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Predicting within country household food expenditure variation using international cross-section estimates

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ABSTRACT

International cross-section demand systems have not been tested on their ability to accurately predict within country consumption expenditures. This paper reports on such a validation exercise for the case of food budget share predictions across expenditure percentiles within Bangladesh.

1. Motivation and introduction

International cross-section demand systems have long been used to estimate, national per capita demands and the evolution of spending patterns as countries become wealthier (e.g. Engel, 1857). Houthakker (1957) notes that empirical consumption studies took on an international flavor from a very early date. Theil, in the late seventies, extended this work to cross-country estimation of consumption demand as a system; a survey of his studies can be found in Clements and Qiang (2003). Researchers have tested the consistency of such international cross-section data with a single preference structure (Dowrick and Quiggin, 1994); alternative models have been compared on the basis of their theoretical consistency (Deaton and Muellbauer, 1980) and their ability to predict per capita consumption for countries (Cranfield et al., 2003). In an interesting application[2] Theil and Finke (1984) use cross-section estimates to do a time-series analysis of the preference changes of Dutch consumers over time; however, no study[3] to date has evaluated the ability of demand systems estimated using cross-country per capita data to predict demand across the income spectrum *within* a given country.

With increasing interest in poverty impacts of external shocks (Levinsohn et al., 2000; Ivanic and Martin, 2008; Hertel and Winters, 2006), having a valid demand system for eliciting the impacts of such changes across the income spectrum can be very useful. Yet it can be difficult to obtain high quality national level data with sufficient price and income variation to permit estimation of an appropriate demand system—particularly for most developing countries. Therefore, using international cross section demand system is very appealing—which begs the question: How accurately can such a demand system predict consumption patterns across the income spectrum for a country?

We employ An Implicitly Directly Additive Demand System (AIDADS) estimated using per capita data from International

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[2] Another interesting work we came across is Clements and Chen (2010). They exploit Engel's Law in the reverse direction; using per capita food budget shares to decipher the per capita real income for countries.

[3] A useful though somewhat dated list of cross-country studies appears in Selvanathan and Selvanathan (1993).

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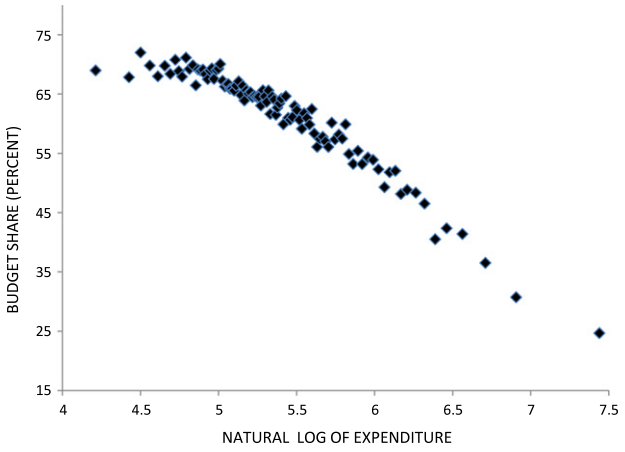

Fig. 1. Observed food budget shares.

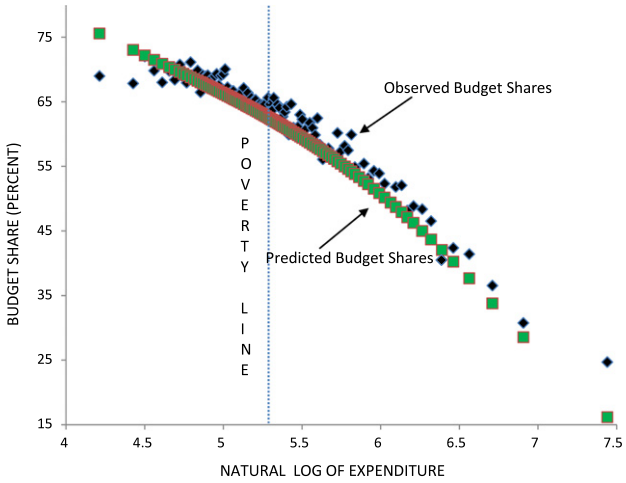

Fig. 2. Observed versus predicted shares.

Comparison Project (ICP) 1996, to evaluate the fit of its predicted expenditure shares across the income distribution, obtained from Household and Income Expenditure Survey (HIES, 2000) for Bangladesh.[4] The estimation is performed at the level of four aggregate commodities—which jointly exhaust total consumption expenditure. The four commodities are: food, non-durables, durables and services. ICP 1996 provides us with the cross-sectional data on total nominal and real expenditure in 1996 USD for 26 commodities and population for 114 countries; of which 40 are high income, 53 middle income and 21 are low income according to the World Bank income classification. 26 ICP commodities are aggregated to arrive at corresponding data for the four aggregates.[5]

2. Estimation

The model used here is a slightly modified version of one employed by Cranfield et al. (2007)[6] (we add durable goods to the previous authors' commodity aggregates). The estimated system is used to predict commodity budget shares across expenditure spectrum in Bangladesh. The model employed here also addresses the macro–micro synthesis due to its ability to model the aggregate mean expenditure as a weighted average of the individual expenditures across the distribution; Cranfield et al. (2007) use an entropy-based procedure to estimate per capita demand for final goods and services as an explicit aggregation of households' demands at different points of the expenditure distribution. As noted above, the idea of using an international demand system to predict expenditures across the income distribution within a country is quite new, and (to our knowledge) this is the first study to test the validity of this approach.

3. Survey data and methodology

For validation purposes, we start with household data from the HIES for the year 2000, conducted by Bangladesh Bureau of Statistics. It provides household level data for income, expenditure and consumption. HIES (2000) has a total of 7440 households surveyed, of which 5040 were rural and 2400 were urban, to reflect the dominant rural population in the country. HIES reports the actual number of days and number of people in household for whom daily food consumption data are collected. For more details, one can refer to the survey report (BBS, 2003).

The information we have from the survey is the household consumption expenditure split into two categories – food and non-food expenditure – which we use to calculate observed food expenditure shares to validate[7] the model results.

4. Results

The observed budget shares are plotted along with the predicted budget shares; results are shown visually in a set of figures below. The vertical axis reports the percent share of a commodity in total consumption expenditure while the horizontal axis represents the natural log of per capita total annual expenditure of a household. A movement along the axis represents increasing total per capita expenditure, i.e. richer households.

Fig. 1 shows the observed food budget shares for each population percentile. Conforming to Engel's law, these shares are decreasing with increasing expenditure.

Fig. 2 superimposes model-predicted food budget shares onto Fig. 1. It shows that the AIDADS model, estimated using mean per capita consumption and income distribution, nicely predicts the food budget shares for nearly the entire expenditure spectrum, including the percentiles around the nutritional poverty line.[8] As might be anticipated, at the very extreme ends, the estimated model over or underpredicts food consumption. As can be seen the AIDADS Engel curve allows for non-linearity in comparison to two other very popular demand specifications; a homothetic Cobb–Douglas (constant budget shares and therefore linear Engel curves) or Constant Elasticity function.[9] Also as against for some other rank 2 and rank 3 systems like AIDS (Deaton and Muellbauer, 1980) and QAIDS (Banks et al., 1997) the AIDADS predicted budget shares always remain within the [0, 1] interval even in the face of large changes in income.

[4] Choice of Bangladesh is determined by availability of reliable household data.

[5] A list of countries and commodity mappings is available on the GTAP working paper version of the paper (https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=3171).

[6] For a formal treatment of the model used here please see Cranfield (1999); the motivation and estimation strategy can be found in the working paper version (see footnote 5) and its Appendix A.

[7] Validation is undertaken only for food consumption. The reason being that observed food expenditure for Bangladesh is available from the (HIES, 2000) whereas the expenditure on all the other commodities appears in the survey as an aggregate—non-food expenditure. It is possible but tedious to map the consumption of households to the three non-food commodity groups and has not been attempted here.

[8] Nutritional poverty line is defined in terms of per day per capita calorie intake. The population fraction consuming below 2122Kcal is identified as nutritionally poor. BBS (2003) claims to have approximately 44% of the population in Bangladesh to be nutritionally poor.

[9] For a CES the budget shares vary with prices but are independent of income. With prices fixed this is equivalent to constant budget shares and linear Engel curves. So even though the shares differ across the countries, they do not differ across income distribution within a country.

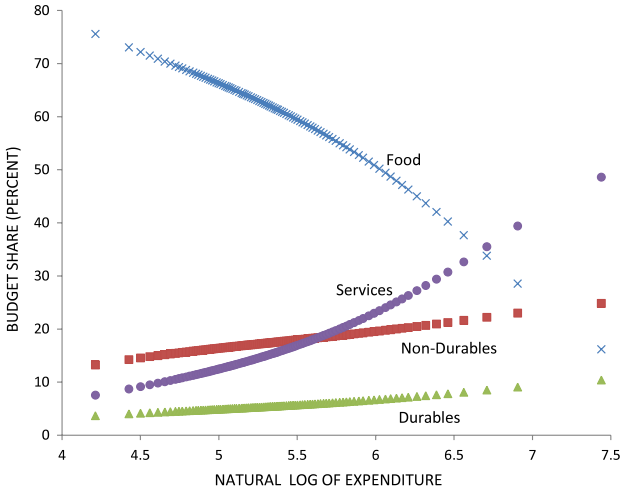

Fig. 3. Model predicted shares.

Though we do not attempt a similar validation for the other three aggregate commodities it is interesting to see how their *predicted* budget shares vary across the expenditure distribution for Bangladesh (Fig. 3). The patterns of the budget shares for non-food commodities, especially for services, rising with increasing income, conform to expectations as well as international evidence.

To conclude, the approach adopted here is less demanding in terms of data requirements as compared to models estimated using household data, especially when reliable household data is difficult to obtain for many developing countries. Where reliable household consumption data do exist, they are often difficult to map to international consumption categories, which can make comparisons across countries difficult. Furthermore, building on these advantages, variants of AIDADS international cross-section demand system have been successfully embedded in economy-wide simulation models in order to assess the poverty impacts of global trade reforms across a diverse set of developing countries (Verma et al., 2011; Hertel et al., 2009).

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