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Using the CE to Model Household Demand

Laura Blow, Valérie Lechene, and Peter Levell

5.1 Introduction

The focus of this chapter is to reflect on the interaction between core Consumer Expenditure Survey (CE) goals and fundamental research questions in the area of consumer demand analysis. Demand analysis uses information on household choices and their incomes not only to summarize the variability of responses of demand to prices, incomes, and characteristics, but also to predict responses to changes in the environment and to assess the corresponding changes in welfare. Price and income elasticities predicted from the estimation of demand systems are used, for example, to assess the welfare effects of tax changes, transfers, and so on. Knowing what is needed in survey data to enable a relatively accurate prediction of consumer responses is of fundamental importance.

Demand analysis is done within the conceptual framework of the theory of choice, where the choices that are observed are assumed to correspond to the maximization of an objective subject to constraints. In theory, all information from all periods is pertinent to the current period's choices, and much of demand theory has been devoted to the business of simplifying this framework. For example, the analysis of choices can fruitfully be restricted to the analysis of the allocation of a given budget between different com-

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modities within one period given only that period's prices under a number of assumptions, some of which are testable. The assumption under which it is possible to concentrate on within-period behavior is that there is intertemporal separability.[1]

Under this assumption there is two-stage budgeting, so that at the top stage the consumer chooses how to allocate income between current consumption and savings and expenditures on durables, and at the bottom stage the individual chooses how to allocate total expenditure within the period between the different goods. Under this assumption, once we observe the budget allocated to a period, only the within-period prices matter for the allocation of that total expenditure between goods rather than all the prices of all the periods. Time-separable models and the analysis of within-period allocation are well developed, starting with the Linear Expenditure model of Richard Stone (1954); the Rotterdam model, developed by Theil (1965); the model of Barten (1966); and the Translog model of Christensen, Jorgenson, and Lau (1975). More recent contributions are the Almost Ideal Demand System (AIDS) of Deaton and Muellbauer (1980) and its extension to Quadratic Almost Ideal Demand System (QUAIDS) by Banks, Blundell, and Lewbel (1997). Many of the early empirical tests of these demand systems rejected the restrictions imposed by demand theory, such as symmetry and homogeneity. However, the data used was aggregate data (for example, Christensen, Jorgenson, and Lau 1975; Deaton and Muellbauer 1980), and it has been argued (see Sabelhaus 1990) that aggregation bias leads to the rejection. When Sabelhaus estimates a time-separable demand system on aggregate US data and on household-level CE data, he finds the restrictions are rejected in the former but not the latter. Here we do not have to worry about aggregation bias and are more focused on whether the separability assumptions need to be relaxed and what the data requirements for doing this are.

A further set of assumptions restrict the aspects of behavior that are considered; for instance, separability between consumption and the use of time is invoked to enable the analysis to be focused on choices between goods, without reference to labor supply. However, it is unlikely that use of time is separable from demand. As Browning and Meghir (1991) argue, casual observation reveals that labor supply affects heating needs during the day, and costs of travel and child care. The formal tests they conduct on data from the UK Family Expenditure Survey confirm the rejection of separability of commodity demands from labor supply.

Similar arguments can be put forward concerning potential links between nondurable expenditures and stocks of durable goods. Consider, for

1. As Hussain (2006) points out, if there is no relative price variation within nondurables, then the composite goods theorem applies, and separability obtains without resorting to behavioral assumptions. However, in this case, there are no substitution effects within the group of nondurables either.

instance, housing stock and utilities. Those living in a larger home are, other things equal, likely to spend more on furnishing and maintaining their properties. This means that we should either condition on the price of housing or on housing stock when we consider the demand for utilities. Stocks of durables such as housing can also be expected to affect nondurable consumption choices when levels of the durable stock are costly to adjust. Building on the seminal work of Grossman and Laroque (1990), these issues are discussed for the case of housing decisions by, for example, Flavin and Yamashita (2002) and Flavin and Nakagawa (2008). Furthermore, if there are unobservables in preferences for utilities that are also correlated with housing stock, then there will be an endogeneity problem that requires addressing even if we condition on housing stock. Another example concerns transport. How much households choose to spend on public transport, petrol, and insurance is likely to be affected by whether or not they own a car. In this case, the price of cars affects the demand for public transport and for other nondurable goods. Padula (1999) examines this question using the CE, and his results indicate that the stock of cars should be included in an analysis of demand. Hussain (2006) shows that separability of demand from labor supply is rejected. He also investigates the relationship between demand and housing stock. Both authors are able to conduct these tests thanks to some unusual features of the CE, which we will come back to below.

Testing for separability of commodity demands from labor supply, for intertemporal separability, and for the other restrictions under which demand is analyzed is a task that would ideally require a data set with all the possible information, so that one could do an estimation "pretending" the information was not available to see what leads to the biggest bias. Although such a data set does not exist, the CE offers good opportunities to examine the assumptions of demand theory. Indeed, the CE is an unusual expenditure survey in that together with demand and income data, it contains data on durables and cars, and also has a short panel element.[2] Thus, we will be able to consider durables and labor supply to discuss whether they can be omitted without biasing the results. More precisely, we test for separability of cars, housing stock, and labor force participation from demand for nondurables, first under the assumption of exogeneity and then allowing for endogeneity of cars. We compute the elasticities obtained in the different models. We also discuss possible instrumenting strategies for housing and labor force participation, but we do not find suitable instruments in the data.

2. These features have permitted much research to be conducted on consumption and dynamic aspects of behavior using the CE. Our focus, however, is on the analysis of demand, that is, the choices that take place within a period, and we will have little to say about consumption, intertemporal choices, savings, and other dynamic aspects of behavior per se.

Our results are aligned to those of Padula (1999), who rejects separability for cars in the context of Euler equations, and to those of Hussain (2006), who rejects separability of labor force participation. Regarding housing, Hussain's results are mixed, while we find that separability is unambiguously rejected. We compute elasticities obtained under the different assumptions. We find that income elasticities change with the different modeling assumptions, while price elasticities are more robust.

We have structured the chapter in the following manner. We start in section 5.2 with the model of consumer choice and the functional forms of the associated elasticities. We present the CE data and sample, which we use in this chapter in section 5.3. In section 5.4, we start with a discussion of instrumenting strategies, we then show the first-stage regressions for the endogenous variables, the Engel curves, and finally the demand system estimates under the different assumptions. In the first model, we make the usual assumption of full intertemporal separability between stocks of durables and demand for nondurables, as well as the assumption of separability of time use from nondurable demand. We then relax the separability assumptions and condition on stock variables (cars and housing) and labor force participation, all assumed exogenous. We test for and reject separability, under the assumption of exogeneity. We then show results obtained instrumenting for cars, where separability is again rejected. We are not able to conduct similar tests instrumenting for labor force participation or housing. We contrast the elasticities obtained in the different models.

5.2 Modeling Household Demand

5.2.1 Almost Ideal Demand System and Quadratic Almost Ideal Demand System

Demand analysis starts with the assumption that the consumer, h, has a utility or welfare function, $U^h(\mathbf{q})$ that tells us the level of welfare associated with consuming a vector of goods $\mathbf{q}$. The superscript h reminds us that the welfare function might vary across households. Demand choices are made by maximizing this welfare function subject to the consumer's budget constraint, M^h, and to prices, $\mathbf{p}$:

$$\max U^h(\mathbf{q}) \;\; s.t. \;\; \mathbf{p}'\mathbf{q} = M^h,$$

and this results in the (Marshallian) demand functions for each good $q_i^h(\mathbf{p}, M^h)$, where i indexes the good, $i = 1 \ldots I$. An alternative way of modeling the consumer's decision is to use the cost function, $C^h(u,\mathbf{p})$, which tells us the minimum level of expenditure needed to attain a given level of welfare at a given set of prices. That is,

$$C^h(u, \mathbf{p}) = \min_q \mathbf{p}'\mathbf{q} \;\; s.t. \;\; U^h(\mathbf{q}) = u\,.$$

The cost function is often used as the starting point for theoretical demand modeling since it can be shown that

$$\frac{\partial \ln C^h(u, \mathbf{p})}{\partial \ln p_i} = w_i^h(u, \mathbf{p}),$$

where w_i^h is the budget share of the *ith* good for household h, that is,

$$w_i^h(u, \mathbf{p}) = \frac{p_i q_i^h(u, \mathbf{p})}{M^h}.$$

The Almost Ideal Demand (AIDS) model derives from the following specification of the consumer cost function, $\ln C^h(u, p)$

$$\ln C^h(u, p) = \ln a^h(p) + u b^h(p),$$

so that the share, w_{it}^h, of the *ith* good for household h in time period t $(= \partial \ln C^h \ / \ \partial \ln p_{it})$ is

$$\begin{aligned} w_{it} &= \frac{\partial \ln a^h(p_t)}{\partial \ln p_{it}} + \frac{\partial b^h(p_t)}{\partial \ln p_{it}} u \\ & \frac{\partial \ln a^h(p_t)}{\partial \ln p_{it}} + \frac{\partial b^h(p_t)}{\partial \ln p_{it}} \left(\frac{\ln M^h - \ln a^h(p_t)}{b^h(p_t)} \right). \\ & \frac{\partial \ln a^h(p)}{\partial \ln p_{it}} + \frac{\partial \ln b^h(p)}{\partial \ln p_{it}} [\ln M^h - \ln a^h(p_t)] \end{aligned}$$

For the price indices $\ln a^h(p)$ and $b^h(p)$, the forms typically employed in the AI demand system are a translog form for $\ln a^h(p)$ and a Cobb–Douglas form for $b^h(p)$:

$$\begin{aligned} \ln a^h(p_t) &= \alpha_0 + \sum_i \alpha_i^h \ln p_{it} + \frac{1}{2} \sum_i \sum_j \gamma_{ij} \ln p_{it} \ln p_{jt} \\ b^h(p_t) &= \prod_i p_{it}^{\beta_i^h} \end{aligned},$$

where

$$\begin{aligned} \alpha_i^h &= \alpha_{i0} + \sum_k \alpha_{ik} z_k^\alpha \\ \beta_i^h &= \beta_{i0} + \sum_k \beta_{ik} z_k^\beta \end{aligned},$$

in which the zs denote demographic characteristics such as age of head, number of children, and so on.

The theoretical restriction of additivity implies

$$\sum_i \alpha_{i0} = 1, \sum_i \alpha_{ir} = 0 \ \forall r, \sum_i \beta_{i0} = 0, \sum_i \beta_{ir} = 0 \ \forall r, \sum_i \gamma_{ij} = 0,$$

while that of homogeneity of degree zero implies

$$\sum_j \gamma_{ij} = 0,$$

and finally symmetry implies

$$\gamma_{ij} = \gamma_{ji} \ \forall\, i \neq j.$$

This gives the following form for the share equations:

$$(1) \qquad w_{it}^h = \alpha_i^h + \sum_j \gamma_{ij} \ln p_{jt} + \beta_i^h \ln\left[\frac{M_t^h}{a^h(p_t)}\right].$$

From work starting with Banks, Blundell, and Lewbel (1997), we know that the AIDS assumption of shares that are linear in log expenditure is too restrictive for some goods and the Quadratic Almost Ideal Demand (QUAIDS) model allows, as its name implies, more curvature in the Engel path. The QUAIDS model extends the consumer cost function to the following form:

$$\ln C^h(u, p) = \ln a^h(p) + \frac{ub^h(p)}{1 - ug^h(p)},$$

so that the share, w_{it}^h, of the *ith* good for household h in time period t $(= \partial \ln C^h \ / \ \partial \ln p_{it})$ is

$$\begin{aligned}
w_{it} &= \frac{\partial \ln a^h(p_t)}{\partial \ln p_{it}} + \frac{\partial b^h(p_t)}{\partial \ln p_{it}}\left(\frac{u}{1 - ug^h(p_t)}\right) + \frac{\partial g^h(p)}{\partial \ln p_{it}}\left(\frac{u}{1 - ug^h(p_t)}\right)^2 b^h(p_t) \\
&= \frac{\partial \ln a^h(p_t)}{\partial \ln p_{it}} + \frac{\partial b^h(p_t)}{\partial \ln p_{it}}\left(\frac{\ln m^h - \ln a^h(p_t)}{b^h(p_t)}\right) + \frac{\partial g^h(p_t)}{\partial \ln p_i}\left(\frac{[\ln m^h - \ln a^h(p_t)]^2}{b^h(p_t)}\right) \\
&= \frac{\partial \ln a^h(p)}{\partial \ln p_i} + \frac{\partial \ln b^h(p)}{\partial \ln p_i}[\ln M^h - \ln a^h(p_t)] + \frac{\partial g^h(p_t)}{\partial \ln p_{it}}\left(\frac{[\ln M^h - \ln a^h(p_t)]^2}{b^h(p_t)}\right).
\end{aligned}$$

For the additional (to the AIDS model) price index $g^h(p)$ we follow the specification used in Banks, Blundell, and Lewbel:

$$g^h(p_t) = \sum_i \lambda_i^h \ln p_{it},$$

where

$$\lambda_i^h = \lambda_{i0} + \sum_k \lambda_{ik} z_k^\lambda,$$

and additivity implies

$$\sum_i \lambda_{i0} = 0, \sum_i \lambda_{ir} = 0 \ \forall\, r.$$

This gives the following form for the share equations

$$(2) \qquad w_{it}^h = \alpha_i^h + \sum_j \gamma_{ij} \ln p_{jt} + \beta_i^h \ln\left[\frac{M_t^h}{a^h(p_t)}\right] + \frac{\lambda_i^h}{b^h(p_t)} \ln\left[\frac{M_t^h}{a^h(p_t)}\right]^2,$$

which is a complicated nonlinear function of prices. The estimation procedure in papers such as Banks, Blundell, and Lewbel (1997) exploits the linearity of the share equation *given* $a^h(p_t)$ and $b^h(p_t)$. The procedure is iterative—first, the price and expenditure parameters are estimated for given values of $a^h(p_t)$ and $b^h(p_t)$, then $a^h(p_t)$ and $b^h(p_t)$ are updated using the estimated values of α_i^h, γ_{ij} and β_i^h, and then the procedure is repeated using the updated price indices, continuing until the difference between the current and previous estimates is negligible.[3] An alternative approach often used is to approximate $a^h(p_t)$ with the Stone price index $\Gamma(p_t)$:

$$\ln a^h(p_t) \simeq \Gamma(p_t) = \sum_i w_{it}^h \ln p_{it}.$$

5.2.2 Elasticities from the AIDS and QUAIDS Models

Denote the income elasticity by e_i, then

$$e_i = \frac{\eta_i}{w_i} + 1,$$

where

$$\eta_i \equiv \frac{\partial w_i}{\partial \ln M},$$

which is equal to β_i for AIDS or AIDS with the Stone Approximation and to

$$\beta_i + 2\frac{\lambda_i}{b(p_t)} \ln\left(\frac{M_t}{a(p_t)}\right)$$

for QUAIDS or QUAIDS with the Stone Approximation.

Denote the elasticity of good i with respect to the price of good k by e_{ik}, then

$$e_{ik} = \frac{\eta_{ik}}{w_i} - \delta_{ik}$$
$$\delta_{ik} = 0 \text{ for } i \neq k \quad ; \quad \delta_{ik}=1 \text{ for } i=k ,$$

where

$$\eta_{ik} \equiv \frac{\partial w_i}{\partial \ln p_k},$$

and takes the following forms:

Model	η_{ik}
AIDS	$\gamma_{ik} - \eta_i\left[\alpha_k + \sum_j \gamma_{kj} \ln p_j\right]$

3. The consistency and asymptotic efficiency of these estimators is described in Blundell and Robin (1999).

AIDS, Stone Approximation $\gamma_{ik} - \eta_i w_{kt}^h$

QUAIDS $\gamma_{ik} - \eta_i \left[\alpha_k + \sum_j \gamma_{kj} \ln p_j\right] - \beta_k \dfrac{\lambda_i}{b(p_t)} \left[\ln\left(\dfrac{M_t}{a(p_t)}\right)\right]^2$

QUAIDS, Stone Approximation $\gamma_{ik} - \eta_i w_{kt}^h$.

By the Slutsky equation, compensated price elasticities, e_{ik}^c, are given by

$$e_{ik}^c = e_{ik} + e_i w_k \; .$$

5.2.3 Weak Separability

Suppose we divide the goods $\mathbf{q}$ into two mutually exclusive groups, call them $\mathbf{q}_A$ and $\mathbf{q}_B$. We say that goods A are weakly separable in the utility function if we can write

$$U^h(\mathbf{q}_A, \mathbf{q}_B) = U^h(\Psi(\mathbf{q}_A), \mathbf{q}_B),$$

and obviously this can be generalized to further grouping. Weak separability is an important concept because if a given group of goods is weakly separable from all other consumption, then the demand for those goods can be analyzed using only total expenditures on those goods and the prices of those goods. So, in our example, for goods in group A, the demand function $q_{Ai}^h(\mathbf{p}, M^h)$ simplifies to $q_{Ai}^h(\mathbf{p}_A, M_A^h)$ where $M_A^h = \sum_{i \in A} p_{Ai} q_{Ai}^h$. So, for example:

- if preferences are weakly separable over time, then we can analyze demand in a given period ignoring what happens in the past or what will happen in the future; and
- if consumption goods are weakly separable from leisure, then we can look at demand for consumption without reference to labor supply and wages.

Thus a simple test of separability, exploited in papers such as Browning and Meghir (1991), is that, conditional on $\mathbf{p}_A$ and M_A^h, demands for goods in group A should not depend on $\mathbf{q}_B$. Browning and Meghir (1991) work with "conditional cost functions," where the conditional cost function for group A would be defined as

$$C_A^{h*}(\mathbf{p}_A, \mathbf{q}_B, u) = \min_{\mathbf{q}_A} \mathrm{p}'_A \mathrm{q}_A \;\; s.t. \;\; U^h(\mathbf{q}_A, \mathbf{q}_B) = u \, .$$

They show that weak separability also has the following implication for the conditional cost function:

$$U^h(\mathbf{q}_A, \mathbf{q}_B) = U^h(\Psi(\mathbf{q}_A), \mathbf{q}_B)$$

$$\Leftrightarrow \qquad ,$$

$$C_A^{h*}(\mathbf{p}_A, \mathbf{q}_B, u) = C_A^{h*}(\mathbf{p}_A, g(\mathbf{q}_B, u))$$

which illustrates, again, that the conditioning goods $\mathbf{q}_B$ only have income effects on the demands for $\mathbf{q}_A$ and that we can test for this by putting conditioning goods in the demand system. The econometric problem that arises in

Table 5.1 **Nondurable goods groupings**

Category	Description
Food in	Food and drink purchased for home consumption (excluding alcohol)
Food out	Catered affairs, restaurant meals (excluding alcohol), and school meals
Entertainment	Recreation and sporting activities, rental of vacation vehicles
Apparel	Clothes and shoes
Utilities	Electricity, gas, and water
Motor fuel	Gasoline and motor oils

this test is that the conditioning goods might be endogenous to the system; for example, unobserved tastes for working might be correlated with unobserved tastes for some consumption goods.

5.3 Data and Sample

5.3.1 The CE Data

The CE is the most extensive expenditure survey in the United States. In 2010 it covered roughly 7,000 consumer units (CUs) throughout the country. The CE comprises a diary survey, where households are asked to record their spending over a two-week period, and an interview survey, where households are asked to recall their spending on various categories over the last quarter. The interview survey is a short panel with households asked expenditure questions for four successive quarters (though households may not complete all interviews and can skip interviews). Both surveys include questions on demographic characteristics, labor supply, household resources (including income and assets), building characteristics, and detailed information about cars.

5.3.2 Sample and Goods

To estimate our demand system, we need to know how much households spent on various product categories, as well as the relative prices of these goods over time and across regions. In our case, we combine spending data from the interview survey of the CE with price data from the product-specific series of the Urban Consumer Price Index (CPI) taken from the Bureau of Labor Statistics (BLS) website. We make use of the four regional price indices (for the Northeast, Midwest, South, and West).

We use spending on six different nondurable product categories, chosen to match price categories in the CPI. These are: food in, food out, entertainment, apparel, fuel and utilities, and motor fuel (what these contain is described in more detail in table 5.1).

We draw the spending data from the years 1998–2010, as we do not have monthly prices for some product categories prior to this. We treat spending

Table 5.2 Average income and nondurable expenditure

	Annual income	Monthly expenditure
1998	68,242	1,296
1999	69,525	1,307
2000	69,963	1,335
2001	74,775	1,361
2002	77,574	1,329
2003	78,589	1,305
2004	81,286	1,333
2005	83,590	1,406
2006	78,807	1,444
2007	80,297	1,538
2008	78,459	1,560
2009	80,288	1,434
2010	78,729	1,408

Note: 2010 dollars deflated with the Consumer Price Index.

choices in each interview as separate observations. Each interview covers three months of spending, so for instance, a CU interviewed in April 2010 would be asked about spending in each of the months January, February, and March. We take the average of spending on each category over the three months that are covered by each interview. This is due to the fact that there is likely to be some noise in individual monthly observations (for instance, with infrequently purchased items). The three-month spending averages are linked to an average of monthly prices in the CPI for the same three-month period (see below). To ensure that all households' spending data is a monthly average over a complete quarter, we drop households interviewed in January, February, or March in 1998.

The sample selected for estimation is composed of households in urban areas in which the adults are a couple with any number of dependent children, where the head is between ages twenty-one and sixty-five, who have less than five cars, and in which the husband works. We also trim those in the top and bottom 5 percent of the income and expenditure distribution in each year. This leaves us with 80,838 observations. Average annual incomes, monthly expenditures, and other demographic characteristics are shown in tables 5.2 and 5.3.

Table 5.4 shows how average budget shares of our various goods (out of total spending on these six goods) have been evolving over time. The shares of some goods, such as food at home, have been steadily decreasing over time, while the share spent on motor fuel, for instance, has tended to increase (rising from 12 percent in 1998 to peak at 21 percent in 2008). Inevitably, changes in the survey have led to occasional discontinuities in budget shares. For example, the share spent on food away from home jumped by 4 percentage points between 2006 and 2007. This is likely due to the fact that in 2007

Table 5.3 **Sample mean demographic characteristics**

	Age of head	White head (%)	Adult earners (%)	Own home (%)	Head with degree (%)
1998	42	88	80	77	33
1999	42	88	79	78	34
2000	42	87	79	78	32
2001	43	87	79	79	36
2002	43	87	79	80	36
2003	43	87	78	81	37
2004	44	87	78	82	38
2005	44	85	78	82	36
2006	44	87	78	81	34
2007	44	88	77	81	37
2008	44	87	77	81	37
2009	44	86	77	79	38
2010	44	85	76	78	38

Table 5.4 **Budget shares by year**

	Food in	Food out	Entertainment	Apparel	Utilities	Motor fuel
1998	38.3	12.7	6.5	11.1	19.4	11.9
1999	38.1	12.7	6.5	11.7	19.0	11.9
2000	37.2	12.4	6.5	11.3	18.6	14.0
2001	36.5	12.1	6.7	10.6	20.5	13.5
2002	37.5	11.9	7.1	10.6	19.9	13.0
2003	37.3	12.0	6.3	9.4	21.2	13.8
2004	37.5	11.8	5.8	8.3	21.4	15.2
2005	35.5	11.2	5.7	8.5	21.2	17.9
2006	34.5	11.0	5.7	8.3	21.7	18.7
2007	32.9	15.0	5.7	7.7	20.5	18.3
2008	32.7	13.9	5.4	6.8	20.6	20.6
2009	34.9	14.6	5.8	6.7	22.3	15.6
2010	34.8	14.3	5.6	6.5	22.0	16.8

the survey question for food out changed from asking households to recall their "usual" monthly spending to asking them to recall their usual weekly spending. To try to account for these sorts of changes we employ year dummies in our share equations rather than a time trend, as is sometimes used. Table 5.5 looks in more detail at budget shares in 2010. There is quite wide variation in budget shares of reported expenditure on our chosen goods. Many households report zero spending over the quarter on entertainment (23 percent), apparel (18 percent), and food away from home (10.5 percent). Table 5.6 looks at how budget shares vary according to the labor force participation of the wife. Households where the wife works spend relatively less on food at home (35 percent compared to 39 percent) and slightly less on

Table 5.5 **Budget shares for households interviewed in 2010**

	Food in	Food out	Entertainment	Apparel	Utilities	Motor fuel
Mean	34.8	14.2	5.5	6.7	22.0	16.8
Min.	0.0	0.0	0.0	0.0	0.0	0.0
Max.	93.5	76.7	81.4	63.5	76.3	79.6
Percent zero	0.002	0.105	0.230	0.182	0.009	0.018

Table 5.6 **Budget shares by LFP of wife**

(Female works, male works)	(0,1)	(1,1)
Sample size	18,869	61,969
Food in	39.3	34.9
	(13.6)	(12.6)
Food out	11.2	13.1
	(9.2)	(9.6)
Entertainment	5.2	6.4
	(7.0)	(7.4)
Apparel	8.5	9.1
	(8.5)	(8.6)
Utilities	21.0	20.6
	(9.7)	(9.0)
Motor fuel	14.9	15.8
	(8.8)	(8.8)

Note: Standard deviations in parentheses.

utilities (20.6 percent vs. 21percent), but more on food out, entertainment, apparel, and motor fuel.

5.3.3 Some Remarks about the Data

We cannot discuss demand analysis using the CE without mentioning the well-known issue concerning the discrepancy between the window of time for the income data and the consumption data. Spending refers to the previous quarter, while income and hours worked are given as a total for the last twelve months. Income data is collected only in the first and final of the four interviews. It may also sometimes be collected in the second and third interviews, but only if a CU member over age thirteen is new to the CU or has not worked in previous interviews and has now started working. In each case, however, the question that is asked is how much income has been earned over the last twelve months, not over the last quarter. The same is true for other variables, including hours worked.

This is a most crucial problem for any analysis of this data, and solving it seems to us to be high on the agenda. Indeed, any assumption used by researchers to link income and consumption introduces a bias whose direction and scale, by definition, cannot be known. While one might hope that

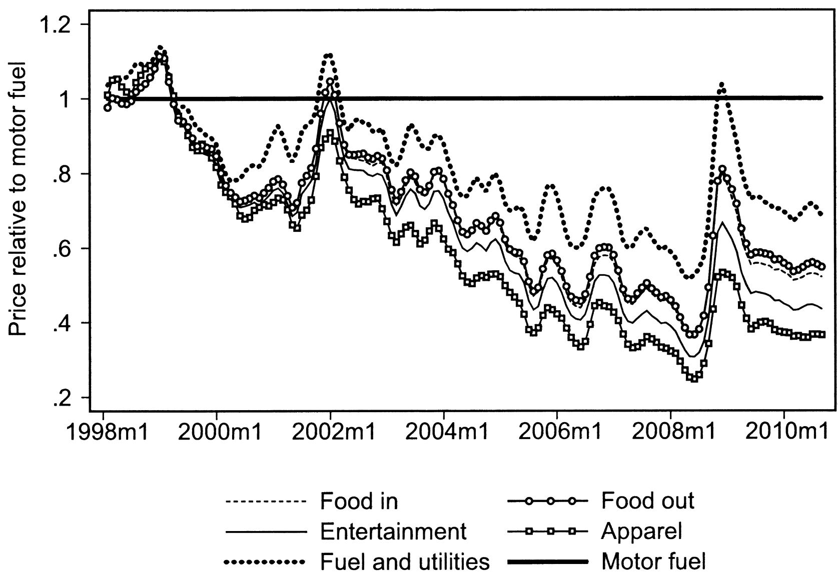

Fig. 5.1 Prices over time (relative to motor fuel)

this is of second order, if the CE data is used to evaluate the effect of policy on choices and welfare, it seems rather problematic.

Other authors have used various methods to get around this problem. For instance, Attanasio et al. (2011) look at separability between consumption and leisure choices over time. In order to be able to link wages in each quarter to quarterly consumption, they divide annual salary income and annual hours (themselves calculated using weeks worked, and typical hours per week) by four. If income or hours are updated in subsequent quarters, they then adjust these to take account of known income changes—for instance if salary is reported in the second quarter, then fourth quarter income is defined as annual income in the fourth quarter less annual income in the second quarter divided by two. Gervais and Klein (2010) implement a more sophisticated method to deal with the mismatch in timing. They construct a proxy for quarterly income by assuming an income process, which they estimate with GMM using the two-income observations they have.

A second data issue we need to raise relates to prices. To estimate price responses it is crucial to have sufficient relative price variation. There are two sources of price variation in our data—variation over time, and variation across regions. As figure 5.1 shows, there is substantial variation in prices across goods and across time (shown relative to motor fuel prices). Prices of motor fuel have been most volatile over the period. All goods have mostly fallen in price relative to motor fuel. Some prices such as food in and food out have tended to move together, with some divergence visible toward the end

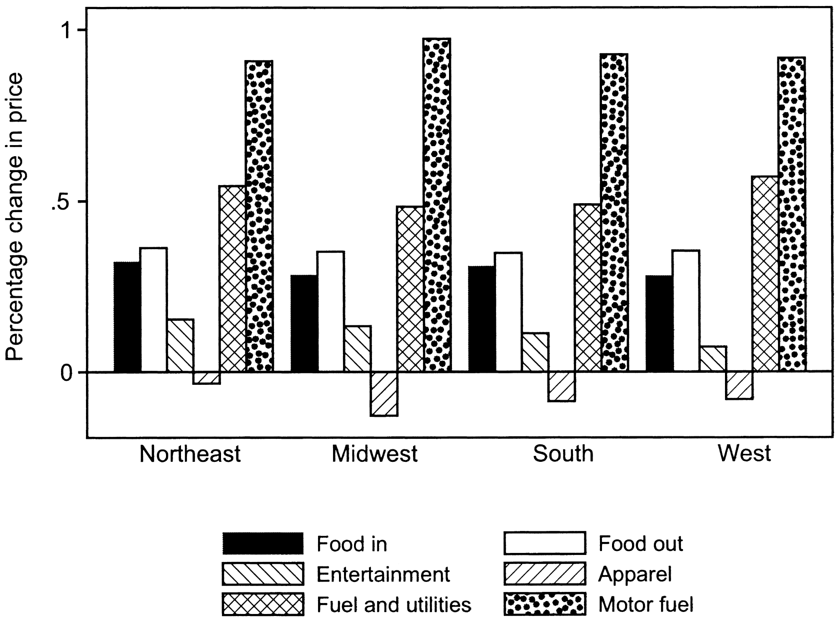

Fig. 5.2 Price changes by region

of the period. Figure 5.2 shows that there has also been important variation across regions. For instance, since 1998 the price of apparel declined by 3.3 percent in the northeast but by 12.8 percent in the midwest, while entertainment increased in price by 7.3 percent in the west compared to 15.4 percent in the northeast over the period.

5.4 Demand System

We estimate six demand systems. In the first model we look at a case where we assume full separability from the "stock" variables (cars and rooms) and labor force participation. In the second and third models, we condition on the number of cars,[4] first assuming them to be exogenous, and then allowing them to be endogenous (instrumenting them with log car prices). In the fourth model, we condition on the number of rooms, and in the fifth we condition on labor force participation of the wife. In the sixth and final model, we condition on all three at once (assuming that all are exogenous). In each case we test for separability, allowing for an effect of the conditioning variable on the intercept of the budget share as well as in the slope of the Engel

4. Ideally, information of the number of cars should be supplemented by information on expenditure on cars.

curve. We discuss instrumenting strategies, first stages and Engel curves, before turning to the demand system estimates and the associated elasticities.

5.4.1 Endogenous Variables and Instruments

In a demand system under separability, it is usual to allow for the endogeneity of total expenditure. There are several reasons why total expenditure might be endogenous in a demand system. It could be that total expenditure is correlated with taste shocks that also affect budget shares. For instance, a shock that increases food spending increases both the budget share of food as well as total expenditure. Another reason for endogeneity is measurement error in total expenditure. To instrument for this, we follow the literature (Banks, Blundell, and Lewbel 1997) by using after-tax income as an instrument for total expenditure.

It should be noted that if labor supply is not separable from commodity demands and is a potentially endogenous variable, then income is not a valid instrument for expenditure (as households who work more will also tend to earn a higher income). As we wish to look at the potential separability of labor force participation, this will be a problem for us. To get around this problem, when estimating a demand system conditional on both total expenditure and labor force participation, Browning and Meghir (1991) and Hussain (2006) use combinations of education, asset income, and average wage by cohort and education as the instrument set rather than total income. However, each of these instruments has its own problem. It is not obvious that the exclusion restriction for education is valid, since as Hussain notes, education is itself a choice variable. Furthermore, for the sample and the period we use, the asset income variable is informed only for 10 percent of the sample. Finally, the CE does not include wage data, and wages must be calculated using measures of salary income and hours and weeks worked (as described above). Tax data is also self-reported and often unreliable, adding further complications to the calculation of marginal net wages.

The other potentially endogenous variables of the system are expenditure on cars (proxied by the number of cars) and on housing (proxied by the number of rooms). The problem of endogeneity arises because households with preferences for larger houses or more cars are likely to have different tastes for the goods included in our demand system. This introduces a correlation between the stocks and a CU's unobserved tastes. We experiment with different instruments to attempt to get around these problems.

For the stock of cars we use the log regional price of cars from the CPI. It is hoped this would affect the number of cars households choose to purchase but be uncorrelated with their tastes. For housing, we employ the log of the regional price of housing services from the CPI, and (following Hussain 2006) a dummy variable for the sex composition of children (1 if children have different sexes, 0 otherwise). The latter instrument is motivated by the belief that households who have a boy and a girl will be more likely to need a separate bedroom for each child (not all of the households in our sample have children, those that do not are assigned a zero for this variable). However, it could also be argued that the exclusion restriction for the sex composition of children is dubious. As we describe in the following section, the instruments for housing do not perform well, and so in the end we estimate the demand system under the assumption that housing is exogenous, despite the potential problems in doing so.

5.4.2 First Stages

In table 5.7 we present results for the first-stage regressions of log expenditure on the various instruments (log of after-tax income, log of after-tax income squared, and the price of cars). The income instruments are highly significant in the first stage (both the linear and quadratic income terms) in all specifications. Model 1 is the demand system under separability. Model 2.1 is the demand system conditional on exogenous cars, and model 2.2 conditional on endogenous cars, using the car CPI as instrument. Model 3.1 is the demand system conditional on exogenous housing, model 4.1 conditional on exogenous labor force participation, and finally model 5 is conditional on cars, housing, and labor force participation. We also estimate model 3.2, where we allow for endogeneity of rooms, but we do not report the estimated coefficients.

In table 5.8, we report the results from the first stages for cars and housing. For cars, the instrument is log regional car prices (homogenized relative to the price of motor fuel in the same way as the other prices we use in the demand system); it is significant at the 5 percent level and has the expected sign (i.e., higher car prices lead to fewer cars). The interaction term with log income is also negative and highly significant. We also estimate two versions of model 3.2, where we allow for endogeneity of housing, in the first instance using the sex composition of the children as instrument and then using the regional shelter CPI. The sex composition variable is significant at the 1 percent level, and it has the expected sign over most of the range of values of income. However, the sex composition of children may also enter the demand system itself, and so not give a truly exogenous source of variation in the number of rooms. We also estimate another version of model 3.2, where we instrument housing with log homogenized regional price of housing. Unlike Hussain (2006), we find that there is a negative relationship between housing price and housing expenditure as proxied by the size of the house. We also investigate an instrument constructed from lagged imputed rents in the region of residence of the household. We do not report the estimated coefficients in this case, because the estimated coefficients of the demand system obtained using this instrument for housing were implausible and we were not sure of the quality of information contained in the imputed rents.

Table 5.7 **First stage for total expenditure on nondurables**

	Model 1	Model 2.1	Model 2.2	Model 3.1	Model 4.1	Model 5
ln(*y*)	–0.86***	–0.96***	–0.87***	–0.83***	–0.90***	–0.92***
	(0.040)	(0.040)	(0.040)	(0.039)	(0.040)	(0.040)
ln(*y*)^2	0.07***	0.08***	0.07***	0.07***	0.07***	0.08***
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)
lfp					0.26***	0.15***
					(0.036)	(0.036)
lfp × *ln*(*y*)					–0.03***	–0.02***
					(0.004)	(0.004)
Cars		0.19***				0.12***
		(0.014)				(0.015)
cars × *ln*(*y*)		–0.02***				–0.01***
		(0.002)				(0.002)
Rooms				0.72***		0.58***
				(0.049)		(0.050)
rooms × *ln*(*y*)				–0.07***		–0.05***
				(0.006)		(0.006)
ln(*pcars*)			0.53***			
			(0.119)			
ln(*pcars*) × *ln*(*y*)			–0.01**			
			(0.005)			
Age	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
White	0.09***	0.08***	0.09***	0.08***	0.09***	0.07***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Elderly	–0.02*	–0.01	–0.02**	–0.01	–0.02**	–0.01
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
ln(*CUsize*)	0.30***	0.28***	0.30***	0.28***	0.30***	0.25***
	(0.005)	(0.006)	(0.005)	(0.005)	(0.005)	(0.006)
Children, 0–2	–0.08***	–0.07***	–0.08***	–0.08***	–0.08***	–0.07***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Children, 3–15	–0.01***	0.00	–0.01***	–0.01***	–0.01***	0.00**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Head < college	0.03***	0.03***	0.03***	0.02***	0.03***	0.02***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Head college	0.05***	0.05***	0.05***	0.03***	0.05***	0.04***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Wife < college	0.04***	0.04***	0.04***	0.03***	0.04***	0.03***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Wife college	0.06***	0.05***	0.06***	0.04***	0.06***	0.04***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Constant	8.82***	9.06***	8.86***	8.10***	8.90***	8.45***
	(0.162)	(0.161)	(0.163)	(0.163)	(0.162)	(0.163)

Notes: Controls include month of interview, year of interview, log prices, and twenty-two state-region dummies. N = 80,838 and t statistics are in parentheses.

***Significant at the 1 percent level.

**Significant at the 5 percent level.

*Significant at the 10 percent level.

Table 5.8 **First stage for cars and housing**

	Model 2.2–cars		Model 3.2–housing
Instruments	Car CPI	Sex diff.	Shelter CPI
$ln(y)$	1.72***	–0.40***	–0.40***
	(0.136)	(0.035)	(0.035)
$ln(y)^2$	–0.09***	0.03***	0.03***
	(0.008)	(0.002)	(0.002)
$ln(pcars)$	–0.99**		
	(0.408)		
$ln(pcars) \times ln(y)$	–0.08***		
	(0.018)		
Sex diff.		–0.17***	
		(0.043)	
$sexdiff \times ln(y)$		0.02***	
		(0.005)	
$ln(phouse)$			0.00
			(0.069)
$ln(phouse) \times ln(y)$			–0.01**
			(0.006)
Age	0.01***	0.01***	0.01***
	(0.000)	(0.000)	(0.000)
White	0.29***	0.06***	0.06***
	(0.011)	(0.003)	(0.003)
Elderly	–0.17***	–0.04***	–0.04***
	(0.031)	(0.008)	(0.008)
$ln(CUsize)$	0.98***	0.15***	0.15***
	(0.019)	(0.005)	(0.005)
Children, 0–2	–0.36***	0.00	0.00
	(0.010)	(0.003)	(0.003)
Children, 3–15	–0.28***	0.02***	0.02***
	(0.006)	(0.002)	(0.002)
Head < college	0.02**	0.04***	0.04***
	(0.010)	(0.003)	(0.003)
Head college	–0.17***	0.07***	0.07***
	(0.011)	(0.003)	(0.003)
Wife < college	0.12***	0.05***	0.05***
	(0.010)	(0.002)	(0.002)
Wife college	0.04***	0.06***	0.06*** .
	(0.011)	(0.003)	(0.003)
Constant	–7.51***	2.19***	2.22***
	(0.558)	(0.141)	(0.144)

Notes: Controls include month of interview, year of interview, log prices, and twenty-two state-region dummies. $N = 80{,}838$, and t statistics are in parentheses.

***Significant at the 1 percent level.

**Significant at the 5 percent level.

*Significant at the 10 percent level.

5.4.3 Engel Curves

To begin we decide which specification is more appropriate: AIDS or QUAIDS. We estimate QUAIDS and AIDS models on data ignoring the stocks of housing and cars, and using the Stone price index to deflate expenditures. The Engel curves produced from this exercise are displayed in the panels below (figure 5.3). These graph log expenditure against predicted shares. Upward sloping Engel curves indicate that a good is a luxury, while downward sloping curves indicate that goods are necessities or inferior. Unsurprisingly, food out, entertainment, and apparel are luxuries, while food in, utilities, and motor fuel are necessities.

For some goods, a linear model is clearly appropriate (the Engel curves for entertainment and food out are essentially linear). For other goods, the QUAIDS model fits U-shaped Engel curves, though in these cases there does not appear to be much curvature in the center of the spending distribution. The steep U-shaped curves therefore appear to be the natural consequence of allowing for a small amount of curvature in the middle of the distribution (with the effect that the gradient becomes quite steep for very high and very low levels of expenditure). We therefore conclude that a liner model is a more appropriate, and proceed using the AIDS demand system.

5.4.4 Demand System Estimates

In this section we present the estimated coefficients of the various demand systems. We start by estimating a benchmark model, where we assume full separability. We then proceed by conditioning on cars (first exogenous and subsequently allowing for endogeneity), rooms, and the labor force participation of the wife. In our final model, we condition on all of these variables simultaneously.

Table 5.9 presents the results for model 1 where we assume full separability (that is, we do not condition on cars, rooms, or labor force participation).

The first column of tables 5.12 and 5.13 present, respectively, the income and price elasticities obtained from the demand system under full separability. We comment on those below, when we contrast the elasticities obtained with the different models.

In table 5.10, we condition on cars assuming them to be exogenous. In table 5.11, we present results where we instrument for the number of cars, using the car CPI as instrument. The differences in estimated coefficients between specifications translate into differences in the budget and price elasticities (calculated at mean values of all the covariates). The intercept and slope interaction terms for cars enter highly significantly in the share equations for food at home, entertainment, apparel, domestic utilities, and (perhaps unsurprisingly) motor fuel. Thus, it appears that the data strongly reject the separability of cars. Once we allow for the endogeneity of cars, however, the number of cars and its interaction with expenditure enter significantly

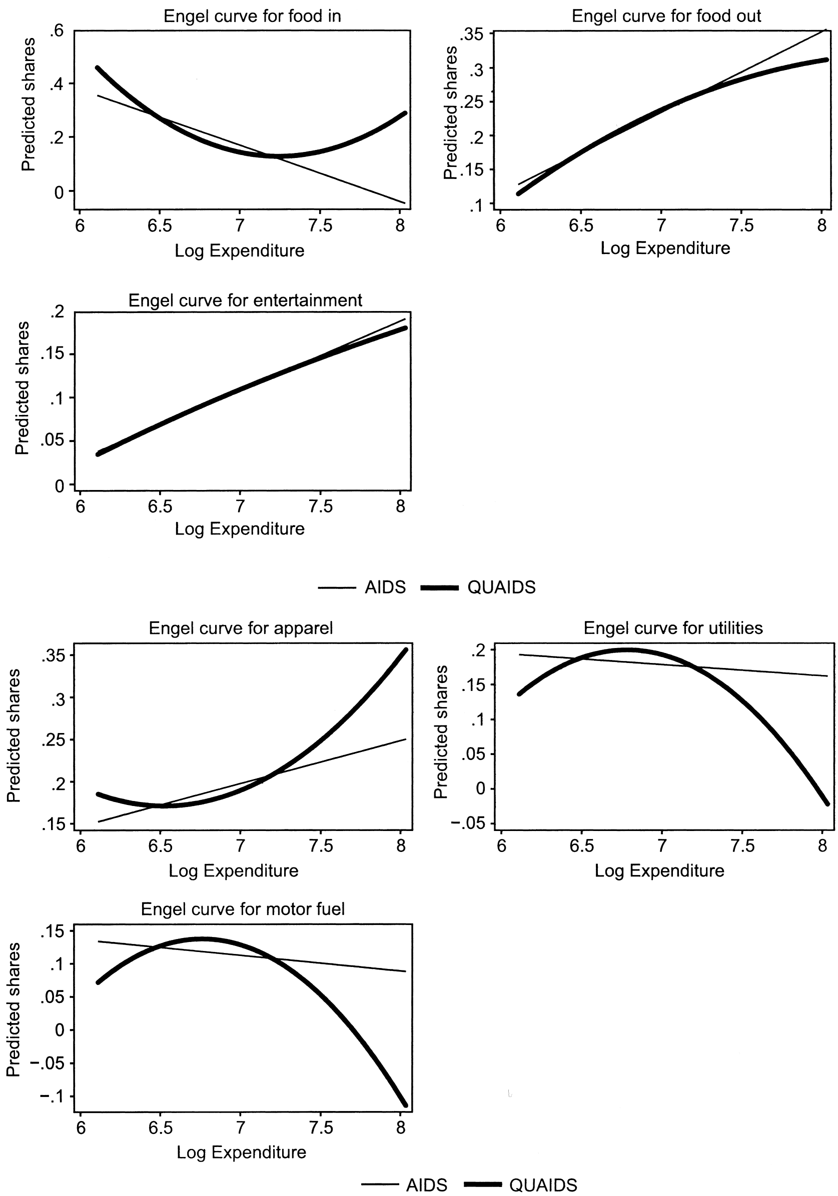

Fig. 5.3 Engel curves (AIDS vs. QUAIDS)

only for food in and for motor fuel (though the intercept and slope terms are jointly significant at the 1 percent level for all goods except food out and entertainment). These differences in the estimated coefficients translate into differences in the estimated elasticities (reported for the basic model, a model including exogenous cars, and a model including endogenous cars in tables 5.12 and 5.13). While the estimated own price elasticities are essentially the same across models, there are some interesting differences in the estimated income elasticities. Apparel becomes more of a luxury when we allow cars to be endogenous (increasing from 1.61 to 1.82). By contrast, utilities become more of a necessity (with the elasticity falling from 0.9 to 0.75). The largest difference is for motor fuel (which rises to 1.1 from 0.7 when we instrument).

In table 5.14, we estimate a demand system conditioning on the number of rooms. The associated elasticities for this model are reported in tables 5.17 and 5.18. The number of rooms and its interaction with expenditure both enter significantly in the share equations of all goods (though for entertainment, it is only the intercept that is significant at the 5 percent level). The intercept shift and slope coefficient are jointly significant in all of the equations of the demand system. Under the assumption that rooms are exogenous, it therefore seems that the data strongly reject separability between the size of the house and commodity demands. However, the elasticities do not vary greatly from the elasticities estimated using the benchmark model (where we assume full separability).

Following the strategy chosen by Hussain (2006) and using the sex composition of the children as an instrument for housing leads to demand system estimates and elasticities that are quite different from what we obtain under the assumption of exogeneity of housing. For instance, entertainment goes from being a luxury to a necessity (income elasticity 0.54) and food out becomes more of a luxury (with an elasticity of 3.57). However, as we explained above, we find the exclusion restriction dubious. We investigate another instrumenting strategy using the housing CPI, and there again the results change substantially. Food becomes an inferior good (with an elasticity of –0.34) while the income elasticity of entertainment increases to 5. These numbers are implausible and we do not believe that we are able to capture the relationship between expenditure on nondurables and total expenditure using this instrumenting strategy for housing. We leave this question for further investigation.

In table 5.15, we include the labor force participation of the wife. Once again, the data strongly reject separability under exogeneity. The intercept shift and slope interaction terms for labor force participation are jointly significant in all equations. The slope interaction terms are also all significant at the 5 percent level, suggesting that labor supply enters the demand system in a nonlinear way.

Table 5.16 shows the results for a demand system conditioning on cars, housing, and labor force participation together. Again, coefficients on the

Table 5.9 Demand system under full separability

	Food in	Food out	Entertainment	Apparel	Utilities	Motor fuel
ln(*x*)	–0.209***	0.119***	0.0793***	0.0509***	–0.0162***	–0.024***
	(–56.33)	(43.77)	(39.04)	(21.04)	(–6.16)	(–9.57)
lnpr1	–0.0645	0.0989**	0.0258	0.0271	–0.0445***	–0.043***
	(–1.42)	(2.94)	(1.06)	(1.45)	(–3.41)	(–6.10)
lnpr2	0.0989**	–0.0743	–0.0689**	0.0439**	–0.00348	0.004
	(2.94)	(–1.74)	(–2.67)	(2.70)	(–0.35)	(0.73)
lnpr3	0.0258	–0.0689**	0.0763**	–0.0285*	–0.00267	–0.002
	(1.06)	(–2.67)	(2.95)	(–2.39)	(–0.36)	(–0.51)
lnpr4	0.0271	0.0439**	–0.0285*	–0.0139	–0.0198*	–0.009
	(1.45)	(2.70)	(–2.39)	(–0.93)	(–2.52)	(–1.96)
lnpr5	–0.0445***	–0.00348	–0.00267	–0.0198*	0.0999***	–0.029***
	(–3.41)	(–0.35)	(–0.36)	(–2.52)	(10.36)	(–6.55)
Age	0.00131***	–0.000984***	–0.000311***	0.000769***	0.00114***	0.000***
	(25.26)	(–25.99)	(–10.99)	(–22.84)	(31.08)	(–10.93)
White	0.0154***	–0.000673	0.00746***	–0.00877***	–0.0121***	–0.001
	(11.46)	(–0.68)	(10.14)	(–10.01)	(–12.66)	(–1.50)
Elderly	–0.00296	0.000859	0.00366	0.00533*	0.00454	–0.011***
	(–0.83)	(0.33)	(1.87)	(2.28)	(1.79)	(–4.74)
ln(*CUsize*)	0.119***	–0.0748***	–0.0414***	–0.0158***	–0.0107***	0.024***
	(46.90)	(–40.17)	(–29.77)	(–9.56)	(–5.95)	(13.78)
Children, 0–2	–0.00601***	–0.00495***	–0.00169*	0.0204***	0.00687***	–0.015***
	(–4.79)	(–5.38)	(–2.47)	(25.00)	(7.73)	(–17.37)
Children, 3–15	0.00165*	0.00142**	0.00708***	0.000584	0.000912	–0.012***
	(2.26)	(2.66)	(17.69)	(1.23)	(1.76)	(–23.67)
Head < college	–0.00857***	0.00351***	0.00522***	0.00195*	–0.000525	–0.002*
	(–7.35)	(4.11)	(8.18)	(2.56)	(–0.63)	(–2.02)

Head college	0.000392	0.00660***	0.0128***	0.00393***	–0.00894***	–0.015***
	(0.30)	(6.91)	(17.92)	(4.62)	(–9.66)	(–16.83)
Wife < college	–0.0108***	0.000834	0.00648***	0.00234**	0.000114	0.001
	(–9.33)	(0.98)	(10.23)	(3.11)	(0.14)	(1.32)
Wife college	–0.00635***	0.00348***	0.0149***	0.00290**	–0.00854***	–0.006***
	(–4.69)	(3.51)	(20.19)	(3.29)	(–8.90)	(–7.07)
Constant	1.633***	–0.600***	–0.447***	–0.159***	0.292***	0.2802***
	(70.26)	(–35.20)	(–35.13)	(–10.47)	(17.74)	(17.93)

Notes: Controls include month of interview, year of interview, log prices, and twenty-two state-region dummies. N = 80,838 and standard errors are in parentheses.

***Significant at the 1/10 of 1 percent level.

**Significant at the 1 percent level.

*Significant at the 5 percent level.

Table 5.10 **Demand system conditional on exogenous cars**

	Food in	Food out	Entertainment	Apparel	Utilities	Motor fuel
ln(*x*)	–0.285***	0.123***	0.0764***	0.0419***	0.0401***	0.004
	(–45.59)	(26.40)	(22.01)	(10.15)	(8.97)	(0.9)
Cars	–0.293***	–0.00193	–0.0127	–0.0413***	0.180***	0.308***
	(–17.25)	(–0.15)	(–1.35)	(–3.69)	(14.84)	(23.01)
cars × *ln*(*x*)	0.0411***	–0.000166	0.00173	0.00567***	–0.0262***	–0.088***
	(16.69)	(–0.09)	(1.27)	(3.49)	(–14.88)	(–14.85)
lnpr1	–0.0593	0.0982**	0.0235	0.0255	–0.0447***	–0.128***
	(–1.31)	(2.93)	(0.97)	(1.37)	(–3.46)	(–9.01)
lnpr2	0.0982**	–0.0748	–0.0684**	0.0442**	–0.00336	–0.039***
	(2.93)	(–1.75)	(–2.65)	(2.72)	(–0.34)	(–3.53)
lnpr3	0.0235	–0.0684**	0.0774**	–0.0284*	–0.00225	–0.044***
	(0.97)	(–2.65)	(2.99)	(–2.38)	(–0.30)	(–5.00)
lnpr4	0.0255	0.0442**	–0.0284*	–0.0138	–0.0192*	–0.068***
	(1.37)	(2.72)	(–2.38)	(–0.92)	(–2.45)	(–7.17)
lnpr5	–0.0447***	–0.00336	–0.00225	–0.0192*	0.0990***	0.029***
	(–3.46)	(–0.34)	(–0.30)	(–2.45)	(10.32)	(2.80)
Age	0.00144***	–0.000953***	–0.000301***	–0.000744***	0.00112***	–0.040***
	(28.34)	(–25.28)	(–10.70)	(–22.23)	(30.78)	(–8.83)
White	0.0176***	–0.0000566	0.00764***	–0.00832***	–0.0122***	–0.057***
	(13.33)	(–0.06)	(10.42)	(–9.54)	(–12.94)	(–12.00)
Elderly	–0.00467	0.000383	0.00352	0.00497*	0.00465	–0.044***
	(–1.32)	(0.15)	(1.80)	(2.13)	(1.84)	(–8.18)
ln(*CUsize*)	0.115***	–0.0727***	–0.0413***	–0.0159***	–0.00409*	–0.025***
	(44.68)	(–37.98)	(–28.88)	(–9.38)	(–2.22)	(–4.92)
Children, 0–2	–0.00570***	–0.00583***	–0.00180**	0.0203***	0.00490***	–0.047***
	(–4.56)	(–6.27)	(–2.59)	(24.58)	(5.48)	(–10.27)

Children, 3–15	0.00155*	0.000583	0.00697***	0.000321	–0.000794	–0.050***
	(2.09)	(1.05)	(16.90)	(0.65)	(–1.49)	(–10.81)
Head < college	–0.00823***	0.00352***	0.00524***	0.00197**	–0.000767	–0.043***
	(–7.16)	(4.12)	(8.22)	(2.60)	(–0.93)	(–9.12)
Head college	–0.00254	0.00592***	0.0126***	0.00326***	–0.00863***	–0.059***
	(–1.95)	(6.12)	(17.45)	(3.79)	(–9.26)	(–12.47)
Wife < college	–0.00973***	0.00110	0.00657***	0.00254***	0.0000524	–0.041***
	(–8.54)	(1.30)	(10.39)	(3.38)	(–0.06)	(–8.67)
Wife college	–0.00597***	0.00345***	0.0150***	0.00288**	–0.00896***	–0.055***
	(–4.47)	(3.47)	(20.22)	(3.28)	(–9.38)	(–11.55)
Constant	2.171***	–0.621***	–0.426***	–0.0929***	–0.0980**	0.067*
	(51.76)	(–19.91)	(–18.27)	(–3.35)	(–3.26)	(2.37)

Notes: Controls include month of interview, year of interview, log prices, and twenty-two state-region dummies. N = 80,838 and standard errors are in parentheses.

***Significant at the 1/10 of 1 percent level.

**Significant at the 1 percent level.

*Significant at the 5 percent level.

Table 5.11 Demand system conditional on endogenous cars

	Food in	Food out	Entertainment	Apparel	Utilities	Motor fuel
ln(*x*)	–0.767***	0.0545	0.0561	0.0717	0.0188	0.565***
	(–5.94)	(0.74)	(1.03)	(1.10)	(0.26)	(4.66)
Cars	–1.600***	–0.115	–0.0404	–0.0262	0.239	1.763***
	(–5.16)	(–0.65)	(–0.31)	(–0.17)	(1.39)	(6.08)
cars * *ln*(*expend*)	0.238***	0.0194	0.00686	0.00101	–0.0309	–0.284**
	(4.95)	(0.71)	(0.34)	(0.04)	(–1.16)	(–2.85)
lnpr1	–0.0214	0.0876*	0.0154	0.0120	–0.0428**	–0.112
	(–0.46)	(2.56)	(0.62)	(0.62)	(–3.15)	(–1.51)
lnpr2	0.0876*	–0.0768	–0.0629*	0.0515**	–0.00315	–0.018
	(2.56)	(–1.79)	(–2.42)	(3.14)	(–0.32)	(–0.25)
lnpr3	0.0154	–0.0629*	0.0789**	–0.0273*	–0.00165	–0.023
	(0.62)	(–2.42)	(3.04)	(–2.27)	(–0.22)	(–0.32)
lnpr4	0.0120	0.0515**	–0.0273*	–0.0129	–0.0175*	–0.042
	(0.62)	(3.14)	(–2.27)	(–0.84)	(–2.17)	(–0.58)
lnpr5	–0.0428**	–0.00315	–0.00165	–0.0175*	0.0975***	0.046
	(–3.15)	(–0.32)	(–0.22)	(–2.17)	(9.96)	(0.65)
Age	0.00123***	–0.00114***	–0.000366***	–0.000584***	0.000860***	–0.018
	(7.32)	(–11.89)	(–5.16)	(–6.84)	(9.22)	(–0.25)
White	0.0117**	–0.00400	0.00631***	–0.00511**	–0.0173***	–0.028
	(3.02)	(–1.80)	(3.86)	(–2.60)	(–8.05)	(–0.39)
Elderly	0.000335	0.00349	0.00458*	0.00245	0.00862**	–0.030
	(0.06)	(1.12)	(1.99)	(0.89)	(2.85)	(–0.41)
ln(*CUsize*)	0.0420	–0.0909***	–0.0470***	–0.00429	–0.0192	0.081
	(1.74)	(–6.58)	(–4.61)	(–0.35)	(–1.43)	(1.22)
Children, 0–2	0.0198*	0.00149	0.000564	0.0153***	0.0117*	–0.056
	(2.18)	(0.29)	(0.15)	(3.31)	(2.33)	(–0.74)

Children, 3–15	0.0257**	0.00768	0.00930*	–0.00454	0.00603	–0.057
	(2.97)	(1.55)	(2.55)	(–1.03)	(1.26)	(–0.76)
Head < college	–0.00577***	0.00379***	0.00534***	0.00190*	–0.000743	–0.024
	(–3.50)	(4.03)	(7.69)	(2.27)	(–0.81)	(–0.34)
Head college	0.00625	0.0108***	0.0144***	–0.000630	–0.00235	–0.050
	(1.27)	(3.85)	(6.90)	(–0.25)	(–0.86)	(–0.68)
Wife < college	–0.0112***	–0.000472	0.00604***	0.00388***	–0.00220*	–0.017
	(–5.76)	(–0.42)	(7.34)	(3.91)	(–2.03)	(–0.24)
Wife college	–0.000638	0.00433**	0.0153***	0.00243*	–0.00841***	–0.040
	(–0.27)	(3.24)	(15.51)	(2.05)	(–6.48)	(–0.56)
Constant	5.442***	–0.178	–0.295	–0.277	0.0146	–3.706***
	(6.29)	(–0.36)	(–0.81)	(–0.63)	(0.03)	(–4.55)

Notes: Controls include month of interview, year of interview, log prices, and twenty-two state-region dummies. $N = 80{,}838$ and standard errors are in parentheses.

***Significant at the 1/10 of 1 percent level.

**Significant at the 1 percent level.

*Significant at the 5 percent level.

Table 5.12 Income elasticities

	Full separability	Exog. cars	Endog. cars
Food in	0.42	0.48	0.42
	(0.010)	(0.011)	(0.051)
Food out	1.94	1.97	1.79
	(0.021)	(0.023)	(0.083)
Entertainment	2.30	2.32	2.18
	(0.033)	(0.036)	(0.128)
Apparel	1.57	1.61	1.82
	(0.027)	(0.029)	(0.104)
Utilities	0.92	0.90	0.74
	(0.013)	(0.014)	(0.050)
Motor fuel	0.85	0.69	1.10
	(0.016)	(0.017)	(0.112)

Note: Standard errors are in parentheses.

Table 5.13 Own price elasticities

	Full separability	Exog. cars	Endog. cars
Food in	–0.97	–0.98	–0.85
	(0.126)	(0.126)	(0.133)
Food out	–1.71	–1.71	–1.71
	(0.337)	(0.336)	(0.338)
Entertainment	0.17	0.19	0.22
	(0.424)	(0.424)	(0.426)
Apparel	–1.21	–1.21	–1.22
	(0.166)	(0.166)	(0.171)
Utilities	–0.50	–0.50	–0.48
	(0.047)	(0.046)	(0.048)
Motor fuel	–0.47	–0.45	–0.45
	(0.031)	(0.030)	(0.056)

Note: Standard errors are in parentheses.

conditioning variables are jointly significant in all equations. The estimated elasticities from these sets of models are presented alongside those for conditioning only on rooms in tables 5.17 and 5.18. There are some small differences across models. For instance, when we condition on rooms the estimated income elasticity for apparel is 1.7, but this falls to 1.55 when we condition on labor supply, and the estimated elasticity of utilities goes from around 0.7 when we condition on rooms to just over 0.9 when we condition on labor supply. Once again, the price elasticities do not vary greatly across models.

To illustrate how the differences in our various estimates of price effects translate into differences in forecast budget shares, table 5.19 shows predicted mean budget shares for each of our models following a 25 percent increase in food prices. Confidence intervals are sufficiently tight that all these shares are significantly different to each other and so we do not report standard errors. It is clear that while many of the predicted shares are similar, allowing for the endogeniety of the number of cars has quite a large impact on forecast budget shares.

Endogeneity of labor force participation in the demand system is a concern, but as we discussed above, there is no credible instrument in the CE survey.

5.5 Conclusion

The estimation of demand systems is an exercise that enables researchers to examine a large set of questions of interest to economists and policymakers. Demand system estimates can be used to answer positive questions regarding responses to price changes and thus to policy interventions, as well as measure the welfare impact of price changes, tax reform, or other interventions that change the environment in which households make decisions.

In the United States, the CE is the only survey with which it is possible to carry out such tasks, thanks to the detailed information of expenditures, prices, incomes, and individual and household characteristics it contains. Additional information on labor supply, durables, and asset incomes allows researchers to go further than standard demand analysis and to test for the validity of the assumptions of the standard model.

Using CE data from 1998 to 2010, we estimate demand systems for nondurable goods under standard as well as more general assumptions regarding the behavior of households. We show that estimated elasticities are dependent on conditioning and thus on the assumptions made on behavior. The next step would be to address the rejection of separability, and condition on labor supply and durables in demand systems. However, we argue that it is difficult to address the likely endogeneity of labor supply and durables in the demand system using data from the CE.

Thus, while an invaluable source of quantified information on households, the CE is not without its limitations, and overcoming some of these would allow it better to fulfill its goal of informing government and policymakers of the impact of policy on household behavior and welfare. The limitations we found in the exercise we conducted are to do with the income and expenditure period mismatch, the difficulties in constructing measures of the values of cars and of housing stock, the absence of information on wages, and the sketchy information on asset income. It would be very useful to have information on the value of cars for all households, rather than only those who have bought a car. Better reporting of asset income would, of course, be useful, as well as information on wages to construct instruments for labor supply. Finally, it would be desirable to know more about housing values and the imputed rent.

Table 5.14 Demand system conditional on exogenous rooms

	Food in	Food out	Entertainment	Apparel	Utilities	Motor fuel
ln(*x*)	–0.418***	0.159***	0.0678***	–0.0150	0.148***	0.059***
	(–27.81)	(14.18)	(8.18)	(–1.53)	(14.61)	(5.83)
Rooms	–0.845***	0.0437	–0.0609*	–0.310***	0.862***	0.310***
	(–15.31)	(1.06)	(–2.00)	(–8.58)	(23.25)	(8.29)
rooms × *ln*(*x*)	0.122***	–0.0110	0.00815	0.0428***	–0.116***	–0.046***
	(14.99)	(–1.82)	(1.82)	(8.07)	(–21.26)	(–8.33)
lnpr1	–0.0565	0.0903**	0.0251	0.0270	–0.0442***	–0.042***
	(–1.24)	(2.67)	(1.03)	(1.44)	(–3.45)	(–5.95)
lnpr2	0.0903**	–0.0761	–0.0665*	0.0435**	0.00374	0.005
	(2.67)	(–1.78)	(–2.57)	(2.66)	(0.38)	(0.95)
lnpr3	0.0251	–0.0665*	0.0750**	–0.0290*	–0.00267	–0.002
	(1.03)	(–2.57)	(2.90)	(–2.43)	(–0.36)	(–0.48)
lnpr4	0.0270	0.0435**	–0.0290*	–0.0147	–0.0190*	–0.008
	(1.44)	(2.66)	(–2.43)	(–0.98)	(–2.46)	(–1.75)
lnpr5	–0.0442***	0.00374	–0.00267	–0.0190*	0.0952***	–0.033***
	(–3.45)	(0.38)	(–0.36)	(–2.46)	(10.50)	(–7.72)
Age	0.00142***	–0.000835***	–0.000281***	–0.000669***	0.000744***	0.000***
	(27.93)	(–22.09)	(–10.03)	(–20.13)	(21.78)	(–11.01)
White	0.0151***	–0.000528	0.00748***	–0.00882***	–0.0121***	–0.001
	(11.33)	(–0.53)	(10.16)	(–10.11)	(–13.50)	(–1.28)
Elderly	–0.00387	0.0000948	0.00347	0.00469*	0.00696**	–0.011***
	(–1.09)	(0.04)	(1.77)	(2.02)	(2.92)	(–4.71)
ln(*CUsize*)	0.116***	–0.0759***	–0.0417***	–0.0175***	–0.00547**	0.025***
	(45.38)	(–39.97)	(–29.66)	(–10.49)	(–3.19)	(14.28)
Children, 0–2	–0.00406**	–0.00359***	–0.00138*	0.0217***	0.00242**	–0.015***
	(–3.21)	(–3.82)	(–1.98)	(26.25)	(2.84)	(–17.61)

Children, 3–15	0.00215**	0.00219***	0.00721***	0.00106*	–0.000975*	–0.012***
	(2.95)	(4.03)	(17.93)	(2.23)	(–1.99)	(–23.55)
Head < college	–0.00774***	0.00414***	0.00538***	0.00250***	–0.00261***	–0.002*
	(–6.70)	(4.82)	(8.45)	(3.31)	(–3.36)	(–2.13)
Head college	–0.000653	0.00809***	0.0129***	0.00408***	–0.0105***	–0.014***
	(–0.50)	(8.39)	(18.10)	(4.82)	(–12.05)	(–15.89)
Wife < college	–0.00979***	0.00145	0.00666***	0.00296***	–0.00216**	0.001
	(–8.54)	(1.70)	(10.54)	(3.95)	(–2.81)	(1.13)
Wife college	–0.00612***	0.00439***	0.0151***	0.00333***	–0.0105***	–0.006***
	(–4.57)	(4.42)	(20.50)	(3.81)	(–11.71)	(–6.84)
Constant	3.079***	–0.821***	–0.361***	0.316***	–0.930***	–0.283***
	(30.40)	(–10.91)	(–6.47)	(4.78)	(–13.67)	(–4.13)

Notes: Controls include month of interview, year of interview, log prices, and twenty-two state-region dummies. N = 80,838 and standard errors are in parentheses.

***Significant at the 1/10 of 1 percent level.

**Significant at the 1 percent level.

*Significant at the 5 percent level.

Table 5.15 **Demand system conditional on exogenous female labor force participation**

	Food in	Food out	Entertainment	Apparel	Utilities	Motor fuel
ln(*x*)	–0.218***	0.108***	0.0861***	0.0411***	0.00653	–0.024***
	(–38.31)	(25.69)	(27.37)	(10.98)	(1.60)	(–6.24)
lfp	–0.234***	–0.0592	0.0727**	–0.0676*	0.196***	0.282***
	(–5.57)	(–1.90)	(3.12)	(–2.44)	(6.50)	(7.74)
lfp × *ln*(*x*)	0.0314***	0.00952*	–0.0105**	0.0104*	–0.0291***	–0.047***
	(5.10)	(2.09)	(–3.07)	(2.56)	(–6.58)	(–5.61)
lnpr1	–0.0617	0.0951**	0.0264	0.0255	–0.0433***	–0.092***
	(–1.37)	(2.84)	(1.08)	(1.37)	(–3.35)	(–6.5)
lnpr2	0.0951**	–0.0694	–0.0699**	0.0449**	–0.00418	–0.007
	(2.84)	(–1.63)	(–2.71)	(2.77)	(–0.43)	(–0.65)
lnpr3	0.0264	–0.0699**	0.0766**	–0.0282*	–0.00288	–0.011
	(1.08)	(–2.71)	(2.96)	(–2.36)	(–0.39)	(–1.31)
lnpr4	0.0255	0.0449**	–0.0282*	–0.0130	–0.0203**	–0.036***
	(1.37)	(2.77)	(–2.36)	(–0.87)	(–2.59)	(–3.83)
lnpr5	–0.0433***	–0.00418	–0.00288	–0.0203**	0.100***	0.064***
	(–3.35)	(–0.43)	(–0.39)	(–2.59)	(10.39)	(6.2)
Age	0.00114***	–0.000942***	–0.000298***	–0.000748***	0.00113***	–0.006
	(21.95)	(–24.58)	(–10.39)	(–21.88)	(30.40)	(–1.39)
White	0.0137***	–0.000182	0.00755***	–0.00851***	–0.0123***	–0.019***
	(10.32)	(–0.19)	(10.24)	(–9.69)	(–12.83)	(–4.35)
Elderly	–0.00745*	0.00183	0.00408*	0.00584*	0.00450	–0.011*
	(–2.10)	(0.70)	(2.08)	(2.50)	(1.77)	(–2.12)
ln(*CUsize*)	0.114***	–0.0739***	–0.0408***	–0.0155***	–0.0102***	0.010*
	(44.84)	(–39.38)	(–29.04)	(–9.30)	(–5.58)	(1.99)
Children, 0–2	–0.00783***	–0.00440***	–0.00159*	0.0208***	0.00656***	–0.014***
	(–6.29)	(–4.78)	(–2.30)	(25.34)	(7.35)	(–3.3)

Children, 3–15	0.00104	0.00175**	0.00705***	0.000820	0.000559	–0.017***
	(1.43)	(3.26)	(17.53)	(1.71)	(1.07)	(–4.16)
Head < college	–0.00947***	0.00385***	0.00523***	0.00215**	0.000764	–0.008
	(–8.21)	(4.51)	(8.19)	(2.83)	(–0.92)	(–1.93)
Head college	–0.00218	0.00752***	0.0129***	0.00448***	–0.00954***	–0.029***
	(–1.68)	(7.83)	(17.90)	(5.24)	(–10.24)	(–6.58)
Wife < college	–0.00962***	0.000609	0.00635***	0.00222**	.0000869	–0.006
	(–8.40)	(0.72)	(10.01)	(2.94)	(0.11)	(–1.41)
Wife college	–0.00517***	0.00306**	0.0149***	0.00260**	–0.00821***	–0.022***
	(–3.86)	(3.09)	(20.08)	(2.94)	(–8.54)	(–4.97)
Constant	1.721***	–0.532***	–0.495***	–0.0966***	0.140***	0.264***
	(45.88)	(–19.18)	(–23.85)	(–3.90)	(5.19)	(10.34)

Notes: Controls include month of interview, year of interview, log prices, and twenty-two state-region dummies. N = 80,838 and standard errors are in parentheses.

***Significant at the 1/10 of 1 percent level.

**Significant at the 1 percent level.

*Significant at the 5 percent level.

Table 5.16 **Demand system conditional on exogenous labor force participation, cars and rooms**

	Food in	Food out	Entertainment	Apparel	Utilities	Motor fuel
ln(*x*)	–0.385***	0.157***	0.0716***	–0.0175	0.167***	0.007
	(–25.28)	(13.58)	(8.33)	(–1.72)	(15.97)	(0.67)
Cars	–0.224***	0.00395	–0.0117	–0.00491	0.0719***	0.069***
	(–12.48)	(0.29)	(–1.15)	(–0.41)	(5.84)	(3.64)
cars × *ln*(*x*)	0.0312***	–0.00100	0.00159	0.000426	–0.0107***	–0.199***
	(11.99)	(–0.51)	(1.09)	(0.25)	(–5.97)	(–18.6)
Rooms	–0.514***	0.0562	–0.0645*	–0.292***	0.791***	0.647***
	(–8.99)	(1.30)	(–2.00)	(–7.66)	(20.15)	(14.22)
rooms × *ln*(*x*)	0.0731***	–0.0126*	0.00873	0.0405***	–0.106***	–0.277***
	(8.70)	(–1.97)	(1.84)	(7.21)	(–18.30)	(–17.41)
lfp	–0.115**	–0.0381	0.0824***	–0.0420	0.101***	–0.054
	(–2.75)	(–1.20)	(3.49)	(–1.50)	(3.52)	(–1.46)
lfp × *ln*(*x*)	0.0144*	0.00641	–0.0119***	0.00673	–0.0152***	–0.183***
	(2.34)	(1.38)	(–3.43)	(1.64)	(–3.61)	(–14.74)
lnpr1	–0.0519	0.0882**	0.0238	0.0243	–0.0431***	–0.251***
	(–1.16)	(2.62)	(0.98)	(1.31)	(–3.41)	(–14.91)
lnpr2	0.0882**	–0.0730	–0.0676**	0.0447**	0.00283	–0.160***
	(2.62)	(–1.71)	(–2.61)	(2.75)	(0.29)	(–10.91)
lnpr3	0.0238	–0.0676**	0.0766**	–0.0286*	–0.00251	–0.171***
	(0.98)	(–2.61)	(2.96)	(–2.40)	(–0.34)	(–13.2)
lnpr4	0.0243	0.0447**	–0.0286*	–0.0133	–0.0194*	–0.194***
	(1.31)	(2.75)	(–2.40)	(–0.89)	(–2.51)	(–14.59)
lnpr5	–0.0431***	0.00283	–0.00251	–0.0194*	0.0953***	–0.105***
	(–3.41)	(0.29)	(–0.34)	(–2.51)	(10.52)	(–7.64)
Age	0.00138***	–0.000773***	–0.000259***	–0.000629***	0.000739***	–0.167***
	(27.57)	(–20.30)	(–9.16)	(–18.74)	(21.42)	(–15.94)
White	0.0159***	0.000513	0.00774***	–0.00814***	–0.0122***	–0.183***
	(12.21)	(0.52)	(10.53)	(–9.34)	(–13.61)	(–17.34)

Elderly	–0.00894*	0.000726	0.00384	0.00511*	0.00650**	–0.168***
	(–2.57)	(0.27)	(1.96)	(2.19)	(2.71)	(–15.42)
/ln/(/CUsize/)	0.111***	–0.0726***	–0.0409***	–0.0158***	–0.00233	–0.149***
	(43.36)	(–37.44)	(–28.40)	(–9.23)	(–1.32)	(–13.84)
Children, 0–2	–0.00648***	–0.00403***	–0.00136	0.0215***	0.00115	–0.177***
	(–5.20)	(–4.26)	(–1.93)	(25.85)	(1.35)	(–16.79)
Children, 3–15	0.000911	0.00159**	0.00708***	0.000761	–0.00223***	–0.178***
	(1.24)	(2.84)	(17.04)	(1.55)	(–4.40)	(–16.91)
Head < college	–0.00845***	0.00441***	0.00541***	0.00268***	–0.00287***	–0.171***
	(–7.47)	(5.13)	(8.48)	(3.55)	(–3.69)	(–16.21)
Head college	–0.00482***	0.00825***	0.0128***	0.00419***	–0.0113***	–0.188***
	(–3.75)	(8.46)	(17.68)	(4.88)	(–12.84)	(–17.8)
Wife < college	–0.00809***	0.00140	0.00658***	0.00291***	–0.00203**	–0.170***
	(–7.21)	(1.64)	(10.41)	(3.89)	(–2.63)	(–16.09)
Wife college	–0.00457***	0.00386***	0.0151***	0.00294***	–0.0105***	–0.184***
	(–3.48)	(3.88)	(20.36)	(3.35)	(–11.65)	(–17.45)
Constant	2.899***	–0.819***	–0.388***	0.329***	–1.060***	0.040
	(28.29)	(–10.54)	(–6.73)	(4.80)	(–15.06)	(0.57)

Notes: Controls include month of interview, year of interview, log prices, and twenty-two state-region dummies. N = 80,838 and standard errors are in parentheses.

***Significant at the 1/10 of 1 percent level.

**Significant at the 1 percent level.

*Significant at the 5 percent level.

Table 5.17 Income elasticities

	Rooms	LFP	Rooms, cars, and lfp
Food in	0.46	0.46	0.53
	(0.012)	(0.010)	(0.012)
Food out	2.09	1.91	2.08
	(0.025)	(0.022)	(0.027)
Entertainment	2.36	2.28	2.35
	(0.039)	(0.034)	(0.041)
Apparel	1.70	1.55	1.70
	(0.031)	(0.028)	(0.033)
Utilities	0.69	0.92	0.70
	(0.014)	(0.013)	(0.015)
Motor fuel	0.84	0.79	0.67
	(0.019)	(0.016)	(0.020)

Note: Standard errors are in parentheses.

Table 5.18 Own price elasticities

	Rooms	LFP	Rooms, cars, and lfp
Food in	–0.96	–0.98	–0.98
	(0.127)	(0.125)	(0.125)
Food out	–1.74	–1.66	–1.71
	(0.338)	(0.336)	(0.337)
Entertainment	0.15	0.18	0.17
	(0.424)	(0.424)	(0.423)
Apparel	–1.23	–1.19	–1.21
	(0.166)	(0.166)	(0.166)
Utilities	–0.48	–0.50	–0.48
	(0.044)	(0.047)	(0.044)
Motor fuel	–0.47	–0.46	–0.44
	(0.031)	(0.031)	(0.030)

Note: Standard errors are in parentheses.

Table 5.19 Predicted budget shares following 25 percent increase in food prices

	Prior to change	Full separability	Exog. cars	Endog. cars	Rooms	LFP	Rooms, cars, and lfp
Food in	35.9	36.2	37.0	42.3	38.3	36.4	38.1
Food out	12.7	14.1	14.0	14.4	13.5	14.1	13.5
Entertainment	6.1	6.0	6.0	6.0	6.1	6.0	6.1
Apparel	9.0	9.2	9.3	8.7	9.8	9.3	9.8
Utilities	20.7	19.7	19.2	19.5	18.3	19.6	18.1
Motor fuel	15.6	14.7	14.5	9.2	14.0	14.8	14.5

This being said, much research is being done using CE data to investigate questions relating to demand estimation (Hussain 2006; Padula 1999), trends in consumption inequality (Aguiar and Bils 2011; Attanasio, Battistin, and Leicester 2006), tests of the life-cycle hypothesis (Gervais and Klein 2010), and asset pricing (Kocherlakota and Pistaferri 2009).

However, there are still many potentially relevant aspects of the life of households that are typically neglected in demand analysis, such as the impact of extended family, (via transfers, sharing of risk or proximity leading to joint consumption choices), or that of health on contemporaneous choices. We do not examine these in the empirical exercise. However, we know that extended families (Browning and Lechene 2003), habit formation (Browning and Collado 2007), and heterogeneity (Christensen 2007; Lewbel and Pendakur 2009) all matter in determining household demand, and having information on these in the CE together with information on demand would allow much progress in understanding household behavior.

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