Data Collection Period and Food Demand System Estimation using Cross Sectional Data

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Background

- Accurate elasticity measures for food products are key elements in food policy discussion and analysis. Hence, the use of biased elasticities may lead to adoption of suboptimal food policies with far-reaching impacts on the target population.
- A potential source of biases in elasticity estimates is the data used in the analysis. For example, some datasets correspond to household surveys with very short reference periods which in turn give raise to problems with reports of zero expenditure. These zeros may come from two sources: 1) genuine non-consumption, and 2) infrequency of purchases. Econometricians have developed models that attempt to account for both problems; however, as argued by Gibson & Kim (2011), there are very few studies that have evaluated the identifying assumptions of these models, in part because of lack of suitable data.

Objectives

1. To analyze the impact of data collection periods in the estimation of food demand models using cross sectional data (biweekly, monthly and yearly data).
2. To provide improved comprehensive elasticity measures of US consumers demand for food at home products

In other words, this paper try to answer this question: "Are there any differences between demand model estimates (elasticities) obtained using biweekly, monthly, and yearly data?"

Data

- The data come from Nielsen Homescan data for the period 2002-2006. The data, provided at the household individual product purchase level, were subsequently aggregated to form commodities and also temporally (biweekly, monthly and annually).
- Eight commodity groups are considered: 1) cereal and bakery products, 2) meats and eggs, 3) dairy, 4) fruits and vegetables, 5) nonalcoholic beverages, 6) fats and oils, 7) sugar and other sweets, and 8) miscellaneous foods.
- Fisher ideal prices indices are constructed and are used as commodity prices.
- The samples considered 35,421 households. For the biweekly and monthly data, we used random samples for each household for a 2 week and 1 month period.

Demand Model and Econometric Procedures

- The demand models used is the Exact Affine Stone Index (EASI) demand system (Lewbel and Pendakur, 2009). This model is in share form (w_n), is linear in log prices (lnp_k's), includes interactions between socio-demographic variables (z_m) and real expenditures (lnx), interactions between socio-demographic variables and prices, and between prices and real expenditures. Moreover, the model accommodates nonlinear Engel curves. The demand equation for the n commodity is:

$$w_n = \sum_{r=0}^{R} b_{rn}(lnx)^r + \sum_{m=1}^{M}(C_{mn}z_m + D_{mn}z_m lnx) + \sum_{k=1}^{N} A_{kn} lnp_k + \sum_{k=1}^{N} B_{kn} lnp_k lnx + \varepsilon_n,$$

where the b_{rn}'s, C_{mn}'s , D_{mn}'s, A_{kn}'s and B_{kn}'s are parameters and ε_n is an error term.

- Two model procedures were used for estimation:

1) The SUR model was used for the yearly data since the proportion of zero expenditures was below 0.6% for all the commodities.
2) Shonkwiler and Yen (2001) two step procedure was used to account for zero expenditures in the case of the biweekly and monthly datasets which have between 7% to 40% and 2% to 22% of zeros expenditures, respectively.

- Estimation of the demand systems was carried out imposing the restrictions implied by demand theory. Heteroskedastic-robust standard errors of parameters and elasticities in all models were calculated using bootstrapping resampling procedures

Results

Table 1. Percent Differences in Biweekly, Monthly, and Yearly Data Based Elasticities (Relative to Yearly Data Based Values).

Commodity Groups	Percent Differences in Marshallian Own-price Elasticities Between Biweekly and Yearly Data		Percent Differences in Marshallian own-price Elasticities Between Monthly and Yearly Data	
	Uncensored	Censored	Uncensored	Censored
Cereals and Bakery	0.816	2.966	-15.426	-15.354
Meats and Eggs	5.674	7.931	-13.094	-11.189
Dairy	9.173	7.228	-6.582	-6.685
Fruit and Vegetables	-8.910	-14.482	-27.240	-28.617
Nonalcoholic Beverages	39.746	36.221	7.672	8.106
Fats and Oils	63.504	80.383	52.762	57.797
Sugar and Other Sweets	45.481	9.516	17.969	2.836
Miscellaneous Goods	19.596	33.831	-2.546	12.134
Average Absolute Difference	24.113	24.070	17.911	17.840
Commodity groups	**Percent Differences in Expenditure Elasticities Between Biweekly and Yearly Data**		**Percent Differences in Expenditure Elasticities Between Monthly and Yearly Data**	
	Uncensored	Censored	Uncensored	Censored
Cereals and Bakery	-2.910	-2.147	-1.144	-0.897
Meats and Eggs	9.725	9.069	3.527	3.176
Dairy	-10.007	-8.755	-5.530	-5.209
Fruit and Vegetables	-3.659	-2.961	-1.157	-1.252
Nonalcoholic Beverages	-5.789	-7.777	-1.494	-1.589
Fats and Oils	10.476	8.489	4.623	3.599
Sugar and Other Sweets	-1.047	1.128	0.073	2.574
Miscellaneous Goods	3.224	3.594	1.339	1.410
Average Absolute Difference	5.855	5.490	2.361	2.463

Censored vs. Uncensored Model

- Overall, the results obtained uncensored models are very similar to those obtained using censored models. In fact, elasticities obtained using uncensored demand models estimated and biweekly and monthly data are, on average, closer to the annual elasticities than those obtained using censored models (Table 1).

Comparison of Annual, Monthly and Biweekly Models

- The mean absolute percent error between the annual and monthly models was about 18% for uncompensated own-price elasticities and 2.5% for expenditure elasticities (Table 1).
- Greater magnitude in percent errors was observed in the comparison between annual and biweekly data: the mean absolute percent error was 24% for own price elasticitiicies, and 6% for expenditure elasticities (Table1).

Table 2. Estimated Own-Price and Expenditure Elasticities using Biweekly, Monthly, and Yearly Data (Uncensored Demand Model)

Commodity Groups	Uncompensated Own-Price Elasticities			Expenditure Elasticities		
	2 weeks	Month	Year	2 weeks	Month	Year
Cereals and Bakery	-0.885	-0.743	-0.878	0.913	0.929	0.940
Meats and Eggs	-1.063	-0.874	-1.006	1.292	1.219	1.178
Dairy	-1.129	-0.966	-1.034	0.868	0.911	0.965
Fruit and Vegetables	-1.331	-1.063	-1.461	0.989	1.015	1.026
Nonalcoholic Beverages	-1.022	-0.787	-0.731	0.883	0.923	0.937
Fats and Oils	-1.060	-0.991	-0.649	1.039	0.984	0.940
Sugar and Other Sweets	-1.717	-1.392	-1.180	0.829	0.838	0.838
Miscellaneous Goods	-0.855	-0.696	-0.715	1.000	0.981	0.968

- Biweekly own price elasticities tended to be more elastic than annual elasticities. Moreover, when using biweekly data more goods are classified as luxury goods (Table 2). We did not observe any pattern in the comparison between monthly and annual elasticities (Table 2).
- Overall, the expenditure and own-price elasticities obtained from the annual data, the monthly and biweekly have the expected signs (Table 2).

Conclusions

- The data collection period does affect the value of elasticities obtained from food demand systems.
- Censored demand models commonly used to address the problem of zero expenditures do not perform better than the simpler uncensored demand models (at this level of commodity aggregation).
- The biweekly and monthly data closely approximate the underlying annual expenditure elasticities but do a poor job estimating own-price elasticities.

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