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Chapter Author: Robert T. Michael

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Detailed Expenditure Items

THE 1960 BLS consumer expenditure survey was also analyzed for more detailed expenditure items. The observations were again grouped by disposable income, education level of the head, and region as described in the previous chapter. The consumption items were disaggregated from the dozen or so used in Chapter 4 into fifty items (see Table 6), and two new items were added to the analysis—personal insurance expenditures and gifts and contributions. These are not included in the definition of total current consumption expenditure but are studied here as items that might also be interpreted via the model developed in the earlier chapters.

These fifty-two items vary considerably in size, from an average yearly expenditure of four dollars (on insurance for housefurnishings) to an average expenditure of nearly one thousand dollars (on food at home) per year. The relative variability in the expenditures also differs considerably among the items, from 33.7 per cent (on utilities) to 240.3 per cent (on real estate other than dwellings) of the mean. For the most part, the degree to which the items were disaggregated was dictated by the availability of the data (e.g., food at home was not available in any detail). However, some discretion was used in aggregating a few items (for instance, the "men's clothing" item is the sum of ten smaller items of outerwear, underwear, footwear, and so forth, for men of various age groups).

Naturally, many of these detailed expenditure items, as they are reported, have idiosyncrasies that raise various questions—say, about

TABLE 6
Detailed Expenditure Items

Item Number	*Item*	*Mean Expenditure*	*Coefficient of Variation*
	Total Current Consumption	5057	51.6
1.	Food at home	989	38.4
2.	Food away from home	245	66.9
3.	Alcohol	78	76.0
4.	Tobacco	91	39.3
5.	Rent expenditure	263	42.0
6.	Owned dwelling–interest on mortgages	119	91.7
7.	Owned dwelling–taxes	99	79.2
8.	Owned dwelling–insurance	27	73.5
9.	Owned dwelling–repairs	88	72.8
10.	Owned dwelling–other	17	134.6
11.	Owned vacation home	5	201.6
12.	Lodging out of town	35	139.3
13.	Other real estate	6	240.3
14.	Utilities	249	33.7
15.	Telephone	78	46.3
16.	Household services	105	115.1
17.	Household supplies	103	45.1
18.	Household textiles and floor coverings	59	75.9
19.	Household furniture	76	68.5
20.	Major appliances	69	54.1
21.	Small appliances	7	47.5
22.	Housewares	14	86.7
23.	Housefurnishings–insurance	4	112.3
24.	Housefurnishings–other	34	66.8
25.	Men's (age $\geq$ 18) clothing	137	69.6
26.	Women's clothing	192	72.4
27.	Clothing upkeep and materials	69	63.2
28.	Children's clothing	124	64.5
29.	Automobile purchase	301	74.3
30.	Automobile operations	396	54.6
31.	Public transportation	78	120.3
32.	Medical–prepaid (premiums)	89	44.0
33.	Medical–hospital	47	81.1
34.	Medical–outside hospital	55	46.1
35.	Medical–dental service	46	85.8
36.	Medical–eye care (including glasses)	16	56.8
37.	Medical–appliances, etc.	16	101.9
38.	Medical–drugs	69	36.2
39.	Personal care–services	65	56.2
40.	Personal care–supplies	80	40.9
41.	Television	38	42.9
42.	Radio, phonographs, etc.	33	87.4
43.	Spectator admissions	24	75.2
44.	Participation sports (equipment, fees)	30	93.4
45.	Club dues, hobbies, pets, toys, etc.	75	84.3
46.	Reading	44	58.6
47.	Education–tuition and fees	32	174.7
48.	Education–books, supplies	10	107.2
49.	Education–music and special lessons	11	189.7
50.	Miscellaneous personal consumption expenditure	111	100.6
51.	Personal insurance	315	79.0
52.	Gifts and contributions	280	96.9

the interpretation of their income elasticity. These make the observed expenditure a less than ideal measure of the service flow from these market goods used in nonmarket production. For example, the owned dwelling expenditure on interest payments on mortgages will necessarily be zero for all renters and all those homeowners who have no outstanding mortgage; or, the household expenditure on medical care prepaid premiums excludes employer-paid medical insurance. These and other similar instances seem to suggest that the expenditure items need some rather important adjustments before they can be analyzed and interpreted unambiguously.

This consideration would indeed be relevant if our interest were focused on a few specific items, or on each one in isolation. But since, instead, this study views the broad character of the expenditure pattern of households and, specifically, observes how this pattern changes in response to changes in certain economic and demographic characteristics of the household, it seems reasonable to take the items as they are—without much effort to adjust and "clean up" each one separately—and see whether the shifts in the expenditure pattern are systematic and predictable. Furthermore, while there is an abundant literature on the appropriate refinements one might make for accurately specifying the income-demand relationship for various items, attempts to adjust the large number of items analyzed here would be an expensive undertaking. So, both because of our principal interest centering on the aggregate shifts and our less than unlimited resources, no adjustment in any of the expenditure items was attempted at this time.

Two aspects of these detailed expenditure items do deserve attention. First, it has been repeatedly pointed out that, while education's effect has been assumed to be neutral (in the sense of affecting the productivity of all factors in all nonmarket production activities proportionately), it may not in fact be neutral, and if not, the empirical analysis should reveal the extent to which the neutrality model is an acceptable first approximation. The question arises, then: How would one expect the use of the more detailed expenditure items to affect the conformity of the empirical results with the neutrality model for any fixed degree of nonneutrality? In short, will the problem of the nonneutralities be exacerbated? Equation (1.18), which expresses the effect of the environmental variable, say education, on the demand for the market good, x_i, suggests that if education is biased toward or away from x_1,

a change in the share w_{x_1} has two effects.[1] These effects, through substitution in consumption and substitution in production, work in opposite directions and their net effect is not at all evident. If the commodities are presumed to be the same for these more detailed items as for the more aggregated ones, then the greater detail means a lower w_{x_i} for the item in question, and thus the effect of the greater disaggregation on $\tilde{x}_i$ (or ϵ_{iE}) is not a priori clear. That is, from this line of reasoning there appears to be no reason to anticipate greater difficulty from the nonneutrality with the more detailed classification of expenditures.

The second aspect of these more detailed items which deserves attention is the increased frequency of zero expenditures. While the procedure of using means from grouped data reduces the frequency of zeros considerably, the average expenditure on some narrowly defined items is frequently less than one dollar. Neither the zero expenditures nor the expenditures of a fraction of a dollar create any special problem in estimating linear or semilog functions,[2] but, when logarithms are used, the zeros cannot be manipulated and the high frequency of small positive expenditures increases the sensitivity to the manner in which the zeros are adjusted. Table 7 indicates the frequency of zero and fractional expenditures.

[1] Equation (1.18) can be written out as

$$\tilde{x}_i = \eta_i \tilde{Y}_e + \epsilon_i(\Pi_i/\Pi) - M\tilde{P}_{x_i} + w_{i_i}(\sigma + 1)(M\tilde{P}_{x_i} - M\tilde{P}_{i_i})$$

and, differentiating with respect to w_x,

$$\partial\tilde{x}_i/\partial w_{x_i} = \epsilon_i[\partial(\Pi_i/\Pi)/\partial w_{x_i}] - (\sigma + 1)(\tilde{M}P_{x_i} - \tilde{M}P_{i_i}).$$

The signs of these separate terms, when education is biased toward x_i, are

$$[(-)(-)] - [(+)(+)],$$

and if education is biased against x_i,

$$[(-)(+)] - [(+)(-)].$$

In neither case is the sign of the whole expression evident, nor would it be if the term $(\partial\sigma/\partial w_{x_i})$ were nonzero.

[2] There is, of course, the problem of interpretation arising from the fact that in many instances zero expenditures are made by persons who are appreciably different from those who do spend—nonsmokers, homeowners, and families with no children spend nothing on tobacco, rent, and children's clothing, respectively.

TABLE 7
Number of Observations With Average Expenditure Under One Dollar on an Expenditure Item

Item[a]	*Number of Observations with an Expenditure of*		*Total*	*Per Cent of Observations Spending Under One Dollar*
	Zero	*Fraction of One Dollar*		
11.	50	21	71	45.2
13.	30	27	57	36.3
10.	37	10	47	29.9
49.	23	15	38	24.2
23.	14	12	26	16.6
48.	8	15	23	14.6
47.	10	11	21	13.4
6.	15	3	18	11.5
21.	12	4	16	10.2
12.	10	4	14	8.9
28.	13	1	14	8.9
29.	14	0	14	8.9
44.	6	6	12	7.6
20.	11	1	12	7.6
37.	9	2	11	7.0
22.	7	3	10	6.4
41.	10	0	10	6.4
33.	8	1	9	5.7
5.	9	0	9	5.7
8.	7	1	8	5.1
19.	8	0	8	5.1
42.	4	4	8	5.1
7.	7	0	7	4.5
9.	7	0	7	4.5
18.	5	2	7	4.5
36.	6	1	7	4.5
3.	4	2	6	3.8
4.	6	0	6	3.8
43.	4	2	6	3.8
34.	5	0	5	3.2
35.	5	0	5	3.2
31.	4	0	4	2.5
25.	3	0	3	1.9

Note: All other items had two or less observations with zero expenditures and no observations with fractional expenditures.
[a] Items are defined in Table 6.

ELASTICITY ESTIMATES FOR DETAILED ITEMS

This section reports on the analysis of the Engel curves estimated for each of the fifty-two items where those observations that showed a zero expenditure were assigned an expenditure of one per cent per year.[3]

[3] This procedure differs from the one used in Chapter 4, which replaced the few existing zeros with a value of one dollar. The elasticities were also estimated for the detailed items using a one dollar figure where this was possible

For each of the fifty-two items listed in Table 6 several forms of the Engel curve were fitted. These were principally linear, semilog, constant elasticity, and constant elasticity with interaction (income-education and income-age) effects.[4] Since our main interest is in the relationship between income (consumption) elasticities and education elasticities, only those two coefficients will be presented in the tables that follow. Note, however, that in all cases the age of the head, the size of the family, and a South–non-South region dummy were also included linearly (unless their F ratio fell below the 0.005 level).

Table 8 presents the point estimates of the income elasticities, η_i, and the education elasticities, ϵ_{iE}, for fifty items obtained from weighted multiple regressions using the linear form. (The items are identified by numbers defined in Table 6). All these elasticities are computed at the mean values of the relevant variables.[5] The items "personal insurance" and "gifts" are not shown here in order to have a set of items that precisely exhausts the "total current consumption," C, and hence satisfies the constraint that the weighted income elasticity be unity (computationally, 0.9984) and the weighted average of the education elasticities be zero (computationally, —0.0016). Considering all fifty items in this linear form, we note that twenty-eight (56 per cent) of them, or 54 per cent of total consumption expenditure, exhibit the pre-

(i.e., where there were no fractional expenditures) and these are discussed later in this chapter.

Replacing the zeros with a small positive expenditure may appreciably affect the estimated coefficients compared to deleting the observations with zeros, especially where the frequency of zeros or small expenditures is high. (Such an item is "owned vacation homes," which has a mean of $4.71 per year and on which 45 per cent of the observations spent less than one dollar per year.)

[4] The specific forms estimated for each item separately were

linear: $X_j = a + b_1C_j + b_2E_j + b_3A_j + b_4F_j + b_5R_j + u_j$

semilog: $X_j = a + b_1 \ln C_j + b_2E_j + b_3A_j + b_4F_j + b_5R_j + u_j$

double log ($\ln E$): $\ln X_j = a + b_1 \ln C_j + b_2 \ln E_j + b_3A_j + b_4F_j + b_5R_j + u_j$

double log (E): $\ln X_j = a + b_1 \ln C_j + b_2E_j + b_3A_j + b_4F_j + b_5R_j + u_j$

interaction: $\ln X_j = a + b_1 \ln C_j + b_2 \ln E_j + b_3A_j + b_4F_j + b_5R_j + b_6 \ln C_j \ln E_j + b_7 \ln C_j \cdot A_j + u_j$

where X_j = mean expenditure by the jth observation; C_j, E_j, A_j, F_j, and R_j are the observations' mean total consumption expenditure, mean level of education of the head, mean age of the head, mean family size, and region (South = 1; non-South = 0), for $j = 1, \ldots, 157$.

[5] For item 34, E was deleted since its F ratio was <0.005.

TABLE 8
Point Estimates of Income and Education Elasticities, Linear Form[a]

Item[b]	Income Elasticity	Education Elasticity	Mean Expenditure	Item[b]	Income Elasticity	Education Elasticity	Mean Expenditure
1.	0.5280	−0.1397	989	26.	1.6595	−0.1101	192
2.	1.4450	−0.0211	245	27.	1.1867	0.1575	67
3.	1.4457	−0.3883	78	28.	0.6470	0.2448	124
4.	0.5280	−0.6007	91	29.	1.1319	−0.0883	301
5.	0.0423	−0.0367	263	30.	0.7832	−0.1584	396
6.	0.7710	1.1425	119	31.	2.3101	−0.3139	78
7.	1.3256	0.5345	99	32.	0.5613	0.1700	89
8.	1.4234	0.2619	27	33.	1.2272	−0.8504	47
9.	1.3356	−0.1718	88	34.	0.7302	0.0000	55
10.	1.4895	0.9734	17	35.	1.3490	0.6380	46
11.	3.3290	0.2347	5	36.	0.8245	0.0889	16
12.	3.1054	0.2701	35	37.	1.6251	−0.1877	16
13.	3.0082	0.3854	6	38.	0.5964	−0.1457	69
14.	0.4440	0.0838	249	39.	1.1412	−0.0189	65
15.	0.7978	0.2239	78	40.	0.5932	−0.1959	80
16.	2.6736	0.3680	105	41.	0.5424	−0.5069	38
17.	0.7553	0.0349	103	42.	1.1099	0.6516	33
18.	1.3106	0.1607	59	43.	1.5558	−0.0759	24
19.	1.0002	0.0637	76	44.	1.6696	0.1873	30
20.	0.6776	−0.1635	69	45.	1.5291	0.4945	75
21.	0.4074	−0.1925	7	46.	0.8328	0.6574	44
22.	1.6278	−0.7517	14	47.	3.0923	1.3583	32
23.	1.9035	0.1280	4	48.	0.7971	1.7852	10
24.	1.1619	0.2196	34	49.	3.2890	1.0242	11
25.	1.4643	−0.2263	137	50.	2.4964	−0.5013	111

[a] The estimates are computed at the point of means.
[b] Items defined in Table 6.

dicted qualitative relationship between η_i and ϵ_{iE}—no better than that which a random process might be expected to produce. Considering the magnitudes of the coefficients as well as their signs, the conformity is somewhat stronger, since the simple correlation between η_i and ϵ_{iE} is +0.226 (unweighted) and +0.142 (weighted by the expenditure shares). The quantitative estimate of the implied elasticity of consumption income will be presented below and discussed in comparison with estimates using other regression forms.

The Engel curves were also fitted using a semilog form, but in a vast majority of the cases the adjusted coefficient of determination was considerably lower than for the linear case, so this semilog form was not analyzed further. For seven of the fifty items the $\bar{R}^2$ was larger for the semilog form; their mean income and education elasticities, computed by the two methods, are compared in Table 9.

The Engel curves were also estimated assuming a constant income

TABLE 9
Semilog and Linear Elasticity Estimates

	Semilog Form			*Mean*	*Linear Form*		
Item[a]	η_i	ϵ_{iE}	$\bar{R}^2$	*Expenditure*	η_i	ϵ_{iE}	$\bar{R}^2$
4.	0.6277	−0.4826	.828	91	0.5280	−0.6007	.815
5.	0.1911	−0.1321	.570	263	0.0423	−0.0367	.562
21.	0.5096	−0.1399	.544	7	0.4074	−0.1925	.530
32.	0.6350	0.3090	.887	89	0.5613	0.1700	.884
38.	0.6949	0.0000[b]	.748	69	0.5964	−0.1457	.731
40.	0.6750	−0.0427	.924	80	0.5932	−0.1959	.919
41.	0.6163	−0.3612	.653	38	0.5424	−0.5069	.650

[a] Items defined in Table 6.
[b] Variable dropped since its F ratio < 0.005.

elasticity, with the education variable entered linearly or logarithmically. Table 10 gives the resulting estimates of the two elasticities where the form with the higher adjusted-R^2 is used. In those cases in which $\bar{R}^2$ was higher with education entered linearly, the elasticity was com-

TABLE 10
Constant Elasticities

Item[b]	*Income Elasticity*	*Education Elasticity*	*Mean Expenditure*	*Item*[b]	*Income Elasticity*	*Education Elasticity*	*Mean Expenditure*
1.[a]	0.6403	−0.2008	989	27.	1.2373	0.0673	67
2.	1.2299	0.1789	245	28.[a]	0.4301	−0.3815	124
3.[a]	1.6663	−0.8131	78	29.[a]	1.7611	−1.2889	301
4.[a]	0.7382	−0.9225	91	30.[a]	1.1685	−0.4698	396
5.	−0.0863	−0.4588	263	31.[a]	1.6251	−0.1566	78
6.[a]	1.6531	−0.2048	119	32.[a]	0.8589	−0.0562	89
7.	1.0765	0.6964	99	33.[a]	0.5734	−0.6033	47
8.	0.9389	0.6272	27	34.	0.7809	−0.1850	55
9.	0.8999	0.0802	88	35.	1.4162	0.3858	46
10.[a]	0.9885	−0.2660	17	36.	0.7086	0.1295	16
11.[a]	3.2212	−0.8071	5	37.	0.7267	0.1874	16
12.	2.1942	0.3401	35	38.	0.6624	−0.1658	69
13.[a]	2.2491	−0.0944	6	39.	1.0754	0.0451	65
14.	0.4249	0.1527	249	40.[a]	0.7954	−0.3082	80
15.	0.9510	0.1476	78	41.[a]	0.8450	−0.9777	38
16.[a]	1.4495	0.7479	105	42.[a]	1.3338	0.0833	33
17.	0.8067	−0.0093	103	43.[a]	1.7705	−0.3453	24
18.[a]	1.0751	0.0171	59	44.[a]	1.7410	−0.1124	30
19.	1.2367	−0.6644	76	45.	1.5101	0.3089	75
20.[a]	0.5962	−0.4106	69	46.[a]	1.1362	0.3614	44
21.[a]	0.6591	−0.8362	7	47.[a]	2.3595	1.0350	32
22.[a]	1.1398	−0.4306	14	48.[a]	0.4970	1.2899	10
23.	0.8142	0.4782	4	49.	2.5946	0.5388	11
24.[a]	0.9328	0.2068	34	50.[a]	1.2415	0.1004	111
25.[a]	1.2694	−0.2600	137	51.[a]	1.3432	0.0934	315
26.	1.3958	0.0983	192	52.	1.7030	0.0970	281

[a] E is entered linearly; ϵ_{iE} at the mean E; $\bar{E} = 10.0384$.
[b] Items defined in Table 6.

puted at the mean level of education. For this set of estimates, qualitatively thirty-one of the items (60 per cent), or 68 per cent of total expenditure, were consistent with the predictions from the neutrality model.[6] While these results are stronger than in the linear case, quantitatively they are weaker when measured by the simple correlations between the elasticities: +0.061 (unweighted) or +0.043 (weighted).

Table 11 shows the elasticities computed at the means using the interaction form and forcing all the explanatory variables into the re-

TABLE 11
Point Estimates of Income and Education Elasticities, Double-Log Form With Interaction Effects

Item[a]	*Income Elasticity*	*Education Elasticity*	*Mean Expenditure*	Item[a]	*Income Elasticity*	*Education Elasticity*	*Mean Expenditure*
1.	0.6239	−0.1814	989	27.	1.1902	0.1249	67
2.	1.2230	0.1933	245	28.	0.3293	−0.2889	124
3.	1.5754	−0.7554	78	29.	1.6323	−1.2168	301
4.	0.6001	−0.7875	91	30.	0.9928	−0.2279	396
5.	−0.0628	−0.4853	263	31.	1.3824	0.0685	78
6.	1.8253	−0.2788	119	32.	0.6879	0.1750	89
7.	1.3147	0.4575	99	33.	0.5177	−0.5642	47
8.	1.0645	0.5141	27	34.	0.8478	−0.2811	55
9.	0.8640	0.1323	88	35.	1.5288	0.2738	46
10.	2.0497	−1.2320	17	36.	0.6791	0.1669	16
11.	3.2974	−0.9445	5	37.	0.8082	0.0940	16
12.	1.9140	0.6357	35	38.	0.7505	−0.2669	69
13.	2.6497	−0.2550	6	39.	0.9399	0.1924	65
14.	0.4109	0.1660	249	40.	0.6786	−0.1390	80
15.	0.9655	0.1424	78	41.	0.6521	−0.7581	38
16.	1.4987	0.6074	105	42.	1.4126	−0.0245	33
17.	0.7934	0.0002	103	43.	1.4425	0.0626	24
18.	1.1084	−0.0514	59	44.	1.7642	−0.0473	30
19.	1.1006	−0.5709	76	45.	1.5874	0.2468	75
20.	0.7331	−0.5552	69	46.	1.1608	0.3561	44
21.	0.3144	−0.4857	7	47.	1.8122	1.4560	32
22.	1.0377	−0.3472	14	48.	0.4581	1.2284	10
23.	0.4948	0.7687	4	49.	2.5604	0.5999	11
24.	0.9617	0.1481	34	50.	1.4438	−0.2272	111
25.	1.2495	−0.2633	137	51.	1.3612	0.0106	315
26.	1.2486	0.2524	192	52.	1.6574	0.1413	281

[a] Items are defined in Table 6.

gression irrespective of their contribution to the total explanatory power of the equation. For this set of estimates twenty-eight (54 per cent) of the items, or 69 per cent of the total expenditure, were qualitatively consistent, while the correlations between η_i and ϵ_{iE} were again

[6] In this sense (with the sum of the expenditures used as weights) the total includes the two items "personal insurance" and "gifts." In no case, however, does the explanatory variable C include these items.

quite low and even negative in the unweighted case: — 0.048 (unweighted) and +0.080 (weighted).

Since the interaction form was computed stepwise[7] and was permitted to delete any variable whose F ratio was below 0.005, a separate set of elasticity estimates is shown in Table 12, which uses that step with the highest $\bar{R}^2$.[8] With these estimates twenty-nine items (56

TABLE 12
Point Estimates of Income and Education Elasticities, Double-Log Form With the Highest $\bar{R}^2$

Item[a]	Form[b]	Income Elasticity	Education Elasticity	Mean Expenditure	Item[a]	Form[b]	Income Elasticity	Education Elasticity	Mean Expenditure
1.	5	0.6420	−0.2008	989	27.	8	1.1869	0.1270	67
2.	5	1.2299	0.1789	245	28.	7	0.3293	−0.2889	124
3.	7	1.5754	−0.7554	78	29.	7	1.6323	−1.2168	301
4.	7	0.6001	−0.7875	91	30.	7	0.9928	−0.2279	396
5.	5	−0.0863	−0.4588	263	31.	7	1.3824	0.0685	78
6.	7	1.8253	−0.2788	119	32.	7	0.6879	0.1750	89
7.	7	1.3147	0.4575	99	33.	3	0.3236	−0.3926	47
8.	7	1.0645	0.5141	27	34.	8	0.8470	−0.2803	55
9.	4	0.9410	0.0687	88	35.	7	1.5288	0.2738	46
10.	7	2.0497	−1.2320	17	36.	5	0.7086	0.1295	16
11.	5	3.2482	−0.8381	5	37.	3	0.8618	0.1045	16
12.	8	1.9152	0.6340	35	38.	7	0.7505	−0.2669	69
13.	7	2.6497	−0.2550	6	39.	7	0.9399	0.1924	65
14.	5	0.4249	0.1527	249	40.	7	0.6786	−0.1390	80
15.	7	0.9655	0.1424	78	41.	7	0.6521	−0.7581	38
16.	7	1.4987	0.6074	105	42.	8	1.4123	−0.0260	33
17.	5	0.8067	−0.0093	103	43.	7	1.4425	0.0626	24
18.	6	1.1391	−0.0801	59	44.	7	1.7642	−0.0473	30
19.	7	1.1006	−0.5709	76	45.	7	1.5874	0.2468	75
20.	6	0.6485	−0.4808	69	46.	7	1.1608	0.3561	44
21.	7	0.3144	−0.4857	7	47.	7	1.8122	1.4560	32
22.	7	1.0377	−0.3472	14	48.	5	0.5644	1.1409	10
23.	7	0.4948	0.7687	4	49.	5	2.5946	0.5388	11
24.	6	0.9776	0.1349	34	50.	6	1.4577	−0.2399	111
25.	7	1.2495	−0.2633	137	51.	7	1.3612	0.0106	315
26.	7	1.2486	0.2524	192	52.	5	1.7030	0.0970	281

[a] Items are defined in Table 6.
[b] For the specific regression form, see footnotes 7 and 8.

[7] The order of entry of the explanatory variables was preassigned to be (1) ln C, (2) ln E, (3) A, (4) F, (5) R, (6) (ln C) (ln E), (7), (ln C)A.

[8] Here the linear estimates are not comparable (see p. 24) and were not considered. The second column in Table 12 indicates the step with the highest $\bar{R}^2$ where the last variable entered is seen from the previous footnote (i.e., a number 5 indicates the explanatory variables were ln C, ln E, A, F, R). For those items with a designation 8, some of the variables were forced out of the step since their F ratio <0.005. This occurred in four cases: in (12), (ln E) was dropped; in (27), (F) was dropped; in (34), (A) and (ln C) (A) were dropped; and in (42), (A) was dropped.

per cent), or 71 per cent of total expenditure, had the predicted sign, but again the correlation was small and even negative in the unweighted case: −0.006 (unweighted) and +0.096 (weighted).

Using each of the four sets of estimates of the income and education elasticities—from the linear, double-log, interaction, and highest $\bar{R}^2$ forms—the elasticity of consumption income was again estimated by regression. In addition to estimating this elasticity from equation (4.3), the regression was also run in the form

$$\epsilon_{iE} = a + b\eta_i + e_i, \tag{5.1}$$

since equation (4.3) is appropriate only when the weighted averages of the income and education elasticities are unity and zero, respectively. Table 13 summarizes these estimates of the elasticity of consumption income. These estimates (the slope coefficients b) vary considerably in the unweighted regressions, which give the same weight to each item regardless of the item's relative size in the consumption basket. The estimates in the weighted regressions, in three of the four cases, are quite similar, and also similar in magnitude to the estimate (0.084) from a weighted regression across the fifteen items discussed in the previous chapter. So, when estimated by weighted regression across the items in the consumption basket, the point estimate of the elasticity of consumption income is in the vicinity of 0.08, and, although not statistically significant, appears to be rather insensitive to the detail in which the consumption items are defined.

ELASTICITY ESTIMATES FOR COMPOSITE AND NONDURABLE ITEMS

This section reports on three modifications of the estimates given in the previous section: (1) replacing the zero values with an expenditure of one dollar per year; (2) grouping a few of the items into composites to reduce the frequency of extremely small or zero expenditures; and (3) estimating the elasticity of consumption income from a subset of nondurable items. The purpose of these few adjustments in the data was to obtain some further indication of the sensitivity of the estimates of ϵ_{Y_CE} to the treatment of the zeros and to the particular detail chosen for the expenditure items.

Replacing the zero expenditures by one dollar was possible only for those items that had no observations with positive average expenditures

TABLE 13
Summary of the Relationship Between Income and Education Elasticities Across Items

Set of Elasticity Estimates Used (Number of Items)	*Means*				*Simple Correlation*		*Regression Slope*[a]		
	Weighted		*Unweighted*		$(\epsilon_{iE}\eta_i)$		$\epsilon_{iE} = a + b\eta_i$		$\epsilon_{iE} = b(\eta_i - 1)$
	ϵ_{iE}	η_i	ϵ_{iE}	η_i	*Weighted*	*Unweighted*	*Weighted*	*Unweighted*	*Weighted*
Linear Table 8 (50)	−0.0016	0.9984	0.1339	1.3456	0.142	0.226	0.0769 (1.00)	0.1415 (1.60)	0.0769 (1.01)
Constant Table 10 (52)	−0.1581	1.0463	−0.0564	1.1934	0.043	0.061	0.0372 (0.30)	0.0513 (0.43)	0.0077 (0.06)
Interaction Table 11 (52)	−0.1296	1.0145	−0.0388	1.1757	0.094	−0.030	0.0786 (0.66)	−0.0248 (−0.21)	0.0708 (0.58)
Highest $\bar{R}^2$ Table 12 (52)	−0.1349	1.0196	−0.0392	1.1777	0.096	−0.006	0.0788 (0.68)	−0.0053 (−0.05)	0.0679 (0.56)

[a] t values are in parentheses.

of less than one dollar. There were twenty-nine such items.[9] The point estimates of the elasticities, using the highest $\bar{R}^2$ from the stepwise regression, are shown in Table 14. A comparison of these elasticities with their counterparts in Table 12 reveals that for these items the coefficients are only very slightly affected by the treatment of the zeros, and in nearly all cases the same "step" gave the highest value for $\bar{R}^2$.[10] (The summary estimates were not computed due to their evident similarity to those in the earlier table.)

TABLE 14
Elasticity Estimates With Zeros Replaced by a Yearly Expenditure of One Dollar

Item Number	η_i	ϵ_{iE}	*Mean Expenditure*	*Item Number*	η_i	ϵ_{iE}	*Mean Expenditure*
1.	0.6544	−0.2145	989	29.	1.7222	−1.0098	301
2.	1.2018	0.2242	245	30.	1.0023	−0.2413	396
4.	0.6065	−0.7213	91	31.	1.4010	0.0722	78
5.	0.1064	−0.3979	263	32.	0.7003	0.1579	89
7.	1.3462	0.4568	99	34.	0.8824	−0.2806	55
9.	0.9578	0.0680	88	35.	1.5697	0.2504	46
14.	0.4416	0.1316	249	38.	0.7551	−0.2762	69
15.	0.9698	0.1404	78	39.	0.9486	0.1842	65
16.	1.4853	0.6262	105	40.	0.6786	−0.1390	80
17.	0.8067	−0.0093	103	41.	0.6493	−0.6224	38
19.	1.0816	−0.4076	76	45.	1.5846	0.2694	75
24.	0.9910	0.1198	34	46.	1.1608	0.3561	44
25.	1.2522	−0.2520	137	51.	1.3703	−0.0051	315
26.	1.2612	0.2362	192	52.	1.7073	0.0895	281
27.	1.1869	0.1270	67				

Since the items with the most frequent zero expenditures were generally also those with frequent expenditures of a fraction of a dollar, the adjustment described in the previous paragraph was not made for them. Instead, a few of those items were combined into somewhat less detailed, homogeneous composite items which reduced the frequency of the zero and fraction expenditures. Table 15 indicates the items that were grouped and the resulting frequency of zeros and

[9] These may be identified from Table 7.

[10] There are four exceptions to this statement. In comparison with the results shown in Table 12, the four items had these changes in the highest $\bar{R}^2$ form when the zeros were replaced by one dollar (the numbers refer to the steps as defined in footnote 7, page 62): food away from home, step (6) instead of (8); automobile purchase, step (3) instead of (7); medical care–MD services, step (6) instead of (8); television, step (8) instead of (7), where (8) for television dropped the variable R.

TABLE 15
Definition of the Composite Items

Original Item	*Composite Item*	*Frequency of Zeros*	*Frequency of Fractions*	*Total*	*Per Cent of Observations Spending Less Than One Dollar*
Owned dwelling Repairs Other	Owned dwelling miscellaneous	7	–	7	4.5
Owned vacation home Lodging out of town Other real estate	Other housing	8	2	10	6.4
Housefurnishings Insurance Other	Housefurnishings miscellaneous	1	–	1	0.6
Spectator admissions Participation sports	Sports	3	2	5	3.2
Education–tuition Education–books Education–lessons	Education	5	9	14	8.9

fractions in the five composite items. The Engel curves were estimated for each of these five, and the elasticities, evaluated at the means, are shown in Table 16 for the interaction and the highest $\bar{R}^2$ forms.

In comparison with the twelve detailed items, these composites are much more consistent with a positive effect of education on nonmarket productivity. Of the twelve, for the interaction form, only 33 per cent

TABLE 16
Elasticity Estimates, Composite Items

Composite Item	*Mean Expenditures*	*Interaction Form*			*Highest* $\bar{R}^2$ [a]		
		η_i	ϵ_{iE}	$\bar{R}^2$	η_i	ϵ_{iE}	$\bar{R}^2$
Owned dwelling miscellaneous	105	1.0030	0.1413	.638	0.9493	0.1967	.641
Other housing	46	2.0559	0.7313	.815	2.0427	0.6454	.816
Housefurnishings miscellaneous	39	0.9202	0.2568	.932	0.9202	0.2568	.932
Sports	54	1.5905	0.0774	.938	1.6047	0.0625	.939
Education	53	1.5374	1.3352	.843	1.5374	1.3352	.843

[a] *Form used in highest* $\bar{R}^2$:

Owned dwelling miscellaneous	$\ln x_i = f(\ln C, \ln E, A, F)$
Other housing	$\ln x_i = f(\ln C, \ln E, A, R, \ln C \cdot \ln E, \ln C \cdot A)$
Housefurnishings miscellaneous	Interaction form
Sports	$\ln x_i = f(\ln C, \ln E, A, F, R, \ln C \cdot \ln E)$
Education	Interaction form

had the predicted sign; of the five composite items, 80 per cent had the correct sign.[11] Similarly, for the highest $\bar{R}^2$ the percentages of items conforming with the predicted signs rose from 33 per cent to 60 per cent. After substitution of these five items for their twelve subcomponents in both the interaction and highest $\bar{R}^2$ forms, the qualitative relationship between η_i and ϵ_{iE} was reestimated. The resulting weighted and unweighted means, correlations, and regression slopes (unconstrained and forced through the origin) are presented in Table 18. For these sets of forty-five items the weighted correlations are higher than for the previous sets (about 0.14 compared to 0.09), and the regression slopes are somewhat higher (0.11 instead of 0.07) and somewhat less insignificant. The unweighted results were even more affected, and now show a positive correlation and statistically significant slope in all four cases.

Since the discussion in Appendix B suggests that biases in the estimates of the income and education elasticities are particularly strong in durable goods, the nondurables were selected from the fifty-two items, using the highest $\bar{R}^2$ form for the thirty-five nondurable items (or 81 percent of total expenditure). Table 17 lists the items considered to be nondurables.[12] Of these thirty-five items, twenty-six (74 per cent), or 84 per cent of the expenditure on nondurables, had the expected sign.[13]

[11] Even in the comparison of the weighted averages of the originally estimated elasticities there were significant improvements in the conformity with the model for "owned dwellings miscellaneous" and "other housing." The weighted averages for the interaction form computed from Table 11 are:

Item	η_i	ϵ_{iE}
Owned dwellings miscellaneous	1.0559	−0.0885
Other housing	2.1603	0.3477
Housefurnishings miscellaneous	0.9125	0.2134
Sports	1.6212	0.0015
Education	1.7119	1.2353

[12] The criterion used in selecting the "nondurables" was whether the expenditure made this year on some item would be likely to be made again in the following and subsequent years. Whether an expenditure is essentially a repetitive one or not was, in some cases, not intuitively clear, and the set of nondurables chosen here might have been a slightly different set.

[13] Of the seventeen durable items only three—major appliances, small appliances, and television sets—were consistent with the hypothesis.

TABLE 17
Nondurable Items

Item Number	*Item*	*Item Number*	*Item*
1.	Food at home	32.	Medical–prepaid (premiums)
2.	Food away from home	33.	Medical–hospital
3.	Alcohol	34.	Medical–outside hospital
4.	Tobacco	35.	Medical–dental service
5.	Rent expenditure	38.	Medical–drugs
7.	Owned dwelling–taxes	39.	Personal care–services
8.	Owned dwelling–insurance	40.	Personal care–supplies
12.	Lodging out of town	43.	Spectator admissions
14.	Utilities	44.	Participation sports (equipment, fees)
15.	Telephone		
16.	Household services	45.	Club dues, hobbies, pets, toys, etc.
17.	Household supplies		
23.	Housefurnishings–insurance	46.	Reading
25.	Men's (age $\geq$ 18) clothing	47.	Education–tuition and fees
26.	Women's clothing	48.	Education–books, supplies
27.	Clothing upkeep and materials	49.	Education–music and special lessons
28.	Children's clothing		
30.	Automobile operations	51.	Personal insurance
31.	Public transportation	52.	Gifts and contributions

The summary statistics, relating the two elasticities quantitatively and estimating b or $\epsilon_{Y_C E}$, are given in Table 18. They show a relatively strong positive relationship—a weighted correlation of 0.53—and a statistically significant and relatively large regression slope of about 0.35.[14] This result suggests that the neutrality model is quite useful in interpreting the effect of education on the behavior of expenditures on these nondurable items.[15]

The iterative procedure discussed at the end of Chapter 4 was used again to obtain an estimate of the value of the consumption income

[14] This slope coefficient is smaller than that obtained from a nondurable subset reported in Table C.8, but the two sets are not really comparable since the latter one used nondurables taken from the less detailed set of items and presumably represented the nondurables less adequately.

Also, the set reported here did not use any of the composite items that probably would have further increased the positive relationship between the elasticity estimates. Since the composites were not used, the results shown for nondurables are most directly comparable to those for the set of highest $\bar{R}^2$ items in Table 12.

[15] The nondurables were also run for the set of constant elasticity estimates taken from Table 10. The results for the weighted regression were $b = 0.2834$ (2.51) with a correlation of 0.401, and, when forced through the origin, $b = 0.2881$ (2.52). The unweighted regression slope b was 0.2404 (1.71) with a correlation of 0.285. Thus, these nondurable estimates also show a strong positive relationship and a sizable elasticity of consumption income.

TABLE 18

Summary of the Relationship Between Income and Education Elasticities Across Items Composites and Nondurables

Set of Elasticity Estimates Used (Number of Items)	*Means*				*Simple Correlation* ($\epsilon_{iE}\eta_i$)		*Regression Slope*[a]		
	Weighted		*Unweighted*				$\epsilon_{iE} = a + b\eta_i$		$\epsilon_{iE} = b(\eta_i - 1)$
	ϵ_{iE}	η_i	ϵ_{iE}	η_i	*Weighted*	*Unweighted*	*Weighted*	*Unweighted*	*Weighted*
Interaction with composites (45)	−0.1202	1.0108	−0.0451	1.0663	0.141	0.342	0.1224 (0.93)	0.3457 (2.39)	0.1166 (0.86)
Highest $\bar{R}^2$ with composites (45)	−0.1232	1.0135	−0.0416	1.0633	0.136	0.336	0.1160 (0.90)	0.3283 (2.34)	0.1087 (0.82)
Highest $\bar{R}^2$ nondurables only (35)	−0.0439	0.9476	0.1239	1.1023	0.530	0.363	0.3509 (3.59)	0.3103 (2.24)	0.3566 (3.71)

[a] t values are in parentheses.

elasticity. Imposing the neutrality constraint for various values of K, equation (4.5) was estimated for each of the forty-five items that included the five "composites" and for each of the thirty-five nondurable items. Table 19 indicates the overall weighted residual sums of squares for given values of K in both cases. That value of K which minimizes this residual is similar in magnitude to the value indicated in Table 5 that utilized the set of fourteen broader expenditure categories. This iterative procedure suggests that the value of K, the esti-

TABLE 19
Overall Residual Sums of Squares of the Detailed Items, by Values of the Elasticity of Consumption Income K

	Weighted Residual Sum of Squares			*Weighted Residual Sum of Squares*	
Value of K	*45 Composites*	*35 Nondurables*	*Value of K*	*45 Composites*	*35 Nondurables*
−1.00	16.198	11.938	0.50	13.470	9.643
0.00	13.765	9.822	0.75	13.447	9.651
0.10	13.663	9.751	1.00	13.457	9.682
0.30	13.533	9.670	2.00	13.585	9.847
0.40	13.495	9.651	5.00	13.860	10.133

mate of the elasticity of consumption income, is in the range of 0.50 to 0.75. The detail in which the items are defined—fourteen broad items or forty-five more narrowly defined items—appears to have very little influence on the estimated magnitude of K. The estimate of this elasticity from the iterative procedure is significantly higher than the estimate obtained from the weighted regression across the independent items.[16] This was also the case in the previous chapter.

While these various point estimates of the effect of education on real full income through nonmarket efficiency—the consumption income elasticity—vary in magnitude with the different techniques of estimation, they appear to be broadly consistent with a positive effect. The estimates from a weighted regression across all items suggest a

[16] Employing the method discussed in footnote 22 of Chapter 4, the value of F is 152.15 for the forty-five composites, with an estimate of $K = 0.75$. Similarly, the F value is 92.89 for the thirty-five nondurables, with an estimate of $K = 0.50$. In both cases the value of K with the lowest residual variation shows a significant improvement over a value of zero.

If the standard errors of K are again estimated from these F values (see footnote 22, Chapter 4), they are $\hat{\sigma} = 0.061$ for the forty-five items, and $\hat{\sigma} = 0.052$ for the thirty-five nondurables.

very low magnitude which is not statistically significant. But when only nondurable goods are considered, the magnitude of this elasticity is about 0.35 and statistically different from zero. By contrast, the iterative procedure imposes neutrality with various values of the consumption income elasticity, and the value that minimizes the residual variation is in the range of 0.50 to 0.75. While these point estimates differ appreciably from one estimation technique to another, there is a tendency for the regression across items to imply a smaller value than that implied by the iterative procedure, while the detail in which the expenditure items are defined appears to have very little influence on the estimates. The following chapter briefly discusses additional evidence from other data sources.