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Anticipating Consumer Demand in a Mercurial Price Climate:

Cross-Price Elasticities across Multiple Goods

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Anticipating Consumer Demand in a Mercurial Price Climate

Cross-Price Elasticities Across Multiple Goods

Introduction

Relative price changes across consumer goods can force consumers to substitute less expensive (but perhaps less beneficial) goods for more costly products. Thus, price fluctuations and generally high prices may quickly reverse the significant strides that poor nations have made toward better nutrition and higher welfare for their citizens. Knowing how consumers respond to price changes helps policymakers assess future needs and anticipate demand for associated transportation and infrastructure facilities. An understanding of demand and consumption trends across countries and the ability to predict potential shifts in demand for different products is be an invaluable tool for agricultural, manufacturing, energy, education, and health professionals.

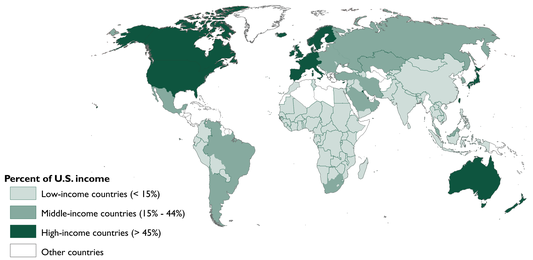
Objective

Past estimates of income and own-price elasticities were calculated using the 1996 and then the 2005 International Comparison Program (ICP) data (Seale et al., 2003 and Muhammad et al., 2011). Cross-price elasticities presented in Regmi and Seale (2010) have been widely used as inputs in economic models such as the U.S. Department of Agriculture's Baseline, Purdue University's Global Trade Analysis Project model, and the International Food Policy Research Institute's IMPACT model. This presentation updates cross-price elasticity estimates, based on 2005 ICP data, using the same two-stage complete demand model under assumptions of preference independence (in the absence of an estimated Slutsky matrix—see Methodology section). Using the parameters estimated from the Florida-Preference Independence (Florida-PI) model in Muhammad et al. (2011), cross-price elasticities are calculated for nine broad consumption categories.

Data

The 2005 ICP data cover 146 countries (see map). The analysis is confined to nine consumption categories: food; clothing and footwear; gross rent, fuel, and power; house furnishings and operations; medical care; education; transport and communications; recreation; and other items. Unlike in earlier years, the food expenditure group includes food prepared and consumed at home, as well as food consumed away from home, and beverages and tobacco.

Countries covered in the 2005 International Comparison Program



Methodology

Price elasticity measures the percent change in quantity demanded given a percent change in price. Three commonly measured types of price elasticities are:

Frisch— assumes that the consumer's marginal utility of income is constant;

Slutsky—assumes that the consumer's real income is constant (substitution effect); and

Cournot—assumes that the consumer's nominal income is unchanged (substitution and income effect).

Our methodology uses the parameters and estimated income/own-price elasticities from the Florida-PI model in Seale et al. (2003). It begins with the Frisch own-price elasticity, estimated as:

$$F_{iic} = \phi \frac{\theta_{ic}}{\overline{w}_{ic}} = \phi \frac{\overline{w}_{ic} + \beta_i}{\overline{w}_{ic}}$$

where $\overline{w}_{ic}$ is the budget share at geometric mean price of good i in country c, θ_{ic} is the marginal share, ϕ is the money flexibility, and β_i are estimated slope parameters of the Florida-PI model. With the above information, which was previously estimated, the following two cross-price elasticities are directly calculated without requiring the estimation of the coefficients of the Slutsky matrix.

The Slutsky cross-price elasticity (pure substitution effect) is given by

$$S_{ijc} = F_{iic}\left(\overline{w}_{jc} + \beta_j\right) \qquad i \neq j$$

And the Cournot cross-price elasticity is given by

$$C_{ijc} = S_{ijc} - \underbrace{\eta_{ic}\overline{w}_{jc}}_{\text{Income effect}} \qquad i \neq j$$

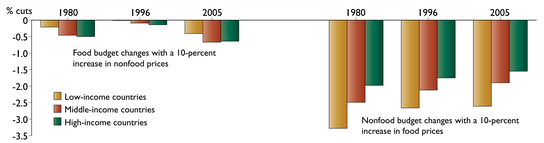
where η_{ic} is the income elasticity of demand for good i in country c.

Results

Using the parameters estimated by Muhammad et al. (2011), we calculate the marginal shares and the cross-price elasticities for food and nonfood; first for a two-good demand model, and then for a nine-good demand model. Results indicate that:

- **Consumer response to a change in food price is much greater than consumer response to a change in nonfood price.**

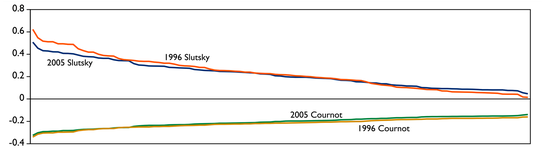
Food and nonfood budgets change with a 10-percent increase in prices



Source: Theil et al., 1989 (calculated from table 5.7 on pgs. 116-17); Regmi and Seale, 2010; and Meade et al., 2013 (anticipated publication). The calculations are based on Cournot elasticities.

- **A percentage change in food price results in greater demand change for nonfood products in lower income countries than in high-income countries.**

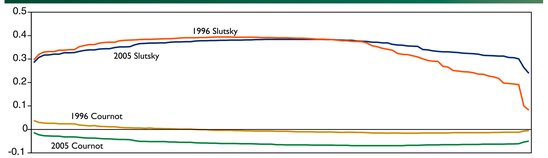
Nonfood demand change with 1-percent food price change



Note: The countries are sorted according to income levels. County marketings differ between 1996 and 2005.
Source: Author's calculations based on 2005 ICP data.

- **A percentage change in nonfood price, in contrast, appears to result in the largest substitution effects (Slutsky elasticity) for the middle-income countries.**

Food demand change with 1-percent nonfood price change



Note: The countries are sorted according to income levels. County marketings differ between 1996 and 2005.
Source: Author's calculations based on 2005 ICP data.

- **Across a nine-good demand system, the cross-price effects from food price changes affect low-income countries five times more (on average) than high-income countries, assuming compensation for income changes.**

Food cross-price elasticity in a nine-good demand system (based on 2005 International Comparison data)

	Clothing & footwear	Housing	House furnishings	Medical & health	Transport & communications	Recreation	Education	Other
	Percent change in other budget with 1-percent change in food prices							
Slutsky (compensated)								
Low-income average	0.278	0.309	0.303	0.564	0.351	0.900	0.268	0.591
Middle-income average	0.148	0.163	0.161	0.201	0.177	0.216	0.141	0.202
High-income average	0.076	0.084	0.083	0.098	0.089	0.102	0.072	0.098
Cournot (uncompensated)								
Low-income average	-0.206	-0.228	-0.224	-1.164	-0.258	-0.121	-0.198	-0.422
Middle-income average	-0.158	-0.174	-0.172	-0.214	-0.189	-0.230	-0.151	-0.215
High-income average	-0.132	-0.145	-0.143	-0.169	-0.155	-0.176	-0.125	-0.169
	Percent change in food budget with 1-percent change in other prices							
Slutsky (compensated)								
Low-income average	0.032	0.091	0.031	0.030	0.072	0.029	0.018	0.045
Middle-income average	0.025	0.086	0.028	0.042	0.079	0.044	0.013	0.062
High-income average	0.018	0.068	0.022	0.039	0.067	0.042	0.009	0.057
Cournot (uncompensated)								
Low-income average	-0.013	-0.025	-0.009	0.005	-0.009	0.010	-0.008	0.007
Middle-income average	-0.010	-0.024	-0.008	-0.002	-0.014	0.001	-0.006	-0.003
High-income average	-0.008	-0.019	-0.007	-0.004	-0.014	-0.002	-0.005	-0.006

Further Research

The above methodology can be extended to estimate cross-price elasticities for the second-stage demand model, which covers eight food subcategories (bread and cereals, meat, fish, dairy products, oils and fats, fruit and vegetables, beverages and tobacco, and other food products). 2011 ICP data covering more than 170 countries are expected to be available in 2014. Given that the new data cover more countries and allow for a greater disaggregation of both the broad consumption categories and the food subcategories, we expect to provide updated demand and cross-price elasticities, which will be valuable to economic modelers.

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