Implementing Rural-Urban Disaggregated Food Demand in a Partial Equilibrium Model

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May 2, 2011

Introduction

Global and partial equilibrium models focused on the agricultural sector can help policy makers do ex-ante analysis by providing a variety of macro-level outcomes, such as changes in flows of international trade, and changes in the supply, demand, and prices of globally traded commodities. IFPRI’s IMPACT model (International Model for Policy Analysis of Agricultural Commodities and Trade) is one such model. Since its inception nearly 20 years ago the model has evolved to inform increasingly complex and nuanced policy issues, such as the explicit modeling of water use and the productive response of agriculture to climate change. However, on the demand side it has remained a fairly blunt instrument.

One oft mentioned shortcoming of global food policy models such as IMPACT model is that they treat national populations as a single composite consumer. As relatively wealthier urban and poorer rural populations exhibit different demand characteristics, have different base levels of consumption, and face different constraints for food acquisition, IMPACT’s results can be misleading regarding both global prices and consumption and the food security of the poorer segments of the population. In this poster we present a global partial equilibrium food security model with disaggregated demand. Working from the IMPACT model, we divided national populations into their urban and rural components.

Studies have shown that rural and urban consumers, as well as poor and rich consumers, have structurally different food demands. Accordingly, we present a global partial equilibrium food security model with disaggregated demand. Working from the IMPACT model, we divided national populations into their urban and rural components.

Studies were conducted over various time frames with the earliest study conducted in 1971, and the latest in 2006.

Objectives

- Disaggregated by urban-rural split for 29 IMPACT Commodity in 115 IMPACT countries/region:
  - Income Elasticities
  - Own-Price Elasticities
  - Annual food demand

Disaggregated Elasticities

- Reviewed 67 disaggregated food demand studies
- The studies covered 41 countries
- The studies were conducted over various time frames with the earliest study conducted in 1971, and the latest in 2006

Process

Step 1: Measure differences between rural and urban elasticities (“elasticity gaps”)
Step 2: Consolidate elasticity gaps into a set of price and income elasticity gaps
Step 3: Use differences in elasticities between non-poor and poor to predict missing urban-rural gaps
Step 4: Use descriptive statistics and region controls to predict a complete set of elasticity gaps
Step 5: Fit gaps around the current IMPACT elasticities

Urban-Rural Price Elasticity Gap Regressions

<table>
<thead>
<tr>
<th>Commodity</th>
<th>Marshallian</th>
<th>Hicksian</th>
<th>Food Expenditure</th>
<th>Total Expenditure</th>
<th>Income</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP per capita</td>
<td>2.60e-05*** (43.0e-06)</td>
<td>2.60e-05*** (6.13e-06)</td>
<td>2.43e-05*** (6.05e-06)</td>
<td>2.60e-05*** (6.13e-06)</td>
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<tr>
<td>Gini Coefficient</td>
<td>0.0328*** (0.00307)</td>
<td>0.0395*** (0.00498)</td>
<td>0.0494*** (0.00401)</td>
<td>0.0494*** (0.00498)</td>
<td></td>
</tr>
<tr>
<td>Middle East, North Africa</td>
<td>0.154e-03</td>
<td>0.141e-03</td>
<td>0.154e-03</td>
<td>0.141e-03</td>
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<tr>
<td>Central Asia</td>
<td>0.145e-03</td>
<td>0.148e-03</td>
<td>0.145e-03</td>
<td>0.148e-03</td>
<td></td>
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<tr>
<td>South and Southwest Asia</td>
<td>0.148e-03</td>
<td>0.148e-03</td>
<td>0.148e-03</td>
<td>0.148e-03</td>
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<tr>
<td>Eastern Africa</td>
<td>0.148e-03</td>
<td>0.148e-03</td>
<td>0.148e-03</td>
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<tr>
<td>Latin America</td>
<td>0.148e-03</td>
<td>0.148e-03</td>
<td>0.148e-03</td>
<td>0.148e-03</td>
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<tr>
<td>Region Fixed Effects (F-stat)</td>
<td>14.55</td>
<td>14.74</td>
<td>2.79</td>
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<tr>
<td>(Province)</td>
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<td>0.0185</td>
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<tr>
<td>(Province)</td>
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<td>0.00010</td>
<td>0.00010</td>
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<tr>
<td>R-squared</td>
<td>0.994</td>
<td>0.994</td>
<td>0.994</td>
<td>0.994</td>
<td></td>
</tr>
</tbody>
</table>

Urban-Rural Consolidated Set

- Ready to be fitted around IMPACT income and own-price elasticities

Results

Disaggregating demand clearly impacts aggregate outcomes. For this reason alone, policy makers should consider taking on this endeavor. However, the differential food security impacts of policy simulations on poorer rural households compared to wealthier urban households will likely be even more illuminating. Next steps for this line of research include examining per capita kilocalorie consumption for these sub-populations using a disaggregated model, and comparing these results with those obtained for the world population using an aggregated model. We can also test how different rates of urbanization in different parts of the world will impact regional and global food security.