Estimating Short- and Long-run Supply Elasticities of Global Agricultural Commodities from Dynamic Heterogeneous Panels

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Background

- Most empirical studies assume agricultural crop supply curve is parallel across individual units (e.g., Haile et al. 2016).

- Existing studies provide only short-run supply response to prices.

Objectives

- Accommodate country-specific (heterogeneous) slope coefficients in the global aggregate supply elasticity estimates of corn, soybeans, wheat, and rice.

- Provide short- and long-run price elasticity estimates of global aggregate crop supply.

Empirical Model and Estimation Methods

(1) \[ Q_t = \mu + \delta_{\mu} P_{t-1} + \delta_{\delta} Z + \lambda_{\lambda} Q + \eta_{\eta} T + \varepsilon_t \]

(2) \[ \Delta Q_t = \phi (Q_{t-1} - \theta Q_{t-2} - \Theta Z_{t-1}) - \delta_{\delta} \Delta P - \delta_{\delta} \Delta Z_t + \varepsilon_t \]

Equation (1) is an autoregressive distributive lag (ARDL) model and equation (2) is the error correction model (ECM). \( Q = \hat{Q}_t \) is total caloric production from four crops, \( P_{t-1} \) is average crop futures price traded in futures market, \( Z_t \) is past year crop prices, \( Z_t \) denotes yield shocks and revenue risk and \( T \) is time trend. The subscript i denotes country. All variables are in natural logarithmic forms.

- Econometric methods: Mean group (MG) and pooled means group (PMG) estimators-developed by Pesaran and Smith (1995) and Pesaran, Shin, and Smith (1999).

- The MG estimator allows the intercepts, slope coefficients (short- and long-term), and error variances to differ across groups.

- The PMG estimator combines both pooling and averaging and allows intercept, short-run coefficients, and error variances to differ across groups.

Data

- Production and growing area: FAOSTAT of the FAO, Futures Price: Chicago Board of Trade (CBOT).
- Sample Observation: 1961 to 2014
- Panel groups are 31. Countries with a share of less than 0.5% of global caloric production for each crop are grouped as the rest of the world (ROW).

Results & Discussion

Several findings from the Tables 1 and 2 are worth mentioning here:

- The estimated long-run caloric supply elasticities are positive across all models, no matter which shock variable we use and these vary with a range of 0.069 to 0.357 (Table 1).

- The estimates of short-run caloric supply elasticities are close to zero, perhaps due to negative short-term yield response to prices.

- The long-run price elasticities of growing area are also positive and these vary from 0.013 to 0.025.

- The effects revenue risk on growing area are positive in the short-run but negative in the long-run.

Table 2. Estimates of Global Aggregate (four crops) Growing Area Responses

<table>
<thead>
<tr>
<th></th>
<th>Long Run</th>
<th>Short Run</th>
<th>Supply Elast.</th>
<th>Revenue Risk</th>
<th>Constant</th>
</tr>
</thead>
<tbody>
<tr>
<td>No shock</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supply Elast.</td>
<td>0.069*</td>
<td>0.025*</td>
<td>0.023</td>
<td>-0.011*</td>
<td>1.764*</td>
</tr>
<tr>
<td>(0.032)</td>
<td>(0.021)</td>
<td>(0.020)</td>
<td>(0.027)</td>
<td>(0.001)</td>
<td>(0.012)</td>
</tr>
<tr>
<td>Yield Shock</td>
<td>-0.011</td>
<td>0.527*</td>
<td>0.245*</td>
<td>-0.002*</td>
<td>0.913</td>
</tr>
<tr>
<td>(0.044)</td>
<td>(0.149)</td>
<td>(0.130)</td>
<td>(0.025)</td>
<td>(0.001)</td>
<td>(0.085)</td>
</tr>
<tr>
<td>Revenue Risk</td>
<td>-0.000</td>
<td>0.000</td>
<td>-0.002</td>
<td>-0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>(0.004)</td>
<td>(0.001)</td>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.001)</td>
</tr>
<tr>
<td>Trend</td>
<td>0.022*</td>
<td>0.022*</td>
<td>0.022*</td>
<td>0.018*</td>
<td>0.022*</td>
</tr>
<tr>
<td>(0.001)</td>
<td>(0.002)</td>
<td>(0.001)</td>
<td>(0.002)</td>
<td>(0.002)</td>
<td>(0.003)</td>
</tr>
</tbody>
</table>

Standard errors in parentheses

Conclusion

- The short-term price elasticity estimates of growing area are significantly lower than the estimates of the existing studies.

- More future research works on this topic are necessary, e.g., i) use of country-specific producer prices in estimating global mean supply response can be one possible area of research, ii) estimation of crop-specific global mean supply response using heterogeneous panel data model can be the another possible area of future research.

References