Demand for Food Away From Home: A Multiple-Discrete/Continuous Extreme Value Model

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Background & Motivation

Easy access to relatively inexpensive, convenient, well-advertised and calorie-dense restaurant meals is frequently cited as a critical factor in the decline of the quality of the American diet (Binkley and Eales 2000; McCrory, et al. 2000; Gillis and Bar-Or 2003; Chou, Grossman and Saffer 2004; Kuchler, et al. 2005). Taxing FAFH seems a reasonable solution, but is based on limited evidence regarding the likely effectiveness of taxes in reducing FAFH consumption. To be effective, the own-price elasticity of demand for fast food, in particular, must be relatively high and the cross-price elasticity of substitution with other FAFH alternatives must be low. We know little of the structure of FAFH demand. Moreover, studies that do provide some empirical estimates are based on methods that do not recognize the unique nature of FAFH demand: (1) types of FAFH are highly differentiated, (2) consumers choose multiple types of FAFH over a period of time, (3) they purchase meals of varying sizes at each occasion, and (4) FAFH demand likely differs among individuals with different BMIs, levels of physical activity or health status.

The decision regarding whether to tax FAFH requires detailed knowledge of the structure of FAFH demand, and how endogenous physical attributes impact the demand for different types of FAFH.

Objectives

The objective of this study is to estimate the structure of FAFH demand, namely how fast food, fast casual, mid-range and fine dining respond to variations in FAFH prices, and FAH prices.

Data Description

We use two sources of FAFH data:

1. NPD NET
   - NET consists of two-week diaries for 4,792 households on all FAFH purchases, demographics, BMI, physical activity level and health status.

2. NPD CREST
   - CREST includes meal expenditure for each panel household. Item-specific prices are derived by estimating a hedonic pricing model based on FAFH occasion attributes.
   - We merge the two datasets by food and estimate with the NET food consumption measures.

Model of FAFH Demand

Utility Function:

$$u^h(q_i^h, D^h, Z^h, \theta) = \left(\frac{1}{\alpha_1}\right) exp(\varepsilon_1^h)(q_1^h)^{\alpha_i} + \sum_{i=2}^{I}\left(\frac{\gamma_i}{\alpha_i}\right)\left(f_i^h\left(\left(\frac{q_i^h}{\gamma_i}\right)+1\right)^{\alpha_i} - 1\right)$$

Estimating Model:

$$P(q_1^h, q_2^h, \dots, q_m^h, 0, 0 \dots 0) = \left(\frac{1}{\sigma^{M-1}}\right)\left(\prod_{k=1}^{M} g_k\right)\left(\sum_{k=1}^{M}\frac{p_k}{g_k}\right)\left(\frac{\sum_{k=1}^{M} e^{V_k^h/\sigma}}{\left(\sum_{i=1}^{I} e^{V_i^h/\sigma}\right)^M}\right)(M-1)!,$$

Key Model Attributes:

1. Additive in quality-adjusted quantities
2. Curvature of utility function due to alphas
3. Translation of utility function due to gammas
4. Solve using KKT conditions to derive corners
5. Continuous demand derived from single utility function.

Elasticity Estimates

	FAH	Fast Food	Casual	Fine Dining	Mid-Range
FAH	-0.829	0.095	0.097	0.061	0.104
Fast Food	0.062	-0.743	0.049	0.035	0.047
Casual	0.009	0.016	-0.917	0.028	0.042
Fine Dining	0.005	0.003	0.003	-0.577	0.026
Mid-Range	0.029	0.019	0.017	0.023	-0.792

Note: Elasticities are of the column variable with respect to the row variable.

	Fast Food	Casual	Fine Dining	Mid-Range
BMI	0.2076	0.0092	0.1066	0.0562
Physical Activity	0.2631	0.0284	0.0088	0.0377
Health Status	0.0361	0.0532	0.0191	0.0098

Note: Elasticities are calculated at the mean of observations.

Simulation Results

	FAH	Fast Food	Casual	Fine Dining	Mid-Range
Base Case	1.11835	0.46755	0.17482	0.10169	0.29655
10% Tax	1.11856	0.42661	0.17485	0.10173	0.29671
25% Tax	1.11914	0.34503	0.17498	0.10178	0.29691
50% Tax	1.11963	0.26908	0.17509	0.10184	0.29712

Note: Simulations conducted using the Pinjari and Bhat (2011) algorithm.

Implications

Price-elasticity results suggest:

1. Casual restaurants are the most elastic
2. Fine Dining restaurants are the least elastic
3. All types of restaurants are inelastic
4. FAH is inelastic in demand
5. All cross-price elasticities are small

Attribute-elasticity results suggest:

1. Fast food demand is highly responsive to BMI and physical activity
2. Casual and mid-range are relatively less affected by differences in physical attributes
3. All types are not sensitive to variations in health status

Simulation results suggest:

1. Small fast food taxes will not change FAH or FAFH demand very much
2. Little impact on other FAFH types if fast food is taxed
3. Fast food tax will raise revenue, but not change behavior

Conclusions

1. Demand for FAFH is inelastic
2. Fast food taxes will not be effective
3. Fast food demand more dependent upon physical attributes:
   a. More obese
   b. More physically active
4. Targeted taxes would be more effective