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Price and Income Elasticities Estimated from BLS Consumer Expenditure Surveys and ACCRA Price Data

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Abstract

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This paper represents a low-key effort to estimate both price and income elasticities for several broad categories of expenditure from cross-sectional data sets that combine price information collected by ACCRA with the BLS Consumer Expenditure Surveys. Sixteen quarters of data for 1996 through 1999 are analyzed. Statistically strong, and for the most part sensible, price elasticities are obtained for six exhaustive categories of expenditure (food consumed at home, housing, utilities, transportation, health care, and miscellaneous expenditures) from both simple double-logarithmic demand functions and equations based upon an Almost Ideal Demand System. The results are clearly supportive of further research.

* I am grateful to Sean McNamara of ACCRA for making EXCEL files of ACCRA surveys available to me and to the Cardon Chair Endowment in the Department of Agricultural and Resource Economics at the University of Arizona for financial support. Construction of data sets and econometric estimation have all been done in SAS.

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I. Introduction

This paper represents a low-key effort to estimate both price and income elasticities for several broad categories of consumer expenditure from cross-sectional data sets that combine price information that is collected quarterly for more than 300 cities and urban areas in the U. S. by ACCRA with individual household consumer expenditure data from quarterly Consumer Expenditure Surveys that are conducted by the U. S. Bureau of Labor Statistics. Sixteen quarters of data are analyzed (1996 through 1999) for six categories of expenditure, namely, food consumed at home, housing, utilities, transportation, health care and miscellaneous expenditures. Since this appears to be an early effort to commingle data from these two sources, the exercise is accordingly more concerned with feasibility than with theoretical or econometric elegance. Among other things, the focus is mostly on the estimation of simple double-logarithmic demand functions, and the econometrics do not extend beyond ordinary least squares. Nevertheless, the results that are obtained make intuitive sense, and suggest that integrating price information with household expenditure surveys is worthy of continuing research.

II. Background and Merging of Data Sets

Household budget surveys have had a variety of uses in a long and venerable history, ranging from concern with the "state of the poor" in late 18th Century and mid-19th Century England and Continental Europe to a need for weights to be used in construction of consumer price indices.[1] For economists, the principal use of data from household budget surveys has usually been in the analysis of relationships between consumption expenditures and income [i.e., in the analysis of what, since Engel (1857), have been known as *Engel Curves*]. Since most budget surveys collect only expenditure data, rather than both quantities and prices, it is generally not possible, absent heroic theoretical assumptions on the structure of consumer preferences, to estimate full-blown demand functions, and hence to obtain estimates of both income and price elasticities.[2]

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[1] The standard reference for the history of early empirical studies of consumer behavior using data from household budget surveys is Stigler (1954); see also Houthakker (1957). Important 20th century studies with a family budget focus include Allen and Bowley (1935), Shultz (1938), Prais and Houthakker (1955), Deaton and Muelbauer (1980), and Pollak and Wales (1992).

[2] The reference here is to price elasticities estimated from conventional household budget surveys. Deaton (1990) provides an exception. In contrast, estimation of price elasticities for goods, such as telephone or utility services, in which the data used in estimation are collected from the records of vendors or from the actual bills of consumers are fairly commonplace. Cf.,

In the absence of information on prices, estimation of demand functions using expenditure data obviously requires price data from some other source. For the BLS-CES surveys, the natural place to turn for such data is in the price surveys that the Bureau of Labor Statistics pursues monthly as input into construction of the Consumer Price Indices. Prices for several hundred categories of expenditure for some 140 urban areas are collected in these surveys, so that cross-sectional price variation is in principle available. However, the problem is that indices reflecting areal variation in price levels at a point in time are not currently constructed by BLS, but rather only indices that measure price variation over time. Thus, the fact that the BLS all-items index for October, 2003, is 190.3 for Philadelphia and 196.3 for San Francisco *cannot* be interpreted as saying that the all-items CPI was 1.03 percent higher in San Francisco than in Philadelphia, but only that the all-items index in Philadelphia was 190.3 percent higher in October, 2003, than it was during the base years of 1982-1984, and similarly for San Francisco. Thus, the areal price indices that are currently constructed by BLS unfortunately cannot serve the need at hand.

A second source of price information is in surveys that are conducted quarterly by ACCRA in 320 or so U. S. cities.[3] Prices are collected by ACCRA for about 60 items of consumption expenditure, from which city-specific indices can be constructed that can be used to measure price differences both though time for a specific city and across cities at a point in time. In principle, this is precisely the form of price information that is required. From the 60 or so items for which price data are collected, ACCRA constructs indices for six broad categories of expenditure, namely, groceries, housing, utilities, transportation, health care, and miscellaneous. The items underlying the six ACCRA categories are given in Table 1 of the appendix.

In the analyses to follow, the six ACCRA categories are allied with comparable categories in the BLS CES surveys. In particular, the ACCRA category "groceries" is identified with the CES category "food consumed at home", while the other four specific ACCRA categories are identified with CES counterparts of the same name. Finally, the ACCRA miscellaneous category is identified with CES total expenditure minus the sum of expenditures for the first five categories. Since, to protect confidentiality, place of residence in the CES samples is specified only in terms of state and size of urban area, the ACCRA city price indices have had to be aggregated to a state level. Weights used in the aggregation are city population from the U. S. Census of 2000. The resulting state-level price indices are then attached to households in the CES samples according to states of residence.

While attaching prices from ACCRA surveys to the CES samples in the manner described yields a cross-sectional consumption data set in which both price and income elasticities can be estimated, it is important to keep in mind that *any* attempt to extract price elasticities from household budget data, not just the present effort, is laden with difficulties. The easiest case, of course, is where a good is both narrowly defined and homogeneous, and the price variation is due solely to price

Taylor and Kridel (1993) and Taylor and Rappoport and Taylor (1997).

[3] See www.ACCRA.com.

differences between regions. In this circumstance, the problem is simply one of obtaining an appropriate set of prices. With non-homogeneous goods, on the other hand, the situation is much more complicated. For not only does price become ambiguous, but so too does the concept of quantity. Quality differences, which are almost always present in some degree in consumer expenditure data, are especially troublesome in this regard, as is also non-homogeneity arising from broad categories of goods. Not surprisingly, both problems have attracted a great deal of attention in the literature.[4] Finally, a third form of price variation that warrants consideration is that caused by regional differences in the cost-of-living. A haircut, for example, may be more expensive in New York City than in Wichita, in part because of scarcity, but in part also because of differences in the cost-of-living.

As noted, the ideal circumstance (at least in principle) is where goods are narrowly defined and homogeneous (i.e., no grouping or quality gradations), and the price variation is due entirely to different prices for the same good (i.e., no cost-of-living effects). The task in this situation is simply to match expenditures for each household with the prices that the households paid. Since expenditure is quantity times price, it obviously does not matter whether consumption is measured in terms of quantity or expenditure. Price and expenditure elasticities can be translated into one another through the addition or subtraction of 1. Unfortunately, however, the ideal circumstance just described is obviously not the one at hand. Consumption categories in the CES surveys are not narrowly defined, quality gradations are almost certainly present, and the same is true of regional differences in cost-of-living. While efforts are made in the presentation to follow to mitigate the problems that these lapses entail, notions that the price elasticities obtained are the clean, pristine ones of theory must be put to the side.

III. Models Estimated

The point of departure for the analysis is a simple double-logarithmic model that relates expenditure to income, price, and a variety of socio-demographical variables (most of which are dummy variables).[5] The basic model accordingly is as follows:

$$(1) \qquad \ln E = a + b\ln y + c\ln p + \ldots\ldots + u,$$

where E, y, p, and u denote CES expenditure, income, ACCRA price, and a random error term, respectively, and "....." represents a set of socio-demographical variables (age, labor-force status,

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[4] The discussion of these problems in Prais and Houthakker (1955) is as fresh as when it was first written nearly 50 years ago.

[5] Despite problems of non-additivity (i.e., not satisfying the budget constraint as an identity), double-logarithmic expenditure functions are the primary focus of the exercise because of convenience and generally superior goodness-of-fit. However, a system of equations that have the potential to satisfy all of the standard restrictions of neo-classical demand theory (additivity, homogeneity, etc.) is presented in Section VI.

family size, education, etc.). A full listing of the socio-demographical variables that have been considered is given in the appendix. The econometric procedure, to begin with, has been to apply the model in (1) to each of the six categories of CES expenditure (food consumed at home, shelter, utilities, transportation, health care, and miscellaneous expenditures) using data from the 16 quarterly CES surveys between 1996 and 1999. 'Final' models have then been arrived at through elimination of all socio-demographical variables having t-ratios less than 2 (in absolute value). Once a final model has been obtained, the model is re-estimated in the form,

$$(2) \qquad \ln q = a + b\ln y + (c - 1)\ln p + \ldots + u,$$

where q denotes a pseudo quantity-index, defined as $q = E/p$. Since lnq in equation (2) is equal to lnE - lnp, models (1) and (2) are obviously equivalent, the only difference being that the coefficient attaching to lnp in equation (1) represents an expenditure elasticity, while c - 1 in (2) represents the more conventional price elasticity. Equation (2) will accordingly be the focus of attention.

Estimated price and income elasticities from equation (2) for the six categories and 16 quarters of expenditure are tabulated in Tables 1 - 6.[6] Income elasticities from equations in which the price variable is excluded from the otherwise 'final' models are presented as well. The latter are included as a check on bias that might arise in situations in which price information is not available. In assessing the results in these tables, reservations concerning the appropriateness of the ACCRA price indices for the tasks at hand will, for now, be put to the side. The key results in these tables are as follows:

(i). *Price effects are strong, both numerically and statistically, for all six categories of expenditure*. With the exception of transportation and miscellaneous expenditures, and to a lesser extent for food consumed at home, the estimated price elasticities are generally stable over the 16 quarters of data. Estimated price elasticities are, for the most part, of the order of -0.40 for food, -0.70 for housing, -0.85 for utilities, and -1.00 for health care.[7]

(ii). *Income effects are also strong statistically, and highly stable through time*. Estimated income elasticities are generally of the order of 0.15 for food, 0.40 for housing, 0.20 for utilities and health care, and 0.45 for transportation.

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[6] The procedures followed in constructing the data sets used in estimation are discussed in the appendix. Complete tabulations of the "full" and "final" models for the six categories for 1999 Q4 can be found in Tables 2 and 3 of the appendix.

[7] The estimated price elasticities for transportation and miscellaneous expenditures, probably due to the fewness of items included in the ACCRA transportation and miscellaneous price indices, show too much variation to be explicit concerning a central tendency.

Table 1

Food Consumed at Home
(t-ratios in parentheses)

	$\ln Q = \alpha + \beta \ln y + \gamma \ln p + ...$			$\ln E = \alpha + \beta \ln y + ...$		
Yr./Qtr.	Income	Price	R^2	Income	R^2	#Obs.
1996Q1	0.1544 (9.70)	-0.2316 (-2.22)	0.4344	0.1735 (9 .95)	0.4361	2189
1996Q2	0.1538 (11.87)	-0.3384 (-5.80)	0.4010	0.1551 (11.91)	0.3941	3054
1996Q3	0.1615 (11.55)	-0.4921 (-4.96)	0.3856	0.1434 (11.06)	0.3812	3313
1996Q4	0.1781 (13.50)	-0.5075 (-5.02)	0.3712	0.1818 (13.75)	0.3683	3373
1997Q1	0.1722 (13.06)	-0.5152 (-5.19)	0.3752	0.1750 (13.23)	0.3715	3407
1997Q2	0.1765 (14.26)	-0.5057 (-4.62)	0.3635	0.1600 (11.14)	0.3631	3400
1997Q3	0.1539 (11.85)	-0.2739 (-0.35)	0.3876	0.1676 (11.75)	0.3823	3415
1997Q4	0.1682 (13.27)	-0.4498 (-4.63)	0.3931	0.1749 (13.79)	0.3868	3478
1998Q1	0.1534 (12.20)	-0.7085 (-7.35)	0.3935	0.1560 (12.43)	0.3859	3504
1998Q2	0.1848 (15.00)	-0.6034 (-5.73)	0.3753	0.1889 (15.31)	0.3739	3432
1998Q3	0.1489 (10.90)	-0.5997 (-4.47)	0.3685	0.1532 (11.23)	0.3653	3419
1998Q4	0.1635 (12.21)	-0.7193 (-7.29)	0.3706	0.1667 (12.46)	0.3619	3333
1999Q1	0.1622 (13.86)	-0.3929 (-5.00)	0.3734	0.1631 (13.96)	0.3749	4257
1999Q2	0.1720 (15.10)	-0.4014 (-4.93)	0.3649	0.1785 (15.89)	0.3590	4673
1999Q3	0.1381 (12.36)	-0.4420 (-4.82)	0.3665	0.1432 (12.81)	0.3624	4549
1999Q4	0.1870 (17.33)	-0.5466 (-7.45)	0.3960	0.1911 (17.68)	0.3876	4538

Table 2

Shelter Expenditures
(t-ratios in parentheses)

	$\ln Q = \alpha + \beta \ln y + \gamma \ln p + \ldots$			$\ln E = \alpha + \beta \ln y + \ldots$		
Yr./Qtr.	Income	Price	R^2	Income	R^2	#Obs.
1996Q1	0.4702	-0.4787	0.3500	0.4621	0.3401	2172
	(17.69)	(-5.69)		(17.31)		
1996Q2	0.5892	-0.2387	0.3192	0.5742	0.3165	3253
	(26.56)	(-3.68)		(26.55)		
1996Q3	0.4392	-0.5317	0.3517	0.4329	0.3390	3287
	(18.84)	(-7.74)		(18.42)		
1996Q4	0.5022	-0.6917	0.3690	0.4941	0.3396	3345
	(23.06)	(-12.96)		(22.19)		
1997Q1	0.5027	-0.4792	0.3548	0.5002	0.3456	3389
	(22.07)	(-6.76)		(21.85)		
1997Q2	0.4110	-0.3904	0.3378	0.4377	0.3312	3394
	(16.67)	(-4.67)		(19.62)		
1997Q3	0.4624	-0.2870	0.3427	0.4696	0.3370	3398
	(17.50)	(-3.14)		(19.39)		
1997Q4	0.4792	-0.3881	0.3330	0.4944	0.3273	3480
	(20.59)	(-4.46)		(22.41)		
1998Q1	0.4594	-0.4167	0.3409	0.5180	0.3242	3489
	(18.66)	(-4.81)		(24.54)		
1998Q2	0.4327	-0.5486	0.3463	0.4667	0.3259	3436
	(17.73)	(-6.83)		(19.93)		
1998Q3	0.4557	-0.5513	0.3282	0.4773	0.3106	3407
	(18.09)	(-6.75)		(19.71)		
1998Q4	0.4196	-0.4811	0.3172	0.4229	0.3051	3317
	(16.48)	(-5.98)		(17.29)		
1999Q1	0.4345	-0.6543	0.2986	0.4202	0.2808	4248
	(20.47)	(–11.16)		(19.41)		
1999Q2	0.5137	-0.5147	0.2844	0.5083	0.2752	4651
	(27.88)	(-7.86)		(27.45		
1999Q3	0.4726	-0.5039	0.3180	0.4673	0.3079	4524
	(25.53)	(-8.18)		(25.09)		
1999Q4	0.4795	-0.6289	0.3334	0.4524	0.3189	4500
	(25.57)	(-11.93)		(23.69)		

Table 3

Utilities Expenditures
(t-ratios in parentheses)

	$\ln Q = \alpha + \beta \ln y + \gamma \ln p + ...$			$\ln E = \alpha + \beta \ln y + ...$		
Yr./Qtr.	Income	Price	R^2	Income	R^2	#Obs.
1996Q1	0.1834	-1.1153	0.3976	0.1831	0.3662	2174
	(9.01)	(-9.80)		(11.89)		
1996Q2	0.2043	-0.8328	0.3675	0.2047	0.3491	3258
	(11.97)	(-8.46)		(11.89)		
1996Q3	0.2269	-0.8668	0.3939	0.2274	0.3408	3285
	(14.33)	(-15.38)		(14.35)		
1996Q4	0.2693	-0.9595	0.3740	0.2692	0.3507	3353
	(16.04)	(11.56)		(16.04)		
1997Q1	0.2519	-1.0184	0.4130	0.2518	0.3706	3370
	(16.44)	(-11.82)		(16.45)		
1997Q2	0.2291	-1.0376	0.3652	0.2288	0.3166	3385
	(13.75)	(-10.82)		(13.75)		
1997Q3	0.2686	-0.8255	0.3909	0.2694	0.3440	3374
	(17.14)	(-15.77)		(17.16)		
1997Q4	0.2654	-0.8285	0.3814	0.2659	0.3393	3465
	(17.01)	(-13.80)		(17.03)		
1998Q1	0.2074	-0.9225	0.4007	0.2078	0.3685	3480
	(12.83)	(-10.98)		(12.86)		
1998Q2	0.2426	-0.8583	0.3766	0.2439	0.3490	3426
	(15.62)	(-9.64)		(15.72)		
1998Q3	0.2099	-0.9668	0.4017	0.2109	0.3614	3398
	(13.34)	(-10.75)		(13.36)		
1998Q4	0.2567	-0.7802	0.3891	0.2583	0.3440	3309
	(15.83)	(-13.40)		(15.90)		
1999Q1	0.2488	-0.9959	0.3872	0.2489	0.3578	4224
	(18.49)	(-13.18)		(18.51)		
1999Q2	0.2239	-1.0765	0.3792	0.2234	0.3450	4651
	(17.40)	(-14.66)		(17.38)		
1999Q3	0.2013	-1.0365	0.3769	0.2011	0.3219	4499
	(16.56)	(-14.69)		(16.56)		
1999Q4	0.1911	-0.8850	0.3842	0.1915	0.3414	4488
	(14.35)	(-16.92)		(14.37)		

Table 4

Transportation Expenditures
(t-ratios in parentheses)

Yr./Qtr.	$\ln Q = \alpha + \beta \ln y + \gamma \ln p + \ldots$ Income	Price	R^2	$\ln E = \alpha + \beta \ln y + \ldots$ Income	R^2	#Obs.
1996Q1	0.3768 (9.84)	-1.7976 (-6.75)	0.2962	0.3733 (12.21)	0.2818	2080
1996Q2	0.3890 (12.20)	-0.5782 (-1.71)	0.2611	0.3892 (12.21)	0.2579	3113
1996Q3	0.4525 (14.91)	-1.2499 (-6.19)	0.3231	0.4499 (14.86)	0.3186	3184
1996Q4	0.4844 (11.93)	-0.8136 (-6.90)	0.2997	0.3859 (11.98)	0.2706	3232
1997Q1	0.4910 (16.19)	-1.2039 (-3.84)	0.2776	0.4891 (16.21)	0.2761	3253
1997Q2	0.4574 (14.99)	-1.3409 (-5.08)	0.2586	0.4540 (14.93)	0.2544	3265
1997Q3	0.4433 (14.48)	-0.5170 (-1.39)	0.2800	0.4477 (14.66)	0.2778	3285
1997Q4	0.4699 (15.54)	-0.6769 (-2.60)	0.2746	0.4732 (15.71)	0.2729	3358
1998Q1	0.4172 (14.74)	-0.2115 (-0.69)	0.2961	0.4219 (14.92)	0.2927	3365
1998Q2	0.4714 (15.44)	-0.9895 (-3.91)	0.3144	0.4716 (15.52)	0.3118	3296
1998Q3	0.4968 (16.07)	-0.6257 (-2.18)	0.2833	0.4994 (16.19)	0.2817	3263
1998Q4	0.4591 (14.91)	-0.4488 (-1.65)	0.2793	0.4638 (15.10)	0.2780	3188
1999Q1	0.4335 (15.88)	-1.0394 (-3.97)	0.2401	0.4332 (15.91)	0.2372	4081
1999Q2	0.4046 (15.89)	-0.1949 (-0.99)	0.2449	0.4066 (15.95)	0.2448	4491
1999Q3	0.4411 (16.90)	-0.9351 (-3.68)	0.2593	0.4415 (16.95)	0.2568	4380
1999Q4	0.4165 (16.16)	-0.4444 (-1.56)	0.2519	0.4199 (16.32)	0.2497	4350

Table 5

Health Care Expenditures
(t-ratios in parentheses)

	$\ln Q = \alpha + \beta \ln y + \gamma \ln p + ...$			$\ln E = \alpha + \beta \ln y + ...$		
Yr./Qtr.	Income	Price	R^2	Income	R^2	#Obs.
1996Q1	0.1810 (4.68)	-0.7082 (-3.96)	0.1666	0.1856 (4.81)	0.1442	1797
1996Q2	0.2035 (5.74)	-0.9136 (-6.78)	0.1919	0.2041 (5.75)	0.1710	2689
1996Q3	0.1690 (5.06)	-1.2247 (-9.10)	0.2071	0.1664 (4.99)	0.1696	2771
1996Q4	0.2177 (6.52)	-1.1672 (-11.12)	0.2168	0.2162 (6.58)	0.1713	2790
1997Q1	0.2316 (7.08)	-0.9913 (-6.98)	0.2067	0.2318 (7.10)	0.1782	2802
1997Q2	0.2029 (6.74)	-1.0711 (-7.20)	0.1526	0.2042 (6.73)	0.1526	2854
1997Q3	0.1878 (5.84)	-1.2284 (-8.48)	0.1704	0.1840 (5.74)	0.1403	2877
1997Q4	0.2314 (7.83)	-0.9371 (-5.23)	0.1762	0.2318 (7.86)	0.1521	2935
1998Q1	0.2444 (8.47)	-0.9808 (-6.42)	0.1944	0.2446 (8.49)	0.1734	2934
1998Q2	0.1687 (5.68)	-0.9563 (-6.59)	0.1872	0.1695 (5.73)	0.1641	2880
1998Q3	0.2000 (6.63)	-1.2125 (-8.02)	0.1874	0.1942 (6.43)	0.1619	2850
1998Q4	0.2247 (7.27)	-1.2371 (-7.91)	0.2006	0.2191 (7.09)	0.1802	2768
1999Q1	0.1501 (5.35)	-1.1842 (-8.56)	0.1835	0.1482 (5.29)	0.1603	3590
1999Q2	0.2149 (8.31)	-1.1158 (-8.89)	0.1896	0.2135 (8.27)	0.1719	3947
1999Q3	0.2001 (7.84)	-1.3326 (-9.63)	0.1760	0.1959 (7.69)	0.1509	3797
1999Q4	0.1353 (5.15)	-1.0004 (-6.39)	0.1559	0.1353 (5.16)	0.1559	3840

Table 6

Miscellaneous Expenditures
(t-ratios in parentheses)

	$\ln Q = \alpha + \beta \ln y + \gamma \ln p + ...$			$\ln E = \alpha + \beta \ln y + ...$		
Yr./Qtr.	Income	Price	R^2	Income	R^2	#Obs.
1996Q1	0.8496	-1.0319	0.3452	0.8450	0.3434	2195
	(18.99)	(-2.45)		(18.88)		
1996Q2	0.7143	-1.6021	0.6245	0.7083	0.6189	3274
	(35.29)	(-8.43)		(34.86)		
1996Q3	0.7084	-1.2991	0.6061	0.6886	0.6005	3313
	(33.98)	(-7.45)		(32.39)		
1996Q4	0.6761	-0.8310	0.6054	0.6765	0.5966	3375
	(33.41)	(-9.97)		(33.00)		
1997Q1	0.7606	-0.8589	0.4725	0.7961	0.4559	3407
	(29.76)	(-3.83)		(31.20)		
1997Q2	0.8273	-1.0046	0.3023	0.8198	0.3008	3418
	(22.01)	(-2.72)		(21.85)		
1997Q3	0.7636	-0.9922	0.3951	0.7554	0.3930	3419
	(24.71)	(-3.39)		(24.48)		
1997Q4	0.7839	-1.1626	0.2705	0.7750	0.2687	3497
	(19.10)	(-2.94)		(18.92)		
1998Q1	0.6960	-0.8552	0.3592	0.6879	0.3578	3514
	(20.09)	(-2.75)		(19.91)		
1998Q2	0.8172	-1.6334	0.2720	0.8039	0.2704	3446
	(19.84)	(-4.18)		(19.58)		
1998Q3	0.8546	-1.1057	0.3033	0.8469	0.3014	3427
	(22.62)	(-3.00)		(22.14)		
1998Q4	0.8809	-0.6831	0.2537	0.8374	0.2566	3337
	(20.97)	(–1.59)		(19.43)		
1999Q1	0.6783	-0.2649	0.4768	0.6773	0.4767	4269
	(29.72)	(-1.00)		(29.70)		
1999Q2	0.6629	-0.4776	0.6064	0.6593	0.6067	4697
	(40.45)	(-3.00)		(40.26)		
1999Q3	0.6706	-0.8305	0.6064	0.6671	0.6052	4563
	(41.12)	(-5.38)		(40.85)		
1999Q4	0.6899	-0.9763	0.6125	0.6825	0.6128	4555
	(42.67)	(-5.92)		(42.29)		

(iii). Comparison of columns 2 and 5 in the tables shows that, for these data sets, *estimates of income elasticities are little affected by the presence or absence of price as a predictor*.

Two things, in my view, stand out about these results, namely, the statistical strength of the estimated elasticities and their stability over all of the 16 quarters of data. The magnitudes of the vast majority of t-ratios associated with the price elasticities are really pretty amazing (at least to me), for while high t-ratios are in general the norm with income elasticities, this is not the case for price elasticities. Indeed, if my own experience (of now more than 40 years) in trying to coax price elasticities out of time-series data is any guide, the usual situation is, first, *to hope* for estimated coefficients for price to be negative, and then *to rejoice* if associated t-ratios are greater than 2! Price elasticities with t-ratios of the magnitudes in Tables 1 - 5 are thus both gratifying and rare.[8]

Impressive, also, is the general stability of the price-elasticity estimates over all 16 quarters of data. Interestingly, the category displaying the least stability -- transportation expenditures -- is the one with the weakest coverage of prices, in that bus fares, tire balancing, and gasoline are the only prices represented in the ACCRA price index. In contrast, the two categories showing the most stability of price elasticity estimates -- housing and utilities -- are the ones with the most extensive price coverage.

A perennial question in the analysis of budget surveys is the extent to which dynamics are reflected in expenditure data.[9] If dynamics are absent, then the price and income elasticities that are being estimated here can be interpreted as measuring long-run (or steady-state) values, whereas if dynamics are present the estimates are neither fish nor fowl, in the sense of being neither short-run nor long-run. Following the debate in the 1950's concerning the efficacy of incorporating income elasticities that are extraneously estimated from budget surveys into time-series regressions for estimating price elasticities, the view has pretty much been that the situation with budget data is the former, that is, that short-term dynamics are largely absent, so that the estimates obtained (assuming that models are otherwise properly specified) represent steady-state values. The basis for this argument is that, whereas time-series estimates of price and income elasticities will reflect short-run adjustment to changes in income and prices, cross-section estimates will reflect long-run, steady-state adjustment.[10] The latter is seen as being the case if households, even though they may be in temporal disequilibrium, are affected equally by cyclical and other time-varying factors.

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[8] Of the 96 estimated price elasticities tabulated in Tables 1 - 6, only one is positive, this for miscellaneous expenditures for the 1999 Q2.

[9] Dynamics, in the sense being considered here, appear to have been first discussed as a problem in the analysis of family budgets by Prais and Houthakker (1955).

[10] For detailed discussions of the differences between cross-section and time-series estimates of the same parameters, see Kuh and Meyer (1957) and Kuh (1959, 1963).

On the other hand, when dynamic phenomena other than inter-temporal variety are present, the argument needs modification. Reference here is to the fact that, for most commodities, purchases are influenced by existing stocks (including stocks of "habits") as well as by income, price, family size, etc. Stocks inject a dynamic element into the consumption process in that a change in income, say, gives rise to a change in purchases before stocks have a chance to adjust. The new purchases affect stocks, which in turn feeds back on purchases, and so on, with long-run equilibrium being achieved when stocks cease adjusting. Since income and prices change through time, this type of dynamic adjustment will of course be reflected in time-series data, and both types of adjustment (that is, short-run and long-run) can be isolated if a proper model is employed.[11]

Less obvious, however, is the fact that this type of dynamic behavior can also be reflected in budget data, even if all households are affected equally by inter-temporal phenomena. An extreme would be when a household has purchased a durable good (an automobile, say) in a time period just before information is to be provided to the budget survey. Current expenditure will obviously be affected by the recent purchase of the durable good, and proper modeling would require that this be taken into account.[12] In the present context, however, such counsel is seen as one more of perfection than of practice. For present purposes, accordingly, the elasticities that have been obtained are assumed to represent primarily steady-state (or long-run) values.

IV. Pooling Across Quarters and Years

The stability in income and price elasticities over the 16 quarters of data in Tables 1 - 6 supports the estimation of models from data sets pooled over quarters and years. The results are in Tables 7 and 8. The estimates in Table 6 refer to within-year quarters pooled by year, while the estimates in Table 8 are for a pooling of all 16 quarters. The models in Table 8, it should be noted, allow for price elasticities to vary by year.[13]

As is to be expected, the results with the pooled models are similar to those reported in Tables 1 - 6. T-ratios are increased, of course, as a consequence of substantial increases in sample sizes and degrees of freedom. Food, transportation, and miscellaneous expenditures continue to have the greatest variation in estimated price elasticities, and housing and health care the least. From the

[11] See, Houthakker and Taylor (1970), Deaton (1975), Deaton and Muellbauer (1980a), Phlips (1983), and Pollak and Wales (1992).

[12] Ideally, this would be through inclusion of information on the level of stocks.

[13] This is done through interacting logarithms of prices with yearly dummy variables (D97, D98, and D99). As D96 is the left-out year, the coefficients on the interaction terms accordingly represent deviations from the coefficient for D96•lnp. Although allowance could also be made for price elasticities to vary by quarter as well as by year, this has not been done. Neither have models been estimated that allow for income elasticities to vary across quarters and years.

Table 7

CES Expenditures
Quarters Pooled by Years
(t-ratios in parentheses)

	$\ln Q = \alpha + \beta \ln y + \gamma \ln p + \ldots$			$\ln E = \alpha + \beta \ln y + \ldots$		
Year	Income	Price	R^2	Income	R^2	#Obs.
Food						
1996	0.1592	-0.3963	0.3952	0.1619	0.3930	11963
	(22.16)	(-7.95)		(23.08)		
1997	0.1617	-0.4188	0.3800	0.1675	0.3765	13701
	(24.38)	(-7.92)		(25.22)		
1998	0.1563	-0.6269	0.3780	0.1609	0.3713	13688
	(23.31)	(-12.25)		(24.03)		
1999	0.1653	-0.4364	0.3760	0.1658	0.3692	18017
	(29.56)	(-10.75)		(29.44)		
Shelter						
1996	0.4614	-0.5074	0.3501	0.4497	0.3367	12057
	(37.99)	(-15.75)		(35.69)		
1997	0.4542	-0.3279	0.3396	0.4516	0.3351	13661
	(36.27)	(8.56)		(36.11)		
1998	0.4400	-0.4389	0.3303	0.4312	0.3238	13649
	(36.22)	(-11.56)		(35.39)		
1999	0.4266	-0.5675	0.3180	0.4125	0.3034	17924
	(42.25)	(-19.61)		(38.66)		
Utilities						
1996	0.2250	-0.8824	0.3763	0.2256	0.3461	12070
	(25.48)	(-22.13)		(25.46)		
1997	0.2533	-0.8379	0.3827	0.2545	0.3378	13594
	(31.92)	(30.97)		(32.03)		
1998	0.2045	-0.8742	0.3916	0.2063	0.3559	13612
	(22.73)	(-20.77)		(22.96)		
1999	0.2102	-1.0120	0.3792	0.2101	0.3390	17862
	(30.75)	(-2745)		(30.76)		

Table 7 (contd.)

Year	$\ln Q = \alpha + \beta \ln y + \gamma \ln p + \dots$ Income	Price	R^2	$\ln E = \alpha + \beta \ln y + \dots$ Income	R^2	#Obs.
Transportation						
1996	0.3767	-0.9583	0.2949	0.3770	0.2829	11609
	(21.98)	(-11.61)		(22.01)		
1997	0.4629	-0.7024	0.2720	0.4651	0.2697	13161
	(30.32)	(-3.97)		(30.57)		
1998	0.4132	-0.5454	0.2986	0.4163	0.2966	13111
	(25.66)	(-3.59)		(25.90)		
1999	0.4205	-0.7398	0.2511	0.4223	0.2486	17302
	(31.92)	(-6.28)		(32.10)		
Health Care						
1996	0.1540	-1.0996	0.2063	0.1530	0.1737	10046
	(8.18)	(-16.84)		(8.14)		
1997	0.1843	-0.8769	0.1931	0.1857	0.1663	11468
	(10.51)	(-9.70)		(10.60)		
1998	0.2188	-0.9382	0.1966	0.2199	0.1762	11431
	(12.94)	(-10.09)		(13.06)		
1999	0.1800	-0.9895	0.1896	0.1801	0.1682	15173
	(12.89)	(-12.65)		(12.92)		
Miscellaneous Expenditures						
1996	0.6958	-0.9929	0.5264	0.7026	0.5219	12157
	(52.56)	(-12.35)		(53.83)		
1997	0.7097	-0.8683	0.3428	0.7019	0.3424	13742
	(38.17)	(-5.18)		(38.26)		
1998	0.7223	-1.1139	0.2991	0.7204	0.2989	13724
	(34.56)	(-3.05)		(34.73)		
1999	0.6661	-0.3845	0.5711	0.6644	0.5708	18084
	(73.88)	(-3.54)		(73.77)		

Table 8

CES Expenditures
1996 - 1999 Pooled
(t-ratios in parentheses)

	lnQ = a + blnincome + clnp + dD97lnp + eD98lnp + fD99lnp + ...						*lnE = a + blnincome + ...*		
category	income	price	D97price	D98price	D99price	R^2	income	R^2	#Obs.
food	0.1576	-0.4251	0.0040	-0.2019	0.0057	0.3807	0.1637	0.3759	56659
	(47.97)	(-15.60)	(2.80)	(-3.60)	(4.25)		(50.22)		
shelter	0.4513	-0.5692	0.1022	0.0711	0.0092	0.3336	0.4448	0.3225	57291
	(77.82)	(-29.37)	(3.81)	(2.55)	(4.43)		(76.33)		
utilities	0.2240	-0.8564	-0.0778	-0.0446	-0.1187	0.3810	0.2247	0.3432	57139
	(53.70)	(-26.55)	(-2.05)	(-1.14)	(-3.12)		(53.89)		
trans.	0.3905	-0.9976	0.2770	0.5436	0.2963	0.2797	0.3917	0.2753	55183
	(49.35)	(-13.37)	(1.68)	(3.66)	(2.20)		(49.56)		
hlthcare.	0.1669	-0.9990	0.0007	0.0037	0.0103	0.1970	0.1689	0.1711	48121
	(19.69)	(-24.31)	(0.23)	(1.18)	(3.46)		(19.99)		
misc.	0.6983	-0.8742	-0.0037	-0.0048	0.3978	0.4014	0.6942	0.4004	57706
	(91.19)	(-10.71)	(7.82)	(7.46)	(11.38)		(90.75)		

estimated coefficients on the interaction terms, food consumed at home is seen to be the only category in which the price elasticity appears to lack a trend, for the elasticities for housing, transportation, health care, and miscellaneous expenditures become uniformly smaller (in absolute value) between 1996 and 1999, while the elasticity for utilities becomes larger. Finally, as in Tables 1 - 6, income elasticities are seen both to be stable across years and little affected by the exclusion of the price variable.

V. Effects of Other Variables

Since the focus in this exercise is on price and income elasticities, the other variables in the models are viewed as controls, their inclusion being necessitated in order to avoid bias problems associated with "omitted" variables. However, this is not to say that these other predictors are neither of importance nor of interest in their own right. As has been noted, complete tabulations for both the "full" and "final" models for the six categories of expenditures for the 4th quarter of 1999 are given in Tables 2 and 3 in the appendix. For the most part, the equations for this quarter typify those of the other 15 quarters. In general, age, family size, and dummy variables denoting age and number of children, rural/urban, region of the country lived in, race, sex, home-ownership, and whether the household is recipient of food stamps are significant in some form.[14] The number of wage-earners and education are occasionally important. Seasonal effects, on the other hand, are usually unimportant. The variables that are most sensitive to inclusion of ACCRA prices are the regional dummy variables (northeast, midwest, south, and west). Obviously, this is hardly a surprise, for, in the absence of price variables, these variables will pick up differences in regional price levels. Complete tabulations of the equations underlying the estimates in Table 7 are given in Table A4 of the appendix.

VI. An Almost Ideal Demand System of Equations

Despite their empirical appeal, a defect of double-logarithmic demand functions is that they are neither additive nor integrable -- i.e., they neither satisfy the budget constraint nor are consistent with an underlying utility function. In view of this, it is of interest compare double-log results with those obtained from a utility-derived system of equations. This section reports such a comparison using the Almost Ideal Demand System of Deaton and Muellbauer (1980b).

The estimating equations of the Deaton-Muellbauer system have the form:

$$(3) \qquad w_i \quad = \quad \alpha_i + \sum\gamma_{ij} \ln p_j + \beta_i \ln(y/P), \quad i,j = 1, ..., n,$$

where w_i denotes the budget share of the i^{th} good, p_j denotes the price of the j^{th} good, y denotes the budget constraint, and P is a price index defined by:

$$(4) \qquad \ln P \quad = \quad \alpha_0 + \sum\alpha_j \ln p_j + (1/2)\sum\sum\gamma_{ij} \ln p_j p_i \,.$$

The own-price elasticities obtained from estimating this system of equations for the six BLS-ACCRA expenditure categories for the four quarters of 1996 and 1999 are tabulated in the first two columns of Table 9. Comparable estimates from the double-log equations are given in the third and fourth columns.[15]

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[14] Since demographic factors related to family size and children are especially important in food consumption, the approach that has been employed here in taking these into account is simple-minded in comparison what is available in the literature, such as, for example, the use of household production functions or adult-equivalent scales. Cf., Deaton and Paxson (1998), Lanjouw and Ravallion (1995), Prais and Houthakker (1955), and Rothbarth (1943). Browning (1992) provides a useful survey.

[15] Since saving is not included as an "expenditure" category, the budget constraint in Table 9 is total expenditure (defined as the sum of expenditures for food consumed at home, housing, utilities, transportation, and miscellaneous expenditures), rather than CES income-after-tax employed in the previous estimations. To simplify estimation, I have used the ACCRA all-items index in place of P as defined in expression (4). Others' experience in estimating the Deaton-Muellbauer system suggests that any bias that this might cause is not large. Also, the six

Table 9

Own-Price and Total Expenditure Elasticities:
Almost Ideal and Double-Log Demand Systems
1996 and 1999

	Demand System			
	Almost Ideal		Double-Log	
Category	1996	1999	1996	1999
Own-Price Elasticities				
Food	-0.3563	-0.5486	-0.7020	-0.5766
Shelter	-0.7124	-0.9168	-0.6153	-0.7276
Utilities	-0.8817	-1.0271	-0.8937	-1.0926
Trans.	-1.1564	-0.9872	-1.0777	-1.2270
Health	-1.0542	-1.1133	-1.1671	-1.1139
Misc.	-0.9127	-1.1111	-1.1101	-1.0679
Total Expenditure Elasticities				
Food	0.4474	0.4662	0.3069	0.3118
Shelter	0.9660	0.9336	0.9088	0.8678
Utilities	0.3931	0.4191	0.3154	0.3335
Trans.	1.6683	1.7196	1.3224	1.3206
Health	0.6690	0.6758	0.4484	0.5024
Misc.	1.1476	1.1056	1.1217	1.0463

In general, the elasticity estimates are seen to be in fairly close agreement between the two

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data sets that are used in estimation are not identical across categories, so that the Almost Ideal equations that are estimated should be viewed as being only "stochastically" integrable. Lastly, the elasticities for the Almost Ideal Demand System models are calculated according to the following formulae:

$$\eta_{tot.exp.} = 1 + \beta_i/w_i$$

$$\eta_{price} = -1 + (\gamma_i/w_i) - [\beta_i p_i w_i^*]/Pw_i],$$

where w_i* is the weight of the i^{th} expenditure category in the ACCRA all-items index. The elasticities for both systems are calculated from the "full" models (i.e., with *all* socio-demographical and regional variables included as predictors).

models for both years. The biggest differences are in food and miscellaneous expenditures for the price elasticities, and in food, transportation, and health expenditures for total expenditure. However, the result that several of the price elasticities and all of the expenditure elasticities from the AIDS equations are larger than their double-log counterparts is almost certainly reflective of two important structural differences between the AIDS and double-logarithmic demand systems. The first of these is simply the fact -- which might account for the uniformly smaller double-log expenditure elasticities -- that the budget-share-weighted sum of double-log expenditure elasticities must necessarily be less than 1.[16] A second important difference is the fact (readily apparent in footnote 15) that the default values (i.e., absence of any statistical price or expenditure effects) for the price and expenditure elasticities in the AIDS equations are -1 and 1, respectively, whereas in the double-log equations the default values are all 0.[17]

Before leaving this section, a few words are in order concerning the use of total expenditure, rather than income, as the budget constraint.[18] Since saving is not included as an expenditure category, we must naturally expect "income" elasticities to be larger when total expenditure (which excludes saving) is used as the budget constraint than when income itself (which includes saving) is used. Despite this expectation, however, the magnitudes of the increases, as seen in Table 10, are rather startling, as most of the total expenditure elasticities are double or triple their income counterparts.[19] The own-price elasticities, in contrast, display much less sensitivity to the choice of budget constraint, as only food expenditures (in 1996) and miscellaneous expenditures (in 1999) show much change.[20]

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[16] The sums in question for the double-log equations are 0.9102 for 1996 and 0.8301 for 1999.

[17] Default values of -1 and 1 in the AIDS equations are, of course, a consequence of integrability, which, among other things, implies that at least some non-zero price elasticities must necessarily be found. The fact that this is not the case with double-log equations is, in my view, a real plus in favor of employing simple double-log models in exploratory research.

[18] Whether income or total expenditure is to be used as the budget constraint is, of course, a long-standing question in applied demand analysis. A standard argument (which derives from the Permanent Income Hypothesis) in favor of total expenditure as the budget constraint is that, since households have more control over their expenditures than over receipts of income, total expenditure provides a better measure of permanent income.

[19] The estimates in this table are obtained from "full" models in which all predictors except for the budget constraint are common. This accounts for the small differences between the elasticities reported in columns 1 and 3 of the table and their counterparts in Table 7.

[20] The comparisons and remarks in this section are really only made in passing. Application of other theoretically plausible demand systems [including the addilog systems (both indirect and direct) of Houthakker (1950)] is planned, as is also a much more detailed analysis of

Table 10

Comparison of Elasticities
Income and Total Expenditure as Budget Constraints
Double-Logarithmic Models
1996 and 1999

	1996		1999	
	Budget Constraint		Budget Constraint	
Category	Income	Total Exp.	Income	Total Exp.
Own-Price Elasticities				
Food	-0.6521	-0.7020	-0.4416	-0.5766
Shelter	-0.5772	-0.6153	-0.6218	-0.7276
Utilities	-0.8697	-0.8937	-1.0197	-1.0926
Trans.	-0.9597	-1.0777	-0.8185	-1.2270
Health	-1.0791	-1.1671	-0.9268	-1.1139
Misc.	-0.9279	-1.1101	-0.3685	-1.0679
Budget-Constraint Elasticities				
Food	0.1369	0.3069	0.1408	0.3118
Shelter	0.4639	0.9088	0.3950	0.8678
Utilities	0.1747	0.3154	0.1642	0.3335
Trans.	0.3461	1.3224	0.3287	1.3206
Health	0.1303	0.4484	0.1480	0.5024
Misc.	0.6694	1.1217	0.6323	1.0463

VII. Conclusions

As noted at the outset, the purpose of this exercise has been to explore the feasibility of estimating consumer demand functions from data sets that combine household level expenditure data from the on-going quarterly Consumer Expenditure Surveys conducted by the U. S. Bureau of Labor Statistics with price data from the price surveys undertaken quarterly by ACCRA. Simple double-logarithmic demand functions have been estimated for six (exhaustive) categories of expenditure for 16 quarters for the years 1996 through 1999. In general, strong price effects -- indeed, surprisingly strong in terms of my personal expectations! -- are obtained that, for the most part, are stable over time.

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the sensitivity of elasticities to the choice of budget constraints.

Among other things, the exercise confirms that commingling of expenditure and price data from disparate surveys is indeed feasible, and is an area that is quite clearly worthy of further investigation. Natural next steps include the estimation of theoretically plausible demand systems, such as Houthakker's indirect and direct addilog systems, as a follow-up to the Deaton-Muellbauer Almost Ideal Demand System that has been estimated in passing here, together with development of price data sets from the BLS monthly price surveys that input into the Consumer Price Index. The latter is warranted in order to overcome the limited commodity coverage of the ACCRA surveys.

Despite the nearly overwhelming interest of economists in price elasticities, the unfortunate truth is that, except for a few specific categories of consumption (such as food consumed at home, telecommunications, and household utilities), there is little empirical evidence as to their values. For this reason, it seems to make little sense at this stage to get caught up in discussion of whether or not the price elasticities that have been obtained here are "plausible". Such assessments, at least in my opinion, must await development of more comprehensive price data sets than the ones that have been used here.

My final observation concerns the sharp differences in the budget-constraint elasticities in Table 10 that are associated with whether the budget constraint is income or total expenditure. These differences, which seem especially large for transportation and miscellaneous expenditures, clearly merit further attention.

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Appendix

A. Consumption Expenditure Categories Included in ACCRA Price Surveys.

Groceries	Housing	Utilities	Transportation	Health Care	Miscellaneous
t-bone stk.	apt. rent	all electric	bus fare	hosp. room	hamburger sand.
gd. beef	home price	part electric	tire bal.	Dr. appt.	pizza
sausage	mortgage rate	other energy	gasoline	dentist	2-pc. chicken
fry chicken	home P+I	telephone		aspirin	hair cut
tuna					beauty salon
gal. milk					tooth paste
dz. eggs					shampoo
margarine					dry clean
parmesan cheese					men's shirt
potatoes					underwear
bananas					slacks
lettuce					washer repair
bread					newspaper
cigarettes					movie
coffee					bowling
sugar					tennis balls
cereal					monopoly set
sweet peas					liquor
tomatoes					beer
peaches					wine
Kleenex					
Cascade					
Crisco					
orange juice					
frozen corn					
baby food					
Coke					

B. Preparation of Data.

The CES quarterly data sets employed in the analysis have been developed from the Public Use Interview Microdata sets for 1996 through 1999 that are available on CD-ROM from the U.S. Bureau of Labor Statistics.[21] "Cleansing" of the CES files included elimination of households with reported income of less than $5000 and then of households with zero (or negative) expenditures for the commodity category in question. The CES surveys do not include price data. The price data for

[21] See http://www.bls.gov/cex/home.htm.

the analysis are taken from the on-going price surveys of the 62 items of consumer expenditure listed in Table A1 above in more than 300 cities in the U.S. that are conducted quarterly by ACCRA[22]. From the 62 items of expenditure, ACCRA constructs six price indices (food, housing, etc.), and then from these an all-items index (which in principle are comparable, on a city basis, to BLS city CPI's). The ACCRA city indices in a state for each quarter are aggregated to the state level using city populations from the US Census of 2000 as weights.[23] The resulting ACCRA prices are then attached to CES households according to state of residence.[24]

C. Definitions of Variables.

lnfood	logarithm of expenditures for food consumed at home
lnhous	logarithm of housing expenditures
lnutil	logarithm of expenditures for household utilities
lntrans	logarithm of transportation expenditures
lnhealth	logarithm of health care expenditures
lnmisc	logarithm of miscellaneous consumption expenditures
lnincome	logarithm of household income
lntotexp	logarithm of total consumption expenditure
lnpfood	logarithm of price index for food consumed at home
lnphous	logarithm of price index for housing
lnputil	logarithm of price index for utility expenditures
lnptrans	logarithm of price index for transportation expenditures
lnphealth	logarithm of price index for health care expenditures

[22] See http://www.ACCRA.com.

[23] See http://www.census.gov/Press-Release/www/2003/SF4.html

[24] In instances in which CES does not code state of residence for reasons of non-disclosure, the households in question are dropped.

lnpmisc	logarithm of price index for miscellaneous expenditures
lnpall	logarithm of all-items price index
no_earnr	number of income earners in household
fam_size	size of household
age_ref	age of head of household
dsinglehh	dummy variable for single household
drural	dummy variable for rural area of residence
dnochild	dummy variable for no children in household
dchild1	dummy variable for children in household under age 4
dchild4	dummy variable for oldest child in household between 12 and 17 and at least one child less than 12
ded10	dummy variable for education of head of household: grades 1 through 8
dedless12	dummy variable for education of head of household: some high-school, but no diploma
ded12	dummy variable for education of head of household: high-school diploma
dedsomecoll	dummy variable for education of head of household: some college, but did not graduate
ded15	dummy variable for education of head of household: Bachelor’s degree
dedgradschool	dummy variable for education of head of household: post-graduate degree
dnortheast	dummy variable for residence in northeast
dmidwest	dummy variable for residence in midwest

dsouth	dummy variable for residence in south
dwest	dummy variable for residence in west (excluded)
dwhite	dummy variable for white head of household
dblack	dummy variable for black head of household
dmale	dummy variable for male head of household
down	dummy variable for owned home
dfdstmps	dummy variable for household receiving food stamps
D1, D2, D3, D4	seasonal quarterly dummy variables.

D. Estimated 'Full' Models for 1999 Q4.[25]

Variable	Food	Shelter	Utilities	Trans.	Health	Misc.
intercept	6.7697	1.1887	7.3297	6.2895	7.9342	3.4029
	(12.18)	(2.77)	(17.22)	(3.34)	(8.67)	(3.13)
lnincome	0.1690	0.4375	0.1870	0.3797	0.1410	0.6855
	(13.41)	(21.13)	(12.64)	(13.84)	(4.77)	(42.25)
lnprice	-0.4732	-0.6552	-0.9049	-0.9106	-0.9876	-0.7655
	(-4.30)	(-11.94)	(-11.49)	(-2.36)	(-6.15)	(-3.37)
no_earnr	-0.0026	0.0060	0.0244	0.1639	-0.1050	0.1178
	(-0.24)	(0.33)	(1.88)	(6.83)	(-4.12)	(8.26)
age_ref	0.0031	-0.0046	0.0023	-0.0047	0.0196	-0.0088
	(5.45)	(-4.83)	(3.40)	(-3.67)	(14.50)	(-11.84)
fam_size	0.1202	0.0094	0.0778	0.0321	0.1038	-0.0097
	(13.36)	(0.64)	(7.39)	(1.64)	(4.77)	(-0.84)
dsinglehh	-0.3446	-0.0631	-0.2104	-0.3169	-0.3353	-0.1228
	(-14.13)	(-1.59)	(-7.35)	(-5.95)	(-5.90)	(-3.91)
drural	-0.1341	-0.6659	-0.792	0.0804	0.0195	-0.2240
	(-1.99)	(-6.06)	(-2.31)	(0.57)	(0.13)	(-2.59)

[25] T-ratios are in parentheses.

dnochild	-0.0863	-0.0801	-0.0205	0.0058	0.1150	-0.0126
	(-3.53)	(-2.01)	(-0.72)	(0.11)	(2.01)	(-0.40)
dchild1	-0.0199	0.0415	-0.1055	-0.1314	-0.0104	-0.1094
	(-0.61)	(0.78)	(-2.75)	(-1.86)	(-0.13)	(-2.59)
dchild4	0.0808	0.0271	0.0049	-0.1537	-0.0724	-0.0013
	(2.23)	(0.46)	(0.12)	(-1.97)	(-0.86)	(-0.03)
ded10	-0.0221	-0.1121	-0.0449	-0.4019	-0.1750	-0.2775
	(-0.53)	(-1.65)	(-0.92)	(-4.21)	(-1.76)	(-5.21)
dedless12	-0.1874	0.2137	0.2786	0.5666	-0.6847	0.6161
	(-1.23)	(0.83)	(1.50)	(1.44)	(-1.72)	(3.14)
ded12	-0.1940	0.2830	0.2866	0.5493	-0.6552	0.7022
	(-1.28)	(1.10)	(1.55)	(1.40)	(-1.65)	(3.60)
dsomecoll	-0.1880	0.4528	0.3422	0.6815	-0.6344	0.8896
	(-1.24)	(1.76)	(1.85)	(1.73)	(-1.60)	(4.55)
ded15	-0.1548	0.6871	0.3998	0.7408	-0.5709	1.0231
	(-1.02)	(2.66)	(2.16)	(1.88)	(-1.44)	(5.22)
dgradschool	-0.0787	0.7987	0.4424	0.7457	-0.5875	1.0934
	(-0.51)	(3.07)	(2.37)	(1.88)	(-1.47)	(5.53)
dnortheast	0.0020	-0.2515	0.0444	-0.1656	-0.0101	-0.0532
	(0.08)	(-5.47)	(1.14)	(-3.13)	(-0.18)	(-1.51)
dmidwest	-0.0245	-0.1244	0.0572	-0.0780	0.1394	-0.0022
	(-0.99)	(-3.32)	(2.20)	(-1.35)	(2.48)	(-0.07)
dsouth	0.0276	-0.2671	0.2122	-0.0646	0.1835	-0.0808
	(1.07)	(-7.19)	(8.86)	(-1.11)	(3.22)	(-2.67)
dwhite	0.0480	0.0238	0.1593	-0.0497	0.3205	0.1843
	(1.19)	(0.36)	(3.38)	(-0.57)	(3.28)	(3.58)
dblack	0.0023	-0.1215	0.2353	-0.1866	0.0727	0.0451
	(0.05)	(-1.63)	(4.36)	(-1.85)	(0.64)	(0.76)
dmale	0.0285	-0.0031	-0.0578	0.0837	-0.0326	0.0162
	(1.76)	(-0.12)	(-3.04)	(2.39)	(-0.87)	(0.78)
down	0.0866	-0.2856	0.4668	0.2711	0.2626	0.1882
	(4.51)	(-9.08)	(20.72)	(6.41)	(5.81)	(7.60)
dfdstmps	0.0494	-0.2222	0.0982	-0.3925	-0.7914	-0.2467
	(1.15)	(-3.14)	(1.90)	(-3.85)	(-6.49)	(-4.45)

d4	0.0471	-0.0303	-0.0392	-0.1481	-0.1443	-0.0214
	(1.68)	(-0.66)	(-1.19)	(-2.43)	(-2.23)	(-0.59)
R^2	0.4012	0.3458	0.3884	0.2588	0.1881	0.6146
#Obs.	4538	4500	4488	4350	3840	4555