Evaluating Agricultural Productivity’s Impact on Food Security

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and

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at the

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Motivation

• FAO estimates global demand will increase 60% by 2050, but this could still leave ~ 1 billion people food insecure (FAO, 2012)

• Key to meeting that future food demand is an increase in productivity growth, but estimates show wide range in agricultural TFP growth across countries and regions.

• Could faster TFP growth reduce food insecurity? Does it matter where this TFP growth occurs?
Research Approach

- We use a macro-micro approach
- Components of model
  - USDA food insecurity model
  - GTAP CGE model of global economy
  - Shock GTP model with Fuglie’s (2012) estimates of country-specific agricultural TFP growth rates
- How does this affect national food import demand?
- How does this affect number of food insecure?
Present paper:

• test the validity of our macro-micro approach to measuring food security;

• introduce new, value-added TFP growth measure, estimated from Fuglie’s (2012) gross output measures of TFP growth, to GTAP.
Methodology – From gross output to value-added agricultural TFP measure

- Fuglie (2012) assumes CRS Cobb-Douglas production technology of the form:

\[ Y_t^G = TFP_t^G \ast f(L_t^G, K_t^G, A_t^G, M_t^G) \]

- We thus scale Fuglie’s TFP measures by the ‘domar’ weight (Domar, 1961):

\[ TFP_t^V = \frac{TFP_t^G}{1 - \delta^G} \]
Comparing Global VA and GO TFP

Source: Authors’ estimates using data from Fuglie (2012).
Comparing Industrialized Countries’ VA and GO TFP

Source: Authors’ estimates using data from Fuglie (2012).
Comparing Developing Countries’ VA and GO TFP

Source: Authors’ estimates using data from Fuglie (2012).
Methodology – Macro model


• Analysis employs three sectors: grains, roots & tubers, and other horticultural and livestock products. — Oilseeds, fibers, and sugarcane were omitted.

• Model also accounts for population, capital, labor, GDP, and investments from Chapius and Walmsley (2011).

• Model is resolved for each year between 2012 and 2022, but is not dynamic due to lack of capital accumulation.
Methodology – Micro model

• Employ the Economic Research Service’s International Food Security Model (IFSA)
  
  – employs GTAP-generated growth rates to estimate food security annually over the 2012-2022 period across 31 developing countries.

  – food security is determined by the gap between domestic consumption (production + imports - nonfood use) and a nutritional target.
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Number of Food Insecure

Baseline Estimate

Impact of VA TFP

Average Annual Decrease of 6.49%

Average Annual Decrease of 9.53%
## How Does TFP Affect Food Security?

### Average Annual Food Production and Import Growth Rates, 2012-2022.

<table>
<thead>
<tr>
<th></th>
<th>Asia</th>
<th>Africa</th>
<th>Latin America</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Production</td>
<td>Imports</td>
<td>Production</td>
</tr>
<tr>
<td><strong>Baseline</strong></td>
<td>1.93%</td>
<td>4.25%</td>
<td>4.40%</td>
</tr>
<tr>
<td><strong>TFP-induced</strong></td>
<td>3.31%</td>
<td>3.02%</td>
<td>2.82%</td>
</tr>
</tbody>
</table>

### Notes:

1. Asia here excludes Armenia and Azerbaijan and Africa excludes the North African countries Egypt, Tunisia, and Morocco.
2. Food Production here consists only of grains and root crops, specified in grain equivalents.
Conclusions

• Value-added TFP growth estimates vary substantially from the gross output measures, particularly in more developed countries.

• To the extent that the macro estimates are credible, agricultural TFP growth appears to play a critical role in reducing food insecurity.

• Replicating last decade’s agricultural performance will enable a balanced approach to food security improvements in Asia and Latin America, but one tilted strongly toward imports in Africa.
Limitations

• Macro projections of production and import capacity for some countries are many times above historical rates.

• Micro food security estimates assume a constant income-to-consumption elasticity across all countries.
Thank you!
Questions or Comments?

You may also address comments or questions to Nicholas Rada, nrada@ers.usda.gov
## Results: VA or GO TFP?

<table>
<thead>
<tr>
<th></th>
<th>Gross Output TFP</th>
<th>Value-added TFP</th>
<th>Number of Countries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample Total</td>
<td>0.3139</td>
<td>0.4514</td>
<td>39</td>
</tr>
<tr>
<td>Industrialized Countries</td>
<td>0.8065</td>
<td>0.8923</td>
<td>4</td>
</tr>
<tr>
<td>Emerging Countries</td>
<td>-0.7616</td>
<td>-0.4044</td>
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<tr>
<td>Developing Countries</td>
<td>0.2600</td>
<td>0.4158</td>
<td>30</td>
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<tr>
<td>African Countries</td>
<td>0.0198</td>
<td>0.241</td>
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<tr>
<td>Asian Countries</td>
<td>0.0667</td>
<td>0.2642</td>
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<tr>
<td>Latin American</td>
<td>0.0094</td>
<td>0.0334</td>
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</tr>
</tbody>
</table>
Food Distribution Gap

Baseline Estimate

Impact of VA TFP

Average Annual Decrease of 7.05%

Average Annual Decrease of 9.83%