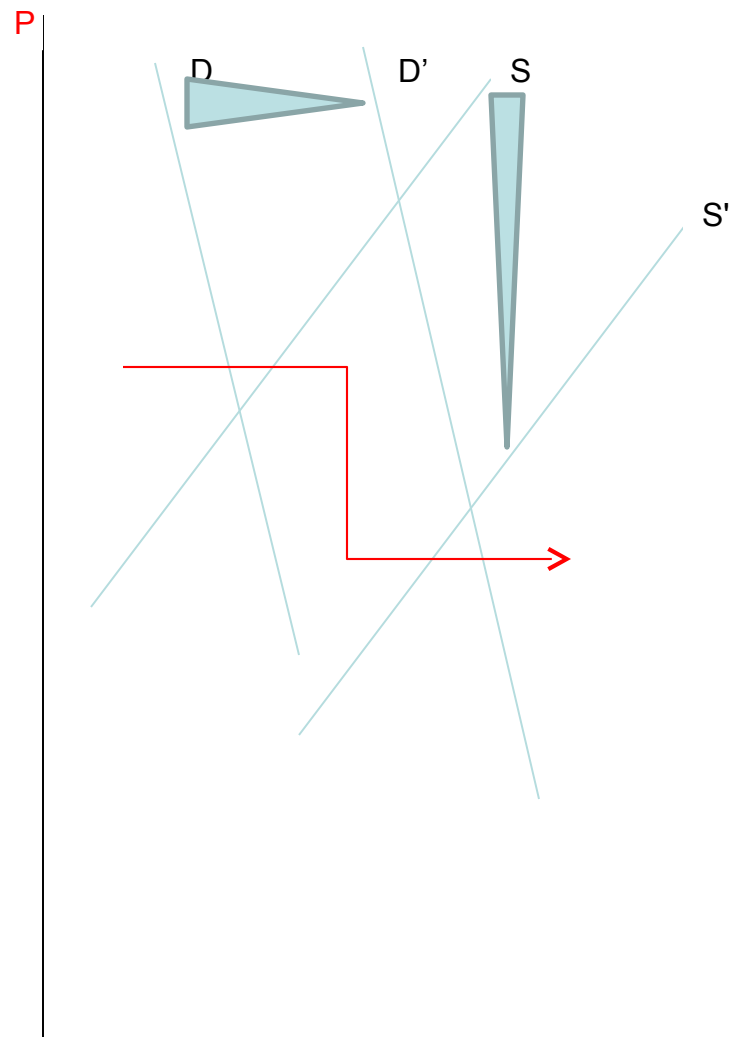
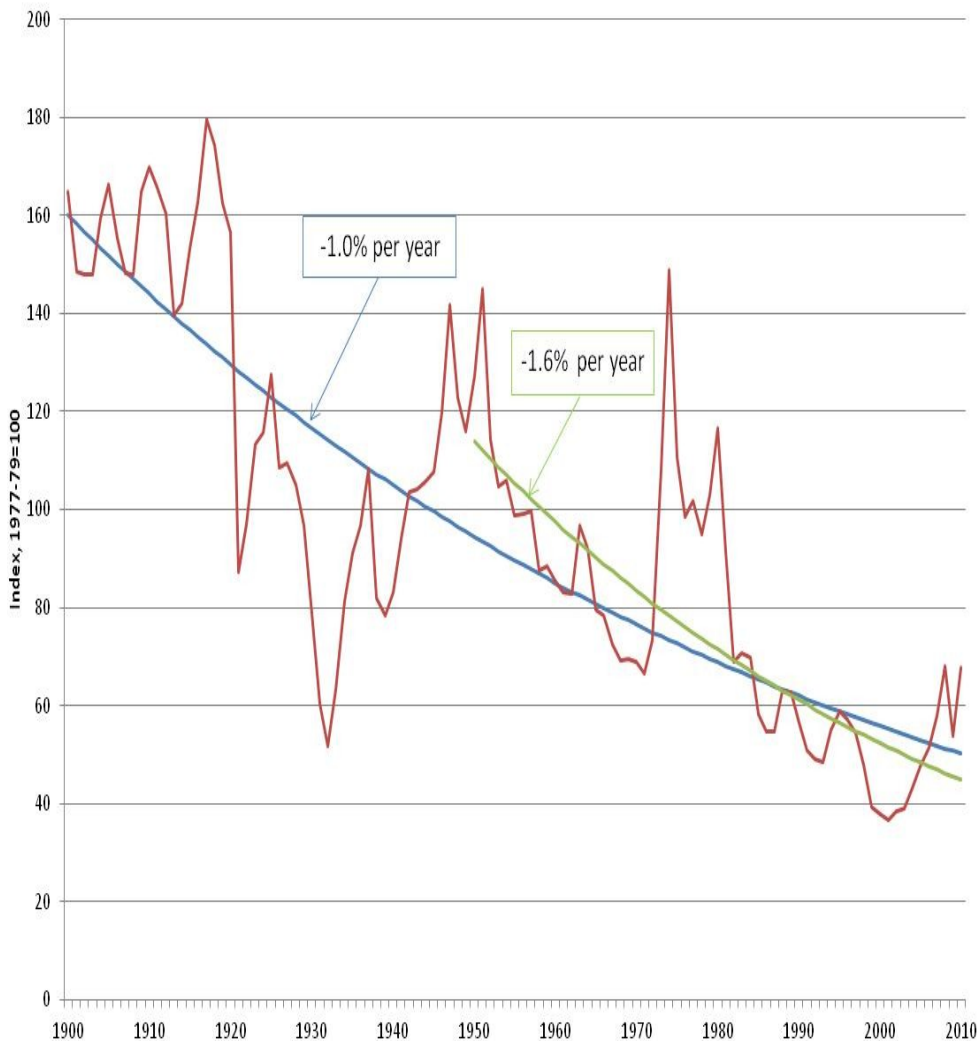
IIEP, Elliot School of International Affairs, GWU

September 30, 2011



The 20th Century decline in food prices

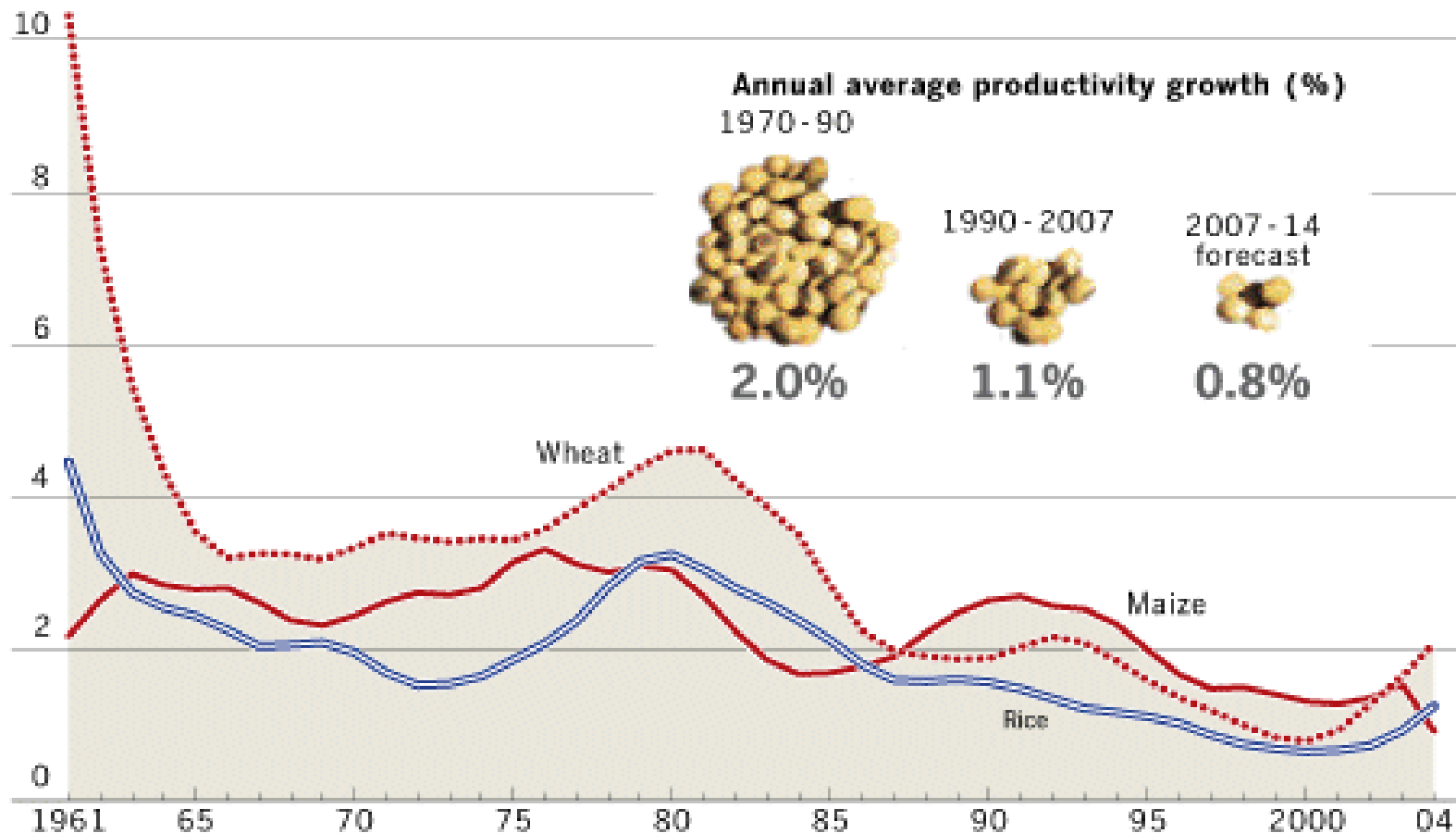
Grillis & Yang Global Agricultural Price Index (Updated)
Adjusted for Inflation by the U.S. GDP Price Deflator



Is the recent agricultural price rise because productivity growth has been slowing down?

The pace of improvement has slowed steadily...

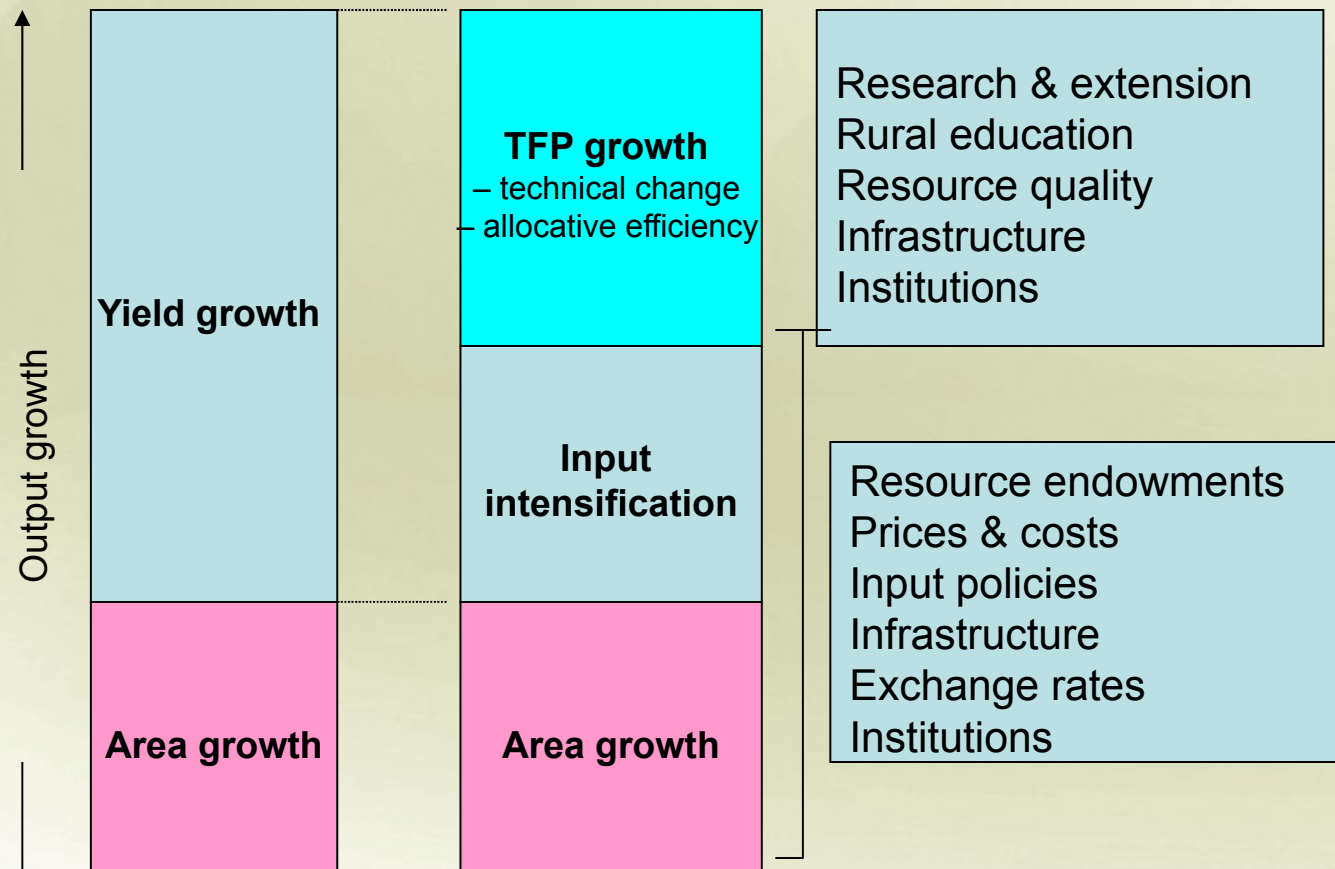
Annual % change in crop yield



Source: World Bank Development Report 2008 (figure refers to developing countries only)



Toward a more complete assessment of productivity growth



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

$$\dot{TFP}_{tc} = \sum_i R_{ic} \dot{Y}_{itc} - \sum_j S_{jc} \dot{X}_{jtc}$$

- 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

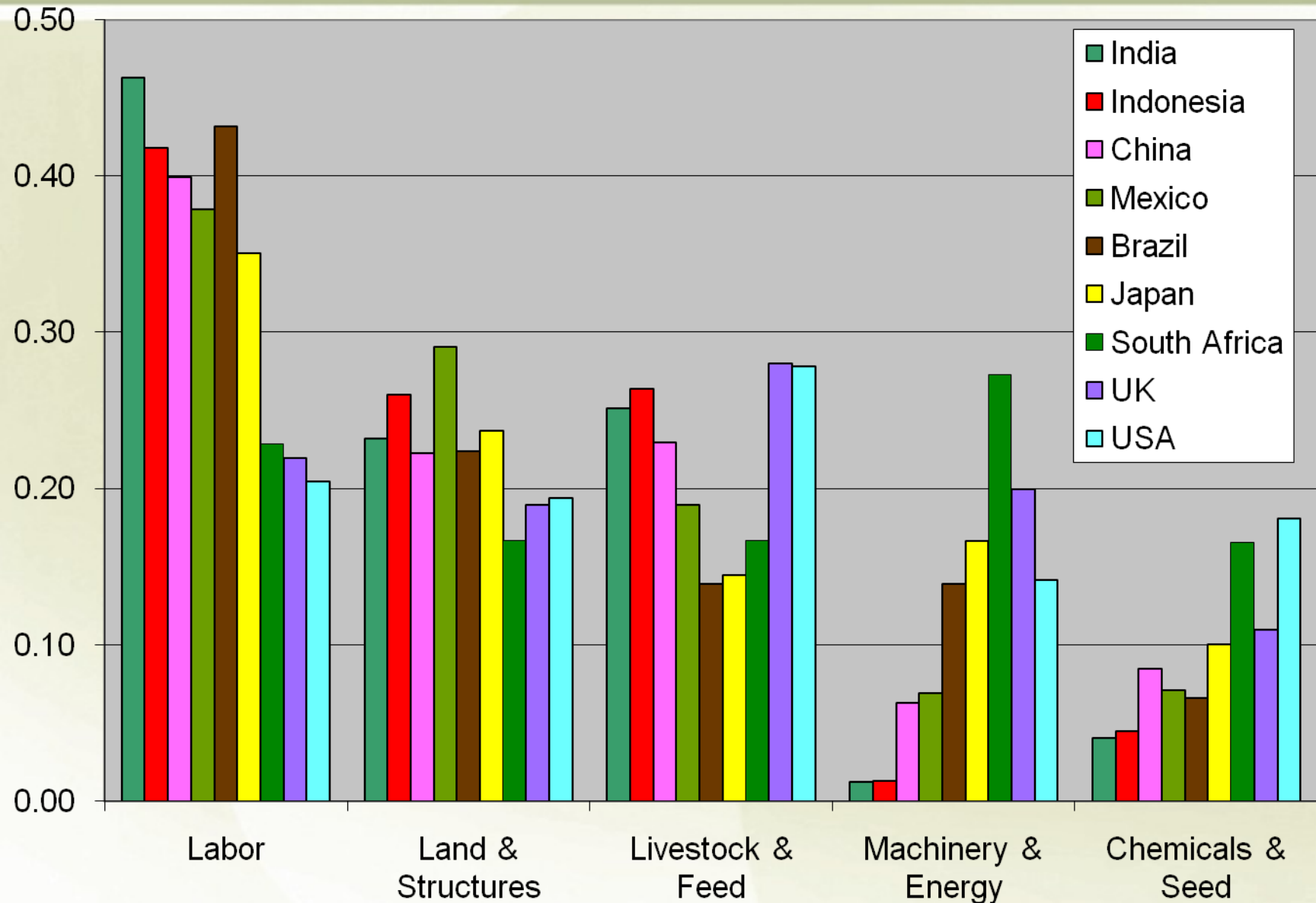
Growth rate of aggregate input is weighted average of growth in Land, Labor, Capital and Materials, where weights are their (fixed or varying) cost shares.



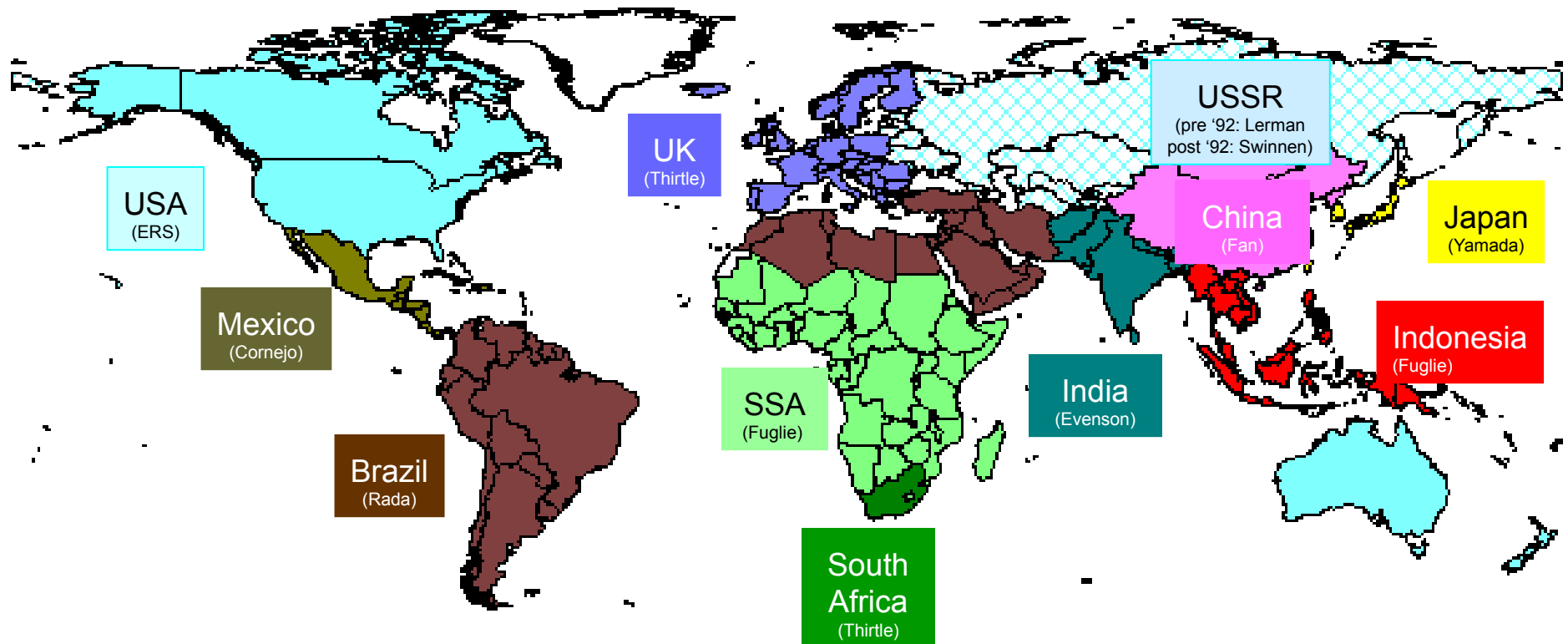
Constructing an input index



Average input cost shares for 9 countries



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 = land)

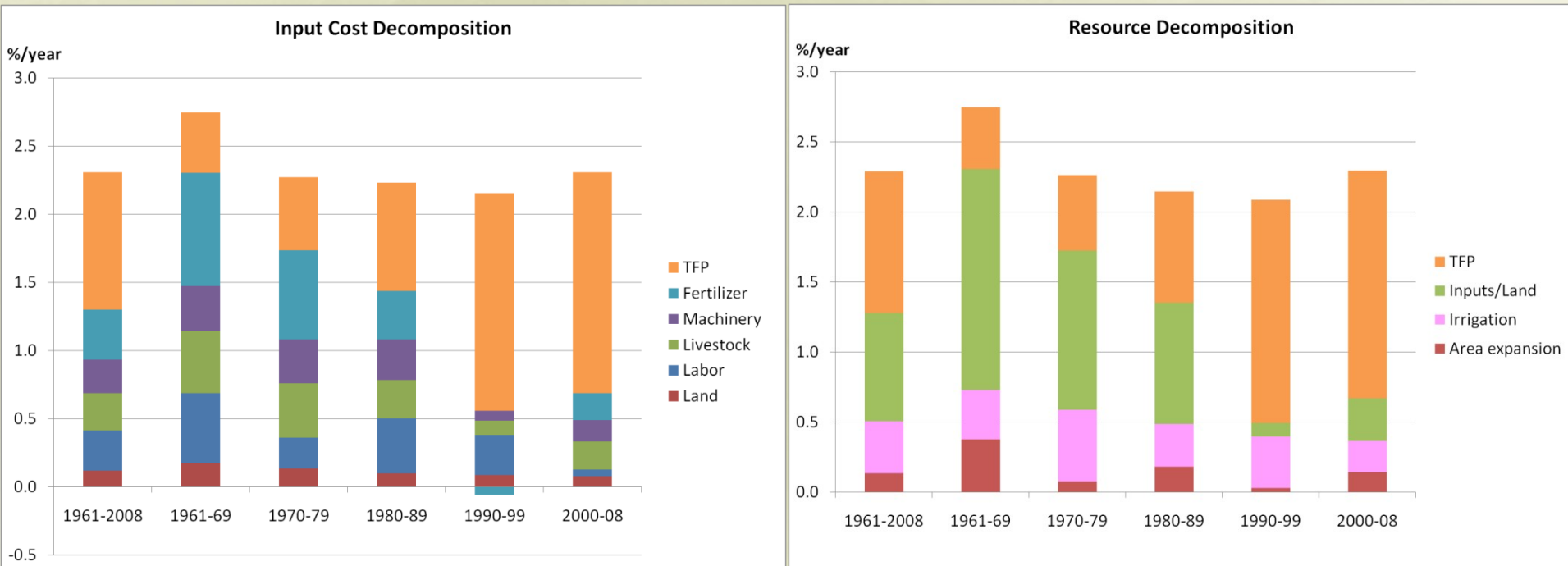
$$\dot{Y} = \dot{X}_1 + \frac{\dot{Y}}{X_1}$$

$$\dot{Y} = \dot{X}_1 + \dot{A} + \sum_{i=2}^n \beta_i \left(\frac{\dot{X}_i}{X_1} \right)$$



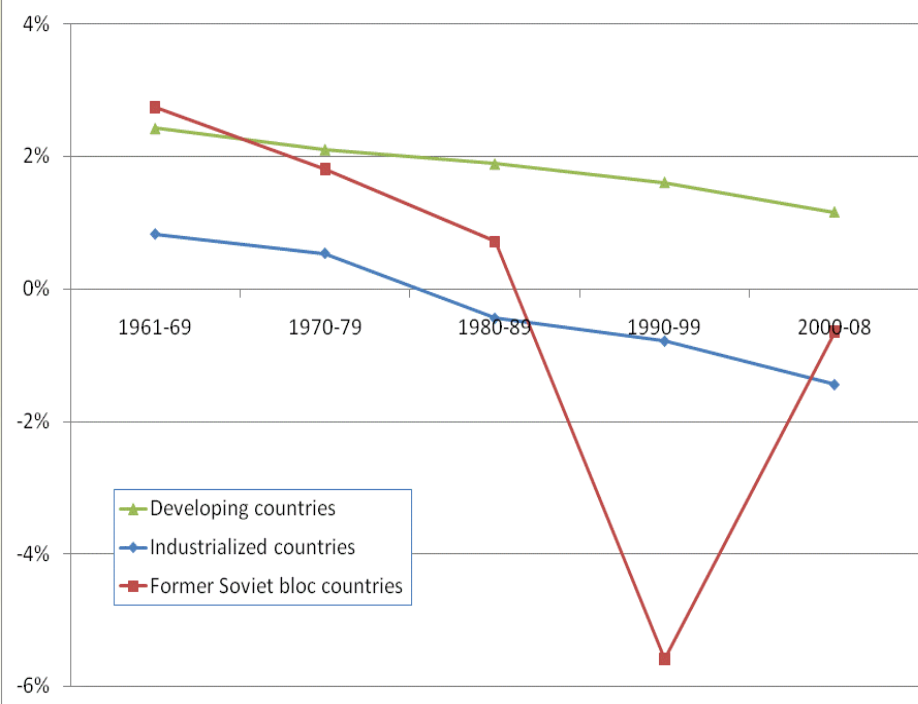
Agricultural growth decomposition shows declining input intensification and rising TFP

Annual growth rate by decade, global average

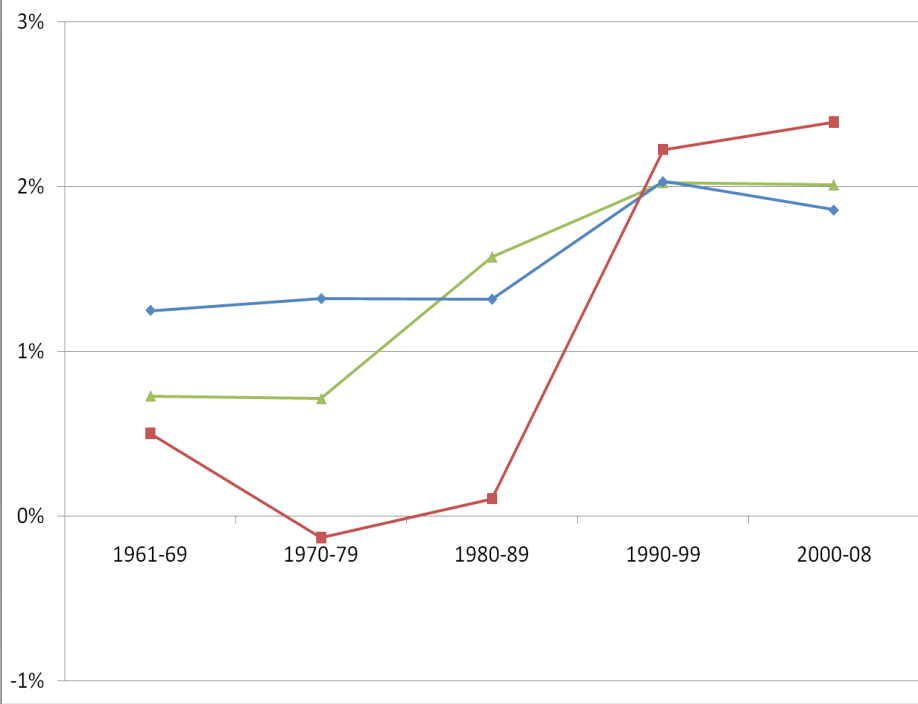


Agricultural TFP growth rates converging among major global regions

Average rate of growth in inputs



Average rate of growth in TFP



Long-run average agricultural TFP growth, 1971-2008 (% per year)

