UNIVERSITAT POMPEU FABRA
Facultat de Ciències Econòmiques i Empresarials

Departament d'Economia

Demand Analysis of Non-durable Goods. Relaxing Separability Assumptions.

Jordi Puig Gabau

1998

(2 de 3)

APPENDIX A.1 - SURVEY DESCRIPTION

Table A.1.1 - VARIATION IN DEMOGRAPHIC CHARACTERISTICS.

	% invariant hh.	% variant hh.
Non active head of hh.	98,2	1,8
Self-employed head of hh.	97,9	2,1
Unskilled head of hh.	96,1	3,9
Illiterated head of hh.	99,7	0,3
Primary studies	99,0	1,0
Secondary studies	98,8	1,2
Superior studies	99,5	0,5

Note: First column presents the percentage of total households (hh.) who do not vary in their position along quarters. On the contrary, second column presents the complementary information with the percentage of households that move from a given position in a quarter to any other in the following.

Table A.1.2 - PERCENTAGE OF ZERO RESPONSE.

	% zeros
Food & non alc.beverages	0,0
Alcoholic beverages	35,8
Clothing and footwear	7,3
Rents & house keeping	0,3
Fuel for housing	0,5
Transport and comunication	9,6
Services	1,4
House nondurables	18,6

Note: % zeros calculated upon the whole sample.

APPENDIX A.2 - PARAMETER ESTIMATES

Table A.2.1 - FOOD

	1	2	3	4	5	6	7	8
intercept	1,154	1,099						
	(0,016)	(0,020)						
food	0,122	0,116	0,079	0,078	0,091	0,144	0,076	0,017
	(0,052)	(0,052)	(0,060)	(0,060)	(0,061)	(0,035)	(0,060)	(0,067)
alcoholic bev.	0,021	0,018	0,031	0,031	0,036	0,005	0,032	0,016
	(0,034)	(0,034)	(0,035)	(0,035)	(0,035)	(0,009)	(0,035)	(0,040)
clothing	-0,045	-0,046	-0,085	-0,084	-0,096	0,001	-0,074	0,019
	(0,062)	(0,062)	(0,068)	(0,068)	(0,069)	(0,029)	(0,068)	(0,086)
housing	-0,086	-0,092	-0,010	-0,008	-0,036	-0,079	-0,007	0,133
	(0,084)	(0,085)	(0,110)	(0,110)	(0,111)	(0,036)	(0,110)	(0,142)
fuel	0,069	0,072	0,078	0,078	0,075	-0,008	0,087	0,149
	(0,044)	(0,044)	(0,047)	(0,047)	(0,047)	(0,012)	(0,047)	(0,056)
transp.-comunic.	-0,109	-0,109	-0,048	-0,050	-0,025	-0,002	-0,044	-0,169
	(0,060)	(0,059)	(0,061)	(0,061)	(0,063)	(0,024)	(0,062)	(0,072)
services	0,044	0,057	0,157	0,157	0,178	0,001	0,152	-0,119
	(0,081)	(0,081)	(0,089)	(0,089)	(0,090)	(0,034)	(0,089)	(0,106)
house non-durables	0,103	0,107	0,087	0,089	0,069	0,015	0,092	0,135
	(0,080)	(0,081)	(0,086)	(0,085)	(0,086)	(0,020)	(0,085)	(0,099)
expenditure	-0,117	-0,106	-0,103	-0,101	-0,125	-0,102	0,125	0,032
	(0,002)	(0,022)	(0,002)	(0,002)	(0,014)	(0,003)	(0,027)	(0,357)
square expenditure							-0,014	-0,002
							(0,002)	(0,023)
quarter 1	0,001	0,002	-0,000	-0,000	-0,002	0,002	-0,001	0,001
	(0,002)	(0,002)	(0,002)	(0,002)	(0,002)	(0,002)	(0,002)	(0,002)
quarter 2	0,004	0,004	0,001	0,001	-0,000	0,003	0,001	0,000
	(0,003)	(0,003)	(0,003)	(0,003)	(0,003)	(0,002)	(0,003)	(0,003)
quarter 3	0,000	-0,006	-0,001	-0,001	-0,002	0,000	-0,001	0,001
	(0,002)	(0,002)	(0,002)	(0,002)	(0,002)	(0,002)	(0,002)	(0,002)
self-umployed	0,014	-0,003						
	(0,003)	(0,004)						
unskilled	0,011	-0,005						
	(0,003)	(0,003)						
non active	0,032	0,010						
	(0,003)	(0,005)						
number earners	-0,006	-0,006						
	(0,001)	(0,002)						
number members	0,023	0,024						
	(0,001)	(0,002)						
n. members < 14	0,002	-0,005						
	(0,001)	(0,003)						
Price joint sig. χ^2 (8) (P-value)	114,7 (0)	83,3 (0)	41,9 (0)	41,8 (0)	43,0 (0)		41,8 (0)	45,0 (0)

Homogeneity F-test 5,03 [34]
Hausman-test 148,26 [35]
Autocorrelation test 5,89 [36]

	7	8
Rank 3 integrability test δ_i/β_i	-0,115	-0,262
	(0,019)	(2,434)

Note: Standard errors are in parentheses

[34] The test for the presence of individual effects follows an F with 5377,26872 d.f.; The tabulated value is 1.0.

[35] This test of fixed effects versus random effects follows a Chi-square with 18 d.f. The tabulated value is 28,87 at a confidence level of 95%.

Table A.2.2 - ALCOHOLIC BEVERAGES

	1	2	3	4	5	6	7	8
intercept	0,031	0,019						
	(0,003)	(0,018)						
food	-0,000	-0,002	-0,001	-0,001	0,001	0,005	-0,003	-0,011
	(0,011)	(0,011)	(0,013)	(0,013)	(0,013)	(0,010)	(0,013)	(0,015)
alcoholic bev.	-0,011	-0,012	-0,009	-0,010	-0,009	-0,016	-0,011	-0,023
	(0,008)	(0,008)	(0,008)	(0,008)	(0,008)	(0,007)	(0,008)	(0,009)
clothing	-0,003	-0,003	-0,007	-0,007	-0,008	0,002	-0,004	-0,004
	(0,013)	(0,013)	(0,015)	(0,015)	(0,015)	(0,011)	(0,015)	(0,018)
housing	-0,015	-0,015	-0,024	-0,023	-0,027	-0,007	-0,019	0,012
	(0,017)	(0,017)	(0,024)	(0,024)	(0,024)	(0,015)	(0,024)	(0,030)
fuel	0,004	0,004	0,005	0,006	0,005	-0,003	0,006	0,009
	(0,010)	(0,010)	(0,010)	(0,010)	(0,010)	(0,006)	(0,010)	(0,012)
transp.-comunic.	0,016	0,017	0,016	0,016	0,019	0,010	0,017	0,032
	(0,013)	(0,013)	(0,013)	(0,013)	(0,014)	(0,010)	(0,013)	(0,016)
services	0,010	0,011	0,009	0,009	0,012	0,019	0,010	-0,013
	(0,017)	(0,017)	(0,019)	(0,019)	(0,020)	(0,015)	(0,019)	(0,023)
house nondurables	0,016	0,019	0,014	0,014	0,012	0,011	0,017	0,038
	(0,017)	(0,017)	(0,018)	(0,018)	(0,019)	(0,009)	(0,018)	(0,021)
expenditure	-0,003	-0,000	0,000	0,001	-0,002	0,000	0,024	0,169
	(0,000)	(0,000)	(0,000)	(0,001)	(0,003)	(0,001)	(0,006)	(0,078)
square expenditure							-0,001	-0,011
							(0,000)	(0,005)
quarter 1	-0,003	-0,003	-0,003	-0,003	-0,003	-0,002	-0,003	-0,003
	(0,000)	(0,000)	(0,000)	(0,000)	(0,000)	(0,000)	(0,000)	(0,000)
quarter 2	-0,003	-0,003	-0,003	-0,003	-0,003	-0,002	-0,003	-0,004
	(0,001)	(0,001)	(0,001)	(0,001)	(0,001)	(0,000)	(0,001)	(0,001)
quarter 3	-0,001	-0,001	-0,002	-0,001	-0,002	-0,001	-0,001	-0,002
	(0,000)	(0,000)	(0,000)	(0,000)	(0,000)	(0,000)	(0,000)	(0,000)
self-umployed	0,002	0,000						
	(0,001)	(0,001)						
unskilled	0,001	-0,001						
	(0,001)	(0,001)						
non active	0,002	0,000						
	(0,000)	(0,001)						
number earners	0,001	0,000						
	(0,000)	(0,000)						
number members	-0,000	-0,001						
	(0,000)	(0,000)						
n. members < 14	0,000	-0,000						
	(0,000)	(0,000)						
Price joint sig. χ^2 (8) (P-value)	13,4 (0,1)	10,4 (0,2)	9,5 (0,3)	9,5 (0,3)	9,6 (0,3)		9,6 (0,3)	13,1 (0,1)

Homogeneity F-test	3,17	Rank 3 integrability test δ_i/β_i	-0,062	-0,063
Hausman-test	100,19		(0,001)	(0,000)
Autocorrelation test	1,51	Note: Standard errors are in parentheses		

[36]Sargan-test for the strong exogeneity of total expenditure. This follows a Chi-square with 1 d.f.

Table A.2.3 - CLOTHING

	1	2	3	4	5	6	7	8
intercept	-0,226	-0,400						
	(0,014)	(0,078)						
food	-0,016	-0,024	-0,088	-0,086	-0,087	0,001	-0,091	-0,096
	(0,049)	(0,049)	(0,059)	(0,059)	(0,060)	(0,029)	(0,059)	(0,068)
alcoholic bev.	-0,030	-0,031	-0,042	-0,041	-0,043	0,002	-0,042	-0,018
	(0,034)	(0,034)	(0,035)	(0,035)	(0,035)	(0,011)	(0,035)	(0,042)
clothing	0,102	0,099	0,105	0,104	0,108	-0,034	0,113	0,002
	(0,056)	(0,057)	(0,066)	(0,066)	(0,066)	(0,045)	(0,066)	(0,084)
housing	-0,021	-0,015	0,267	0,265	0,267	-0,054	0,281	0,322
	(0,073)	(0,073)	(0,108)	(0,108)	(0,109)	(0,040)	(0,108)	(0,143)
fuel	0,042	0,042	0,033	0,032	0,034	-0,044	0,046	-0,013
	(0,043)	(0,043)	(0,046)	(0,046)	(0,046)	(0,014)	(0,046)	(0,056)
transp.-comunic.	0,047	0,032	0,008	0,011	0,006	0,011	0,019	0,109
	(0,058)	(0,057)	(0,060)	(0,060)	(0,062)	(0,029)	(0,060)	(0,072)
services	-0,014	-0,019	-0,074	-0,072	-0,078	0,086	-0,089	0,024
	(0,079)	(0,079)	(0,087)	(0,087)	(0,088)	(0,040)	(0,087)	(0,107)
house nondurables	0,187	0,212	0,213	0,211	0,214	-0,012	0,219	0,211
	(0,077)	(0,077)	(0,083)	(0,083)	(0,084)	(0,020)	(0,083)	(0,098)
expenditure	0,045	0,069	0,076	0,073	0,079	0,075	0,376	-0,116
	(0,001)	(0,002)	(0,002)	(0,002)	(0,013)	(0,003)	(0,027)	(0,361)
square expenditure							-0,019	0,012
							(0,002)	(0,023)
quarter 1	-0,001	-0,001	0,001	0,001	0,001	0,003	0,000	-0,002
	(0,002)	(0,002)	(0,002)	(0,002)	(0,002)	(0,002)	(0,002)	(0,002)
quarter 2	-0,006	-0,007	-0,011	-0,007	-0,007	-0,004	-0,008	-0,010
	(0,002)	(0,003)	(0,003)	(0,003)	(0,003)	(0,002)	(0,003)	(0,003)
quarter 3	-0,017	-0,018	-0,016	-0,016	-0,016	-0,017	-0,016	-0,019
	(0,002)	(0,002)	(0,002)	(0,002)	(0,002)	(0,002)	(0,002)	(0,002)
self-umployed	0,005	0,008						
	(0,002)	(0,004)						
unskilled	0,010	0,003						
	(0,002)	(0,003)						
non active	0,001	-0,003						
	(0,002)	(0,005)						
number earners	0,006	0,008						
	(0,001)	(0,002)						
number members	0,001	-0,002						
	(0,001)	(0,002)						
n. members < 14	-0,006	-0,001						
	(0,001)	(0,002)						
Price joint sig. χ^2 (8) (P-value)	33,4 (0)	25,3 (0)	11,8 (0,2)	11,6 (0,2)	11,7 (0,2)		12,6 (0,1)	24,1 (0)

Homogeneity F-test	2,27	Rank 3 integrability test δ_i/β_i	-0,050	-0,102
Hausman-test	378,51		(0,001)	(0,132)
Autocorrelation test	4,87	Note: Standard errors are in parentheses		

Table A.2.4 - HOUSING

	1	2	3	4	5	6	7	8
intercept	0,476	0,564						
	(0,016)	(0,018)						
food	-0,080	-0,074	-0,073	-0,073	-0,101	-0,079	-0,046	-0,065
	(0,047)	(0,047)	(0,051)	(0,051)	(0,053)	(0,036)	(0,051)	(0,052)
alcoholic bev.	0,052	0,056	0,064	0,064	0,055	-0,007	0,067	0,085
	(0,030)	(0,030)	(0,030)	(0,030)	(0,031)	(0,015)	(0,030)	(0,059)
clothing	-0,086	-0,089	-0,101	-0,101	-0,084	-0,054	-0,107	-0,070
	(0,058)	(0,058)	(0,061)	(0,061)	(0,063)	(0,040)	(0,060)	(0,036)
housing	0,010	0,007	-0,146	-0,147	-0,094	-0,014	-0,188	-0,207
	(0,082)	(0,083)	(0,098)	(0,098)	(0,101)	(0,076)	(0,097)	(0,079)
fuel	-0,062	-0,062	-0,050	-0,050	-0,044	-0,070	-0,058	-0,006
	(0,039)	(0,039)	(0,041)	(0,041)	(0,042)	(0,019)	(0,041)	(0,132)
transp.-comunic.	-0,024	-0,020	-0,035	-0,035	-0,076	0,001	-0,041	-0,127
	(0,054)	(0,054)	(0,055)	(0,055)	(0,057)	(0,038)	(0,054)	(0,051)
services	0,024	0,017	0,008	0,009	-0,030	0,060	0,026	-0,074
	(0,074)	(0,075)	(0,079)	(0,079)	(0,081)	(0,054)	(0,078)	(0,067)
house nondurables	-0,168	-0,179	-0,084	-0,085	-0,045	0,007	-0,116	-0,123
	(0,073)	(0,073)	(0,076)	(0,076)	(0,078)	(0,031)	(0,075)	(0,097)
expenditure	-0,029	-0,044	-0,055	-0,055	-0,014	-0,054	-0,710	0,096
	(0,001)	(0,019)	(0,002)	(0,002)	(0,012)	(0,004)	(0,023)	(0,316)
square expenditure							0,041	-0,009
							(0,001)	(0,020)
quarter 1	-0,007	-0,003	-0,008	-0,008	-0,005	-0,009	-0,007	-0,007
	(0,002)	(0,002)	(0,002)	(0,002)	(0,002)	(0,001)	(0,002)	(0,002)
quarter 2	-0,008	-0,004	-0,009	-0,009	-0,006	-0,010	-0,007	-0,007
	(0,002)	(0,003)	(0,002)	(0,002)	(0,003)	(0,002)	(0,002)	(0,003)
quarter 3	0,000	0,004	-0,001	-0,001	0,002	-0,000	-0,000	-0,001
	(0,002)	(0,002)	(0,002)	(0,002)	(0,002)	(0,001)	(0,002)	(0,002)
self-umployed	-0,008	-0,002						
	(0,003)	(0,004)						
unskilled	-0,011	-0,002						
	(0,002)	(0,003)						
non active	-0,002	0,009						
	(0,003)	(0,004)						
number earners	-0,006	-0,005						
	(0,001)	(0,002)						
number members	-0,011	-0,014						
	(0,001)	(0,003)						
n. members < 14	-0,002	-0,003						
	(0,001)	(0,003)						
Price joint sig. χ^2 (8) (P-value)	53,9 (0)	33,5 (0)	18,3 (0)	18,3 (0)	17,9 (0)		20,1 (0)	22,8 (0)

Homogeneity F-test	8,76	Rank 3 integrability test δ_i/β_i	-0,058	-0,097
Hausman-test	504,04		(0,001)	(0,142)
Autocorrelation test	3,48	Note: Standard errors are in parentheses		

Table A.2.5 - FUEL

	1	2	3	4	5	6	7	8
intercept	0,202	0,234						
	(0,004)	(0,023)						
food	-0,025	-0,024	0,000	0,000	0,004	-0,008	0,002	-0,006
	(0,014)	(0,014)	(0,017	(0,017)	(0,017)	(0,012)	(0,017)	(0,020)
alcoholic bev.	-0,028	-0,028	-0,019	-0,020	-0,018	-0,003	-0,020	-0,024
	(0,009)	(0,009)	(0,010	(0,010)	(0,010)	(0,006)	(0,010)	(0,012)
clothing	-0,018	-0,018	-0,040	-0,040	-0,043	-0,044	-0,041	-0,014
	(0,016)	(0,016)	(0,018	(0,018)	(0,018)	(0,014)	(0,018)	(0,024)
housing	-0,030	-0,029	-0,086	-0,086	-0,092	-0,070	-0,088	-0,054
	(0,021)	(0,021)	(0,029	(0,023)	(0,030)	(0,019)	(0,029)	(0,041)
fuel	0,013	0,012	0,001	0,001	-0,000	0,003	0,001	0,015
	(0,012)	(0,012)	(0,013	(0,013)	(0,013)	(0,010)	(0,013)	(0,016)
transp.-comunic.	0,034	0,036	0,062	0,061	0,067	0,048	0,063	0,036
	(0,016)	(0,016)	(0,017	(0,017)	(0,017)	(0,014)	(0,017)	(0,021)
services	0,053	0,053	0,111	0,111	0,117	0,078	0,113	0,071
	(0,022)	(0,022)	(0,024	(0,024)	(0,024)	(0,020)	(0,024)	(0,031)
house nondurables	0,038	0,034	0,007	0,008	0,003	0,003	0,006	-0,001
	(0,021)	(0,021)	(0,023	(0,023)	(0,023)	(0,012)	(0,023)	(0,028)
expenditure	-0,021	-0,024	-0,026	-0,026	-0,030	-0,026	-0,108	0,048
	(0,000)	(0,003)	(0,001	(0,001)	(0,004)	(0,001)	(0,007)	(0,103)
square expenditure							0,005	-0,005
							(0,000)	(0,007)
quarter 1	0,005	0,005	0,004	0,004	0,004	0,004	0,004	0,005
	(0,000)	(0,001)	(0,001)	(0,001)	(0,001)	(0,001)	(0,001)	(0,001)
quarter 2	0,002	0,002	0,002	0,002	0,001	0,002	0,002	0,002
	(0,001)	(0,001)	(0,001)	(0,001)	(0,001)	(0,001)	(0,001)	(0,001)
quarter 3	-0,002	-0,003	-0,003	-0,003	-0,003	-0,003	-0,003	-0,003
	(0,000)	(0,001)	(0,001)	(0,001)	(0,001)	(0,000)	(0,001)	(0,002)
self-umployed	-0,000	-0,001						
	(0,001)	(0,001)						
unskilled	-0,002	0,000						
	(0,001)	(0,001)						
non active	0,001	0,001						
	(0,001)	(0,001)						
number earners	0,000	-0,000						
	(0,000)	(0,000)						
number members	0,000	-0,000						
	(0,000)	(0,001)						
n. members < 14	0,000	0,000						
	(0,000)	(0,001)						
Price joint sig. χ^2 (8)								
(P-value)	71,7 (0)	65,5 (0)	111,4 (0)	110,9 (0)	88,4 (0)		113,9 (0)	34,7 (0)

Homogeneity F-test	2,94	Rank 3 integrability test δ_i/β_i	-0,047	-0,096
Hausman-test	163,89		(0,001)	(0,076)
Autocorrelation test	4,35			

Note: Standard errors are in parentheses

Table A.2.6 - TRANSPORT & COMUNICATION

	1	2	3	4	5	6	7	8
intercept	-0,126	-0,214						
	(0,011)	(0,014)						
food	0,007	0,010	0,000	-0,002	0,008	-0,002	-0,003	0,054
	(0,036)	(0,036)	(0,044)	(0,044)	(0,045)	(0,024)	(0,045)	(0,050)
alcoholic bev.	-0,003	-0,003	-0,010	-0,011	-0,007	0,010	-0,007	0,017
	(0,025)	(0,025)	(0,026)	(0,026)	(0,026)	(0,010)	(0,026)	(0,031)
clothing	0,016	0,019	0,044	0,045	0,037	0,011	0,041	0,024
	(0,042)	(0,042)	(0,049)	(0,049)	(0,049)	(0,029)	(0,049)	(0,063)
housing	-0,017	-0,019	0,020	0,024	0,003	0,001	0,023	-0,158
	(0,053)	(0,053)	(0,080)	(0,080)	(0,081)	(0,038)	(0,080)	(0,106)
fuel	-0,025	-0,025	-0,023	-0,023	-0,025	0,048	-0,021	-0,062
	(0,032)	(0,032)	(0,035)	(0,035)	(0,035)	(0,014)	(0,035)	(0,042)
transp.-comunic.	0,025	0,019	0,002	-0,002	0,016	-0,012	0,002	0,024
	(0,043)	(0,042)	(0,045)	(0,045)	(0,046)	(0,039)	(0,045)	(0,054)
services	-0,036	-0,038	-0,090	-0,093	-0,077	0,011	-0,095	0,062
	(0,058)	(0,059)	(0,065)	(0,065)	(0,066)	(0,040)	(0,065)	(0,079)
house nondurables	-0,064	-0,056	-0,051	-0,048	-0,063	-0,052	-0,047	-0,093
	(0,057)	(0,057)	(0,062)	(0,062)	(0,063)	(0,018)	(0,062)	(0,073)
expenditure	0,024	0,035	0,036	0,040	0,023	0,035	-0,002	0,577
	(0,001)	(0,002)	(0,001)	(0,002)	(0,010)	(0,002)	(0,020)	(0,267)
square expenditure							0,002	0,039
							(0,001)	(0,017)
quarter 1	0,005	0,006	0,006	0,007	0,005	0,005	0,006	0,008
	(0,001)	(0,001)	(0,001)	(0,001)	(0,002)	(0,001)	(0,001)	(0,002)
quarter 2	0,007	0,008	0,008	0,008	0,007	0,008	0,008	0,012
	(0,002)	(0,002)	(0,002)	(0,002)	(0,002)	(0,001)	(0,002)	(0,002)
quarter 3	0,008	0,009	0,009	0,010	0,009	0,009	0,009	0,011
	(0,001)	(0,001)	(0,001)	(0,001)	(0,001)	(0,001)	(0,001)	(0,002)
self-umployed	-0,006	-0,000						
	(0,001)	(0,003)						
unskilled	-0,003	-0,002						
	(0,002)	(0,002)						
non active	-0,012	-0,003						
	(0,001)	(0,003)						
number earners	0,002	0,001						
	(0,001)	(0,001)						
number members	-0,005	-0,004						
	(0,001)	(0,002)						
n. members < 14	0,002	0,001						
	(0,001)	(0,002)						
Price joint sig. χ^2 (8) (P-value)	20,4 (0)	20,6 (0)	10,7 (0,2)	10,9 (0,2)	9,7 (0,3)		10,6 (0,2)	12,1 (0,1)

Homogeneity F-test	2,06		Rank 3 integrability test δ_i/β_i	-1,006	-0,067
Hausman-test	128,56			(18,010)	(0,002)
Autocorrelation test	5,39		Note: Standard errors are in parentheses		

Table A.2.7 - SERVICES

	1	2	3	4	5	6	7	8
intercept	-0,211	-0,127						
	(0,016)	(0,020)						
food	-0,020	-0,012	0,075	0,076	0,043	0,001	0,071	0,084
	(0,051)	(0,051)	(0,059)	(0,060)	(0,060)	(0,034)	(0,060)	(0,066)
alcoholic bev.	0,024	0,025	0,013	0,013	0,001	0,019	0,012	-0,020
	(0,035)	(0,035)	(0,035)	(0,035)	(0,035)	(0,015)	(0,035)	(0,040)
clothing	-0,001	0,006	0,037	0,036	0,062	0,086	0,042	0,006
	(0,061)	(0,061)	(0,068)	(0,068)	(0,069)	(0,040)	(0,068)	(0,085)
housing	0,085	0,088	-0,087	-0,089	-0,023	0,060	-0,076	-0,048
	(0,082)	(0,083)	(0,110)	(0,110)	(0,111)	(0,054)	(0,110)	(0,141)
fuel	-0,015	-0,019	-0,061	-0,062	-0,055	0,078	-0,056	-0,076
	(0,044)	(0,044)	(0,047)	(0,047)	(0,047)	(0,020)	(0,047)	(0,056)
transp.-comunic.	0,065	0,069	0,067	0,069	0,009	0,011	0,077	0,187
	(0,059)	(0,060)	(0,061)	(0,061)	(0,063)	(0,040)	(0,061)	(0,072)
services	-0,034	-0,046	-0,005	-0,004	-0,054	-0,045	-0,005	0,077
	(0,081)	(0,081)	(0,088)	(0,088)	(0,090)	(0,075)	(0,089)	(0,105)
house nondurables	-0,073	-0,082	-0,153	-0,155	-0,108	-0,021	-0,148	-0,071
	(0,080)	(0,081)	(0,085)	(0,085)	(0,086)	(0,027)	(0,085)	(0,098)
expenditure	0,045	0,032	0,040	0,038	0,094	0,041	0,260	0,605
	(0,002)	(0,002)	(0,002)	(0,002)	(0,013)	(0,003)	(0,027)	(0,355)
square expenditure							-0,014	-0,036
							(0,002)	(0,022)
quarter 1	-0,001	-0,002	0,001	0,000	0,005	-0,001	0,000	-0,002
	(0,002)	(0,002)	(0,002)	(0,002)	(0,002)	(0,002)	(0,002)	(0,002)
quarter 2	0,002	0,001	0,006	0,006	0,009	0,004	0,005	0,003
	(0,003)	(0,003)	(0,003)	(0,003)	(0,003)	(0,002)	(0,003)	(0,003)
quarter 3	0,014	0,013	0,015	0,015	0,019	0,015	0,015	0,014
	(0,002)	(0,002)	(0,002)	(0,002)	(0,002)	(0,002)	(0,002)	(0,002)
self-umployed	-0,006	0,005						
	(0,003)	(0,004)						
unskilled	-0,003	0,005						
	(0,002)	(0,003)						
non active	-0,033	-0,008						
	(0,002)	(0,005)						
number earners	0,006	0,003						
	(0,001)	(0,002)						
number members	-0,001	-0,001						
	(0,001)	(0,003)						
n. members < 14	0,008	0,011						
	(0,001)	(0,003)						
Price joint sig. χ^2 (8) (P-value)	65,5 (0)	57,7 (0)	18,7 (0)	18,8 (0)	10,1 (0,2)		18,4 (0)	23,3 (0)

Homogeneity F-test	4,11	Rank 3 integrability test δ_i/β_i	-0,053	-0,059
Hausman-test	156,42		(0,002)	(0,002)
Autocorrelation test	4,99			

Note: Standard errors are in parentheses

Table A.2.8 - HOUSE NON-DURABLES

	1	2	3	4	5	6	7	8
intercept	0,025	0,046						
	(0,006)	(0,031)						
food	0,028	0,026	0,019	0,019	0,025	0,015	0,017	0,009
	(0,018)	(0,018)	(0,021)	(0,021)	(0,021)	(0,020)	(0,021)	(0,023)
alcoholic bev.	0,006	0,005	0,006	0,007	0,009	0,011	0,006	0,003
	(0,012)	(0,012)	(0,012)	(0,012)	(0,012)	(0,009)	(0,012)	(0,014)
clothing	-0,025	-0,024	-0,040	-0,040	-0,044	0,007	-0,039	-0,040
	(0,022)	(0,022)	(0,024)	(0,024)	(0,024)	(0,031)	(0,024)	(0,030)
housing	-0,022	-0,018	-0,012	-0,011	-0,023	0,007	-0,009	0,010
	(0,029)	(0,029)	(0,039)	(0,039)	(0,040)	(0,031)	(0,039)	(0,050)
fuel	-0,009	-0,009	-0,001	-0,001	-0,002	0,003	0,000	0,004
	(0,015)	(0,015)	(0,017)	(0,017)	(0,017)	(0,012)	(0,017)	(0,019)
transp.-comunic.	-0,051	-0,047	-0,054	-0,054	-0,043	-0,052	-0,052	-0,074
	(0,021)	(0,021)	(0,022)	(0,022)	(0,022)	(0,018)	(0,022)	(0,025)
services	0,025	0,023	0,024	0,023	0,032	-0,021	0,021	0,020
	(0,028)	(0,029)	(0,031)	(0,031)	(0,032)	(0,027)	(0,031)	(0,037)
house non-durables	-0,035	-0,039	-0,036	-0,036	-0,045	-0,033	-0,032	-0,041
	(0,028)	(0,028)	(0,030)	(0,030)	(0,030)	(0,027)	(0,030)	(0,034)
expenditure	-0,001	-0,172	-0,002	-0,001	-0,011	-0,002	0,072	0,135
	(0,001)	(0,001)	(0,001)	(0,001)	(0,005)	(0,001)	(0,009)	(0,124)
square expenditure							-0,005	-0,009
							(0,001)	(0,008)
quarter 1	0,002	0,002	0,002	0,002	0,001	0,002	0,001	0,002
	(0,001)	(0,001)	(0,001)	(0,001)	(0,001)	(0,001)	(0,001)	(0,001)
quarter 2	0,003	0,003	0,002	0,002	0,002	0,003	0,002	0,002
	(0,001)	(0,001)	(0,001)	(0,001)	(0,001)	(0,001)	(0,001)	(0,001)
quarter 3	0,002	0,002	0,001	0,001	0,001	0,002	0,001	0,002
	(0,001)	(0,001)	(0,001)	(0,001)	(0,001)	(0,001)	(0,001)	(0,001)
self-umployed	-0,001	-0,002						
	(0,001)	(0,002)						
unskilled	-0,000	-0,001						
	(0,001)	(0,001)						
non active	0,004	-0,000						
	(0,001)	(0,002)						
number earners	0,001	-0,001						
	(0,000)	(0,001)						
number members	0,001	-0,001						
	(0,000)	(0,001)						
n. members < 14	-0,004	-0,001						
	(0,000)	(0,001)						
Price joint sig. χ^2 (8) (P-value)	34,9 (0)	23,6 (0)	17,6 (0)	17,6 (0)	12,6 (0,1)		17,4 (0)	22,6 (0)

Homogeneity F-test	4,18	Rank 3 integrability test δ_i/β_i	-0,064	-0,064
Hausman-test	108,65		(0,001)	(0,001)
Autocorrelation test	5,15	Note: Standard errors are in parentheses		

CHAPTER 3 - PRACTICAL IMPLICATIONS OF LATENT SEPARABILITY WITH APPLICATION TO SPANISH DATA

3.1 - INTRODUCTION

It is usual in the empirical investigation of demand analysis to impose weak separability. This is done with the aim of grouping goods and prices. There are advantages and shortcomings of imposing weak separability. The first consequence (an advantage) is to make tractable problems that are difficult to manage without this assumption. The second, which must be viewed as a shortcoming, is that possible substitution effects among goods are completely hidden. In fact, looking at the individual decisions in a household production framework, we could think of the purchases of some goods as inputs for elaborating other goods rather than as consumption themselves. For instance, one buys petrol or transport services for going to work or holidays or one buys oil or salt for making more elaborated food. In this sense, weak separability avoids that all price effects enter all the demand equations.

There are also empirical reasons which impose the need of invoking weak separability. A common characteristic of recently done exercises, shared by the research in our work, is the use of data at household level. When a high disaggregation of commodities is used, the problem with zero expenditure records is severe. This imposes the necessity to consider broader aggregates than it would be desirable, thus using weak separability. Second, in a short time period and with a high number of commodities entering the demand system, the multicolinearity problem makes difficult to identify all price effects. This restricts the usefulness of estimated demand systems for welfare or revenue analyses, for instance. Again, weak separability plays a fundamental role in grouping the goods.

This chapter presents the estimation of a complete demand system using a new separability concept recently proposed by Blundell and Robin (1997a). Latent separability implies to construct broader aggregates in such a way that the so-called exclusive goods enter one single commodity group whereas the non-exclusive may enter in a non-restricted way all aggregates. We first estimate the Quadratic Almost

Ideal Demand System (QUAIDS) of Banks, Blundell and Lewbel (1997) under weak separability and then, we decide the exclusive groups on which to estimate the latent separable system. As we reject weak separability, we think latent separability could be a useful criterion for grouping related goods and prices. However, the decision about the exclusive goods is completely subjective. Then, we test whether changing the composition, not the number, of exclusive goods affects the estimates.[37] We look at the decomposition matrix and the observed differences are due to the different composition of the aggregates depending on the selected non-exclusive goods. We do think that we should find differences in the estimated elasticities derived for all the different aggregations and those obtained assuming weak separability between the exclusive and non-exclusive goods.

Several reasons qualify the use of a type of Almost Ideal Model of demand. The functional form for preferences of this model is flexible enough and avoids the restriction imposed by additive separability (see Deaton, 1974, Deaton and Muellbauer, 1980a or Gorman, 1981). Moreover, the quadratic extension permits more flexible income (total expenditure) responses because it allows elasticities to depend on expenditure levels, thus classifying goods as necessities or luxuries according to. But even with flexible demand specifications, weak separability is rejected by the data.

We test the practical implications and usefulness of latent separability on a large dataset taken from the Spanish Continuous Family Expenditure Survey covering the period 1985-91. The main results we obtain can be summarized as follows. First, we reject weak separability because there are significant influences of the prices of non-exclusive goods on exclusive ones. Second, the effects on total expenditure elasticities are small (although with some unexplained results), but the consequences for the price elasticities are very important, as expected. Third, when we base the choice of our preferred specification on intuition and or when comparing the results with previous

[37]We do not change the number of exclusive goods because this number is imposed by a previous test.

empirical evidence for Spain, results under weak separability produce a better fit. Finally, evaluating the effects of price changes by simulation, we obtain that the differences, on revenue figures for instance, of using weak or latent separable parameters are also very small using Spanish data.

This chapter contains four sections in addition to this introduction. In section 3.2, we present the economic framework in which we estimate the demand systems and we compare the models under the different separability assumptions. In section 3.3, we briefly describe the data used and the sample selection. The estimation of the model is presented in section 3.4 where we also discuss and compare the obtained results. Section 3.5 concludes.

3.2 - MODELING FRAMEWORK

3.2.1 - The demand model with and without latent separability

Two-stage budgeting requires weak separability. The process of two-stage budgeting considers as a first step the allocation of total income among broad groups. In a second step, consumers decide upon each group, with no dependence on decisions on the other groups. The direct implication of this approach is the reduction of the whole decision process to a sequence of choices. Each step only requires information involved in that level. Nevertheless, weak separability implies a severe restriction on the degree of substitutability among goods belonging to different groups, since goods are mutually exclusive. Hence, we are identifying broad groups so that the relation among goods belonging to different groups is limited to the relation among groups. It is feasible to relax this assumption by grouping goods following another approach. We can do so using the concept of latent separability recently proposed by Blundell and Robin (1997a). Contrary to the concept of weak separability, latent separability is akin to the household production theory. Moreover, it could be seen within an intermediate production process. Some goods are used to produce intermediate inputs, i.e. water or electricity services are used for washing, cooking, or telephone services for booking holidays. These intermediate goods define separable groups and are composed of one exclusive good.[38] Non-exclusive goods are allowed to enter more than one aggregate. Introducing this distinction, we allow relationships among groups in a wider sense throughout the non-exclusive goods.

We focus this study on the demand for non-durable consumed commodities i.e. we exclude durable goods such as houses, vehicles or domestic appliances. Our choice for microdata imposes this limitation, for current expenditure can only proxy consumption if the good is non-durable. When excluding the above commodities, we are also thinking in the severe implications of the zeros observed in them. But, these are not the only goods contaminated by zero expenditure. One can argue that most of the zeros in the goods we are analyzing are generated by infrequency of purchase although one can also argue that all zero expenditures in tobacco and petrol cannot be assumed to be generated by that source.[39] We consider explicitly the possible different nature of zeros for these commodities by selecting a set of households that report at least a non-zero expenditure across the collaborating period. We make this sample selection because the results in Blundell and Robin (1997a) only consider interior solutions for the latent demands, thus ruling out non-participation or corner solutions. We explain this selection process in more detail in the data section below. Finally, we leave out labour supply because there is only limited information about this issue in the surveys.[40]

---

[38]This idea of exclusive goods is originally used in the models of collective household behavior of Chiappori (1988, 1992). See Browning, Bourguignon, Chiappori and Lechener (1994) for an example with collective demand where the exclusive goods are husband and wife clothing.

[39]See Labeaga and López (1997) or Jones, Labeaga and López (1998).

[40]The approach of Browning and Meghir (1991) allows us to obtain consistent parameter estimates using a conditional (on labor supply variables) demand model.

The process of allocation of expenditure may be described according to two-stage budgeting. In the first stage, consumers determine decisions upon labor supply, savings and expenditure on durable goods. In the second stage, the rest of expenditure is allocated between a range of non-durable items. In this chapter, the non-durable categories are food and non-alcoholic drinks, alcoholic beverages, tobacco, clothing and footwear, housing expenses, fuel for housing, household non-durable goods, petrol, transport, education and health services, leisure goods, food out and leisure services, communication services and a residual category of other non-durable goods.[41] The whole allocation process must be embodied within a life-cycle framework with intertemporal separability preferences. This is a rather restrictive assumption. However, since current demands are functions of current expenditure, we can consider that this variable collects information on past choices and future expectations of consumers. The effects of past and future expectations are introduced by considering the first stage as dependent on micro or macroeconomic variables affecting demand (Blundell, 1988).

In terms of the functional form, both the weak and latent separability concepts can be tested in all usually employed demand systems: the Linear Expenditure System, the Translog Demand model, the Almost Ideal Demand model or generalizations of them. Since we want to capture changes in own-price and income effects due to changes in relative prices, we opt for the Quadratic generalization of the Almost Ideal Model (AIM) of Deaton and Muellbauer (1980b) proposed by Banks, Blundell and Lewbel (1997)[42], which in budget shares has the form:

[3.1]

$$w = \alpha + \Gamma \ln p + \beta \left[\ln m - \ln a(p)\right] + \lambda / b(p) \left[\ln m - \ln a(p)\right]^2 .$$

[41]The spread of expenditure on a great dissagregation of commodities makes sense when trying to separate exclusive from non-exclusive goods. Moreover, there is a growing interest in estimating large demand systems for tax and welfare simulation purposes (see Blundell and Robin, 1997b).

[42]It seems important in empirical applications to relax the linearity of the demand equations (see Blundell, Pashardes and Weber, (1993) with UK data or Labeaga and López, (1997), using Spanish data).

This model embodies theoretical restrictions as adding up (which is directly satisfied if the system is estimated by linear methods).[43] We can also impose and test homogeneity and symmetry by setting the implied restrictions on the parameter vectors. We cannot impose negativity but can be tested looking at the sign of the Slutsky matrix.[44]

There are several reasons that justify the choice of the AIM as the most suitable functional form for our purposes. First of all, it is derived from a set of preferences that do not embody additive separability and permit flexible price responses. Secondly, the derived Engel curves belong to the Working-Leser form, that is, linear in the logarithm of total expenditure. Furthermore, the extension of the AIM to a rank three implies a good degree of flexibility in income responses since the elasticities depend on total expenditure.

From the initial demand system, we obtain the demand functions for the exclusive and non-exclusive goods by defining a quasi-separable cost function for the M latently separable goods as:[45]

[3.2]

$$e(p,U) = \tilde{e}\,(b^1(p^1,U),\dots,\ b^M(p^M,U^M)),$$

being $b^k(p^k\ ,\ U)$ the cost index for group k. We assume that the price that characterizes each group, p^k, is defined by an exclusive good price and the non-exclusive good prices that enter that group.

The demands for the exclusive goods can be derived from the above cost function as:

[43]We estimate the system by non-linear methods but additivity is still very easy to be imposed.

[44]See Deaton and Muellbauer (1980a) or Banks, Blundell and Lewbel (1997) for more details.

[45]Blackorby, Primont and Russell (1978).

[3.3]

$$q_k = \frac{\partial\, b^k(p^k,U)}{\partial\, p_k}\frac{\partial\, e(p,U)}{\partial\, b^k(p,U)} \quad \textit{for all } k = 1, \dots, M,$$

but $b_i^k = 0$ if i is different from k.

The demands for the non-exclusive goods are:

[3.4]

$$q_{M+j} = \sum_{k=1}^{M} \frac{\partial\, b^k(p^k,U) \big/ \partial\, p_j}{\partial\, b^k(p^k,U) \big/ \partial\, p_k} q_k = \sum_{k=1}^{M} \frac{\partial\, b_j^k(p^k,U)}{\partial\, b_k^k(p^k,U)} q_k \quad \textit{for all } j = M+1, \dots, N.$$

Defining the latent group price aggregates as:

[3.5]

$$ln b^k(p^k) = \sum_{i=1}^{N} \pi_i^k \ln p_i \quad with \sum_{i=1}^{N} \pi_i^k = 1.$$

Budget shares for the M aggregated groups take the form:

[3.6]

$$\widetilde{w} = \widetilde{\alpha} + \widetilde{\Gamma}\ lnb + \widetilde{\beta}\ [ln\ m - ln\ \widetilde{a}(b)] + \widetilde{\lambda} \big/ \widetilde{b}(b) [ln\ m - ln\widetilde{a}(b)]^2.$$

We can relate the parameter estimates for equation [3.6] with those in equation [3.1] premultipling the former by Π.

[3.7]

$$w = \Pi'\, \widetilde{w}.$$

Hence, comparing coefficients we have:

[3.8]

$$\alpha = \Pi'\, \widetilde{\alpha}\ ,\ \beta = \Pi' \widetilde{\beta}\ ,\ \lambda = \Pi' \widetilde{\lambda} \ \text{ and } \ \Gamma = \Pi' \widetilde{\Gamma}\, \Pi.$$

The parameters $\widetilde{B} = (\widetilde{\alpha}, \widetilde{\beta}, \widetilde{\lambda})$ and $\widetilde{\Gamma}$ related to the M latent group equations are the ones we are searching.[46] These parameters compose a matrix $\widetilde{\Theta}$ which is going to be full rank

[46]In other words, we are interested in unobserved demand functions, whose parameters must be derived from their observed counterparts.

and will satisfy the additivity and symmetry conditions. Equally, we may characterize $B=(\alpha, \beta, \lambda)$ and Γ, for the N initial groups, also satisfying both additivity and symmetry conditions.

For the exchanging matrix Π, the exclusivity assumption implies the existence of a vector of non-zero elements $\lambda \in R^M$ and $\Psi \in R^{Mx(N-M)}$ such that $(\Lambda \mid \Psi)\, i_N = \Pi i_N = i_M$ being $\Lambda = diag\ (\lambda)$.[47] Considering this matrix Π, which verifies additivity, and both sets of parameters $\Theta=(B', \Gamma')'$ and $\tilde{\Theta} = (\tilde{B}', \tilde{\Gamma}')'$ which verify also homogeneity, symmetry and additivity we may finally write:

[3.9]

$$\overline{B}| = A\,(I_{M-1} : \Phi),$$

$$\underline{\Gamma}| = (I_{M-1} : \Phi)' G\,(I_{M-1} : \Phi),$$

where $A = \overline{\tilde{B}} \,|\, \underline{\Lambda}|$ and $G = \underline{\Lambda} | \underline{\tilde{\Gamma}} \,|\, \underline{\Lambda}|$. We denote $\overline{\underline{X}}|$ as the trimmed matrix in which the top row, the bottom row and the right column are deleted.

3.3. - DATA, ESTIMATION AND TESTING

3.3.1 - The data

The data used in this chapter comes from the ECPF and covers the time span 1985-91 (INE, 1985). This is a panel with 3,200 households interviewed each quarter with a rotating rate of 12.5 per cent.[48] Consequently, each household is interviewed 8 times at maximum. Nevertheless, none household stays in the survey 8 or 7 periods along the first 7 quarters of the covered time span. This is the main reason for taking only 6 observations per household. We sacrifice two periods for individual by a long period

[47]See Blundell and Robin (1997a) for further details about the existence of this decomposition.

[48]See Appendix B.1 for a brief description of the sample used in this chapter.

for the whole sample, which allows us more price variability, a crucial question for the purposes of our analysis. By doing so, we keep representativeness across all the available periods and at the same time, we have the maximum price variation. Of course, it is always possible to use the unbalanced panel with households participating from 1 to 8 quarters, although the estimation difficulties do not probably compensate the advantages of employing it.[49]

Another purpose of this work is to test for weak separability. Hence, the starting point is to have a sufficient number of disaggregated goods so that broader aggregates have an economic interpretation. Dissaggretation implies presence of zeros arising from different reasons depending on the analyzed category and on the monitoring period. As usual, zeros can be associated to infrequency of purchase, non-participation decisions or corner solutions. Treatment of zeros coming from different sources is rather cumbersome.[50] Nevertheless, we consider that tobacco and petrol zero records due to non-participation can be perfectly characterized when analyzing a time span of six quarters per household. Hence, we drop those households that display a non-participation profile on these categories.[51] So, we drop households with six zero records and keep those who report at least one positive purchase out of six available observations.[52] At the same time, we are abandoning the possibility to deal with the

---

[49]Comparisons of estimates on the balanced panel with $T = 6$ with those with the unbalanced one (with T_i varying from 1 to 8) could be useful for testing non-random attrition.

[50]It becomes impossible to deal with a large number of goods and zeros arising because of different reasons. See Lee and Pitt (1986) or Wales and Woodland (1987).

[51]We are aware about the possibility of introducing sample selection bias when dropping these observations. However, we try to qualify this sample selection problem in the empirical section of the chapter.

[52]A non-participating household in petrol expenditure is easily identified since it seems very difficult to have people owning a car today and not tomorrow. However, if these zero purchases correspond to the first observation periods, it is possible that the household buys the car while being interviewed (see Labeaga and López, 1997). Zeros on tobacco are more difficult to be associated with infrequency. On the other hand, maintaining those with at least one positive without taking into account the starting-quitting process seems a very bad practice if we do not take account of the reasons for these zeros (see Jones, Labeaga and López 1998).

rest of categories of expenditure using similar selection patterns because it leads to a very reduced sample.

After the selection process, we associate all remaining zeros to infrequency since we are using the results by Blundell and Robin (1997a) which impose interior solutions for every quantity demanded.[53] Besides, our main concern is not the treatment of zero records but testing for separability among the different groups which compose the demand system. However, we are worried about having consistent estimates of the parameters of the demand equations. It is always useful if we would like to employ the results with simulation purposes, for instance. The selection process outlined above leads to a final sample composed by 1813 households followed along 6 periods covering the whole period 1985-91 (i.e. 28 quarters). We present a descriptive analysis of the different variables employed in this chapter in Appendix B.1.

3.3.2 - Estimation of the model

The first step in the estimation procedure implies the specification and estimation of the QUAIDS system. Working with microeconomic data, heterogeneity among individuals explains an important part of consumption behavior. Usually, family characteristics come up as invariant in time. We can partly capture these differences across households by introducing a large heterogeneity specification. In this chapter, differences among families are drawn with all available information from the sample. Characteristics for the head of the household such as age, educational level, labor position and labor participation are included. The family is also characterized with the number of earners, number of members below fourteen years old and dummies for different types of family composition. Although we include a large family profile (see

[53]In fact, once we take account the zeros in petrol and tobacco, the main reason for the remaining zeros is infrequency of purchase (see Table B.1.1).

again Appendix B.1), unobservable heterogeneity could still be present. Finally, we include quarterly dummies for taking account of possible seasonality in demand.

Considering that specification and estimation is done in the model in levels, correlation between time invariant individual effects and total non-durable expenditure introduces inconsistency on OLS estimators.[54] Instrumental variable estimation is the usual procedure to overcome this problem. The usual invoked estimator for total non-durable expenditure under infrequency of purchase is income, following the proposal by Keen (1986). Several analyses about information on income for the ECPF show that this variable is usually underreported (see López, 1993, for instance). In fact, results from a first approach in this study, using IV estimations with income as instrument, give non-intuitive income elasticities. Instead, we use lagged non-durable expenditure as instrument for current expenditure.[55] Nonetheless, if the assumption in footnote 18 above is not fulfilled or under the presence of correlation between unobserved time invariant heterogeneity and lagged expenditure or demographics, we will yet obtain somehow biased estimations.

3.3.3 - Imposing latent separability. Testing the number of exclusive goods and weak separability

We estimate the model with latent separability using the following procedure. We estimate $\tilde{\Theta} = (\tilde{B}', \tilde{\Gamma}')'$ and the decomposition matrix $(\Lambda \,/\, \Psi) = \Pi$, assuming that the rank of the trimmed matrix $\underline{\Theta}|$ is at least M-1. The first step is therefore the

[54]We are using the identifying assumption that prices and demographics are uncorrelated both with individual effects and the mixed error term.

[55]Although under two-stage budgeting, income should be a good instrument, Hausman, Newey and Powell (1995) show that in non-linear Engel curves with errors in variables problems, income is not adequate. They show that lagged total expenditure is a suitable instrument for current total expenditure. They name it the repeated measurement estimator. Another possibility is to adjust an equation for total expenditure with all available demographic variables. This procedure does not work in empirical studies because the fit of this regression is normally poor.

identification of the number of latent groups. According to proposition 4 in Blundell and Meghir (1997a), the number of latent groups is one plus the rank of the trimmed matrix $\underline{\overline{\Theta}|}$, since it determines the number of M-1 linearly independent columns. In order to find the number of independent columns, we use an eigen-value test proposed by Robin and Smith (1994). The test is based upon the eigen values of $\hat{\Theta}' \hat{\Theta}$, being $\hat{\Theta}$ a consistent estimation for Θ, and has as limiting distribution a weighted sum of independent chi-squared variables.[56] Choosing M exclusive goods is sufficient to uniquely identify the complete structure of preferences. Although we are sure about the unique existence of this decomposition, the selection of the M latent groups, which is a subjective issue, affects the decomposition and also it conditions price and income elasticities of the latently separable groups.

As a second step, we must search for the set of parameters of the model under latent separability and the decomposition matrix. The former are obtained by applying Quasi Generalized Least Squares (QGLS) to the implied set of restrictions that relate both initial and latent parameters.[57] For the estimation of the decomposition matrix we use OLS, fixing the set of involved restrictions from the diagonal structure of Λ and from the additivity property. The structure and significance of the terms composing the decomposition matrix provides a direct method for testing weak separability. If the selected non-exclusive goods enter significantly in the wider aggregates we are constructing, weak separability is rejected.

[56]See Robin and Smith (1994) and Blundell and Robin (1997a) for more details on the construction and distribution of this test.

[57] See Blundell and Robin (1997a) for the set of implicit restrictions.

3.4 - EMPIRICAL RESULTS AND DISCUSSION

3.4.1 - Results of the QUAIDS demand system under weak separability

In Table 3.1, we present price and total expenditure elasticities for the symmetry and homogeneity system under weak separability for the different commodities. They are calculated using the parameters estimated with the QUAIDS model.[58] Relative to the parameters from which the elasticities are derived (see Tables B.2.1 to B.2.13 in Appendix B.2), the first thing to note is that the square term of total expenditure is necessary in ten out of fourteen goods. Specifically, it is significantly different from zero in food and non-alcoholic drinks, alcoholic beverages, tobacco, housing expenses, household non-durable goods, petrol, transport, leisure goods, food out and leisure services and communications. Second, the influences of the demographic variables appear as very important in most of the equations of the system. Specifically, the ages of the partners, family composition variables and occupational dummies are important conditionings affecting the demand of most of the goods. On the other hand, educational dummies appear as relevant for some commodities (mainly services). The more educated is the head the more the household spend on holidays, communications, housing and leisure. This is probably because of the correlation among educational background and income. Opposite, the less educated is the head, the less the family spend on alcoholic drinks or tobacco.

---

[58]Income and price elasticities are calculated at mean shares according to the following expressions:

$$e_i=(\mu_i/w_i)+1 \quad and \quad e_{ii}=(\mu_{ii}/w_i)-1,$$

where

$$\mu_i = \frac{\partial w_i}{\partial \ln m} = \beta_i + \frac{2\lambda_i}{b(p)}\left[\ln\frac{m}{a(p)}\right]$$

and

$$\mu_{ij} = \frac{\partial w_i}{\partial \ln p_j} = \gamma_{ij} - \mu_i\left(\alpha_i + \sum_k \gamma_{jk} \ln P_k\right) - \frac{\lambda_i \beta_j}{b(p)}\left[\ln\frac{m}{a(p)}\right]^2.$$

As these equations show, the model does not have constant elasticities since they depend on total real expenditure levels.

Table 3.1 - ELASTICITIES (WEAKLY SEPARABLE SYSTEM)

	Homogeneity test	Income elasticities	Price Elasticities
Food out & leisure services	0.504	1,423	-0,264
		(0,118)	(0,169)
Educ & health services	0.039	1,241	-1,218
		(0,216)	(0,177)
Fuel	2.566	0,509	-0,432
		(0,145)	(0,135)
Transport	0.856	1,112	-0,786
		(0,165)	(0,172)
Communication	4.266	1,098	-2,606
		(0,111)	(0,183)
House non-durables	0.113	1,070	-0,717
		(0,051)	(0,139)
Leisure goods	0.006	1,416	-3,596
		(0,114)	(0,646)
Alcoholic beverages	1.344	0,717	-2,124
		(0,074)	(0,410)
Clothing	1.707	1,112	-0,462
		(0,123)	(0,468)
Tobacco	0.274	0,574	-1,610
		(0,083)	(0,274)
Housing	0.294	1,115	-0,991
		(0,062)	(0,124)
Petrol	0.017	1,045	-0,031
		(0,054)	(0,177)
Food	0.018	0,703	-0,595
		(0,035)	(0,057)

Notes: Global Homogeneity test: 10.934 (13 d.f.)
Symmetry test: 71.579 (78 d.f.)
Standard errors are in parentheses

Turning to the fulfillment of theoretical restrictions, homogeneity is not rejected on most of the categories. Moreover, joint homogeneity of the thirteen equations and global homogeneity and symmetry are not rejected either. Our opinion is that it is related to the number of equations included in the demand system and the non-significance of price parameters. Only thirty per cent of the price parameters are significantly different from zero in this specification, although most of the own price coefficients are statistically significant. Moreover, we necessarily should mention that the use of the QUAIDS model must keep some relationship with the completion of the symmetry restrictions. Banks, Blundell and Lewbel (1997) obtain this same result using UK data and Labeaga, Preston and Sanchis-Llopis (1998) using the ECPF survey in the context of the estimation of an adult goods system. Notice that we reject this assumption in the rank two specifications in Chapter 2, where the number of aggregated goods is 9 and the significance of the price parameters is higher.

The results also show that all goods are characterized as luxuries or necessities according to intuition. Although the elasticities can be evaluated for every value of the distribution of total real expenditure and budget shares (see footnote 22), we only present figures at mean values. These results reflect the adequacy of the QUAIDS using Spanish data. There are not very important differences in the estimated total expenditure elasticities when comparing them with those of our preferred rank two-demand model in Chapter 2. But, this is expected when comparisons are done at sample means. The main feature of the model is the possibility to obtain a distribution of the elasticities that depend on expenditure levels. And, this has important consequences when simulating the effects of tax reforms on welfare or revenue (see, for details, Banks, Blundell and Lewbel, 1997). We also confirm lagged total expenditure as a good instrument for current total non-durable expenditure. This is in line with the presence of non-linear errors in variables in the model which suggests the use of the repeated measurement estimator proposed by Hausman, Newey and Powell (1995) instead of income. Nevertheless, we are aware of the possible correlation between this instrument and individual unobserved effects and hence, on the possible bias of the estimates.[59]

Also, price elasticities fall within the expected value, except probably the results for alcoholic beverages and tobacco. These last values are related with the great incidence of infrequency of purchase in the case of alcoholic drinks and with the inadequacy of the specification in the case of tobacco. The inadequacy of the tobacco specification is

[59]When comparing these results with those in Chapter 2 (when comparable), this source of bias does not seem to be very important. However, for a description on the different sources of bias see the discussion in Chapter 2.

confirmed by Labeaga, Preston and Sanchis-Llopis (1998) and specifically considered with the same survey by Jones, Labeaga and López (1998). Notice also the unexpected low sensitivity of price changes upon consumption for food out. This result is probably related to the heterogeneity of the group. Almost all expenditure and own-price elasticities are significantly different from zero.[60] Finally, we must note that there are important differences amongst these values and those reported in our best model in Chapter 2. Several reasons can explain this fact but we will turn to it later on.

3.4.2 - Comparison of latent separability parameters under alternative decompositions

The rank test of the trimmed matrix $\underline{\Theta}|$ reveals that M-1 is eight and thus the number of exclusive groups is nine (see Table 3.2). Therefore, we have nine exclusive and five non-exclusive goods. As pointed out by Blundell and Robin (1997a), only the number of latent groups, not their composition, is identified by the data.[61] We are interested in comparing what happens when changing the composition of the exclusive goods sets. Then, from the results obtained by the rank test, we select a pair of nine exclusive goods. These two sets differ among them only in a single commodity. Our first decomposition sets the following goods as non-exclusive: food out and leisure services, education and health services, fuel for domestic use, transport and other non-durable goods. In parallel, the second chosen decomposition classifies food out and leisure services, education and health services, transport, household non-durables, and other non-durables as non-exclusive goods. Although the chosen set of non-exclusive goods is completely subjective, we must notice that both sets can be

[60]Standard errors of the elasticities are calculated by bootstrapping.

[61]They argue that one can test whether a particular choice is acceptable on empirical grounds. However, after eliminating choices which correspond to singular solutions, there remain a lot of possible compatible combinations.

characterized literally as non-exclusive, since all of them are usually included in broader aggregates when analyzing reduced commodity demand systems (except sometimes fuel for domestic use and transport).

Table 3.2 - LATENT SEPARABILITY TEST

M-1	Chi-square test	P-value[62]
7	717,12	0,00
8	396,46	0,22
9	247,24	1,00
10	156,57	1,00
11	96,57	1,00
12	48,16	1,00
13	18,67	1,00

Degrees of freedom: (N-M)(K+N)

In order to compare the results from the two chosen decompositions, we present in table 3.3 the income and price elasticities obtained for these two selected groups estimated imposing latent separability (whose parameters are also reported in Appendix B.2). We do so even if we know that weak separability is rejected versus latent separability. The rejection of weak separability comes from the fact that at least one price effect of the non-exclusive goods is statistically different from zero (see the decomposition matrices in Tables 3.4 and 3.5). As expected, we obtain evidence about the fact that income elasticities do not differ very much depending on the selection of exclusive goods whereas price elasticities come up as very sensitive. The most important change in the total expenditure elasticity corresponds to petrol consumption and it is necessarily related to the exclusion of fuel for domestic use from the second set of non-exclusive goods and its inclusion within the exclusive one. Significant differences on price elasticities of the exclusive goods are detected on housing, clothing and footwear, household non-durables and communications. Notice that this is related to the high significance of the parameters of the decomposition.

[62]Given the null hypothesis on the number of latent groups M-1, the P-value reflects the probability of committing an error when accepting the null when the alternative is correct.

Notice also that the own price elasticity of fuel is probably related to the change in the total expenditure of petrol when moving from the first to the second decomposition.

Table 3.3 – ELASTICITIES (LATENT SEPARABLE SYSTEM)

	First decomposition		Second decomposition	
	Income elast.	Price elast.	Income elast.	Price elast.
Food out & leisure serv.	1,611	-1,227	1,454	-0,967
	(0,088)	(0,349)	(0,143)	(0,331)
Educ & health services	1,297	-0,255	1,320	-0,024
	(0,283)	(0,294)	(0,206)	(0,476)
Fuel	0,455	-0,401	0,542	-0,164
	(0,209)	(0,217)	(0,149)	(0,257)
Transport	1,381	-0,908	1,154	-1,114
	(0,246)	(0,170)	(0,072)	(0,143)
Communication	1,098	-1,076	1,278	-0,622
	(0,116)	(0,080)	(0,130)	(0,325)
House nond.	1,078	-1,056	1,195	-1,816
	(0,060)	(0,049)	(0,081)	(0,284)
Leisure goods	1,389	-0,029	1,387	-0,072
	(0,044)	(0,274)	(0,095)	(0,253)
Alcoholic bev.	1,129	-1,561	0,984	-1,607
	(0,061)	(0,161)	(0,093)	(0,161)
Clothing	1,178	-0,175	0,920	-0,753
	(0,233)	(0,340)	(0,106)	(0,123)
Tobacco	0,590	-1,568	0,561	-1,359
	(0,164)	(0,188)	(0,100)	(0,105)
Housing	0,879	-0,546	1,042	-1,085
	(0,130)	(0,171)	(0,089)	(0,064)
Petrol	0,496	-0,223	1,049	-0,253
	(0,155)	(0,264)	(0,086)	(0,055)
Food	0,776	-0,878	0,750	-0,828
	(0,043)	(0,065)	(0,044)	(0,031)

Note: Standard errors are in parentheses

Recall that latent separability sets some restrictions upon the structure of each decomposition matrix. First of all, the structure is composed by two blocks. The first one is a diagonal matrix. Recall also that the whole decomposition matrix must verify additivity. Moreover, we set some restrictions upon the values of its elements. We force some of the initial goods to be exclusive to their own group. This translates into the non-participation of the non-exclusive goods in the pseudo-aggregates we construct and hence, its exclusivity nature. Namely, these exclusive goods are clothing, tobacco and alcoholic beverages. This restriction translates empirically in fixing $\lambda_i = 1$ for these goods. Moreover, we fix other restrictions upon some non-exclusive goods participation on different aggregates. Both sets of restrictions are based upon the intuition on the possible combinations when aggregating our initial set of goods and also on empirical grounds.

Now we turn into the evaluation of the decomposition matrices for the different selections of exclusive goods (Tables 3.4 and 3.5). For instance, looking at the first decomposition parameters, education and health services and fuel for housing appear as substitutes of household non-durables while other non-durables is a complement (probably because this last group is composed by commodities related to). As another example, food out appears as a strong substitute for food in and a complement with petrol since it is sometimes necessary to take the car for going out for lunch or dinner. However, the decomposition matrices are affected by the selection but, as quoted above, there are similar patterns in the effects of the prices of non-exclusive on exclusive goods. For instance, looking at both the first and second decomposition, food out appears as a strong substitute for food in. Equally, transport behaves as a complement for communications. There are some cases where a non-exclusive good behaves as a complement for the first decomposition and as a substitute for the second, for instance food out on petrol. Notice that in these cases, we always observe at least a non-significance estimate on one of the decompositions.

Table 3.4 - FIRST DECOMPOSITION

	lambda	Food out & leisure serv	Educ. & health serv.	Fuel	Transport	Other nondurables
House nond.	0,312	0,000	-0,472	-0,123	0,000	1,283
	(0,021)	-	(0,136)	(0,099)	-	(0,046)
Leisure goods	1,744	-0,037	0,000	0,252	0,273	-1,232
	(0,075)	(0,137)	-	(0,060)	(0,280)	(0,114)
Alcoholic bev	1,000	0,000	0,000	0,000	0,000	0,000
	-	-	-	-	-	-
Clothing	1,000	0,000	0,000	0,000	0,000	0,000
	-	-	-	-	-	-
Tobacco	1,000	0,000	0,000	0,000	0,000	0,000
	-	-	-	-	-	-
Housing	1,338	0,000	-0,498	-0,122	-0,382	0,665
	(0,115)	-	(0,028)	(0,028)	(0,021)	(0,058)
Petrol	0,689	0,960	0,000	0,390	1,124	-2,163
	(0,003)	(0,179)	-	(0,049)	(0,140)	(0,088)
Food	1,013	-1,153	0,000	-0,219	0,000	1,359
	(0,031)	(0,083)	-	(0,019)	-	(0,033)
Communication	0,149	0,000	0,000	0,000	0,129	0,722
	(0,002)	-	-	-	(0,032)	(0,006)

Note: Standard errors are in parentheses

Table 3.5 - SECOND DECOMPOSITION

	lambda	Food out & leisure serv	House nondurables	Transport	Educ. & health serv.	Other nondurables
Fuel	0,977	0,000	-0,097	0,000	-1,292	1,412
	(0,014)	-	(0,018)	-	(0,241)	(0,056)
Leisure goods	1,345	2,567	0,000	-0,337	0,000	-2,575
	(0,130)	(0,404)	-	(0,124)	-	(0,122)
Alcoholic bev	1,000	0,000	0,000	0,000	0,000	0,000
	-	-	-	-	-	-
Clothing	1,000	0,000	0,000	0,000	0,000	0,000
	-	-	-	-	-	-
Tobacco	1,000	0,000	0,000	0,000	0,000	0,000
	-	-	-	-	-	-
Housing	1,936	0,000	-0,291	-0,460	-0,627	0,442
	(0,017)	-	(0,006)	(0,051)	(0,086)	(0,025)
Petrol	0,890	-0.498	0,000	0,153	0,000	0,455
	(0,011)	(0.324)	-	(0,051)	-	(0,008)
Food	1,037	-0,219	0,031	0,000	0,000	0,151
	(0,015)	(0,096)	(0,003)	-	-	(0,014)
Communication	0,029	0,000	0,000	0,149	0,000	0,822
	(0,005)	-	-	(0,010)	-	(0,002)

Note: Standard errors are in parentheses

We finish this subsection making another sort of comparison of the two sets of latently separable results. We base this comparison on the simulation performance when facing to a very well-known Spanish tax reform.[63] In a few words, it consists of increasing in one point all VAT rates and an increase on excise duties levied on alcoholic drinks, tobacco and petrol of roughly one additional point. We only simulate the effects on government revenue under the following scenario: Let w_{ih} is the share devoted to expenditure i by household h. We compute $\hat{w}_{ih}$ as the predicted value of the share given the set of parameter estimates of each of the models. Once we have the new shares,[64] we evaluate the estimated post-reform levels of expenditure for each good and household E^1_{ih} and the level of revenue according to the expression:

[3.10]

$$TR=\sum_{h=1}^{H} g_h \sum_{i=1}^{N} \left[\frac{v_i^1}{1+v_i^1}+\frac{e_i^1}{p_i^1}\right] E^1_{ih},$$

under the assumption of full shift in prices and being g_h the sample weight of each household, v_i^1 the post-reform Value Added Tax (VAT) rate, p_i^1 the post-reform price of good i and e_i^1 the post-reform excise rate. There are some changes in the distribution of the increase in revenue along the different goods when comparing the results corresponding to the two different latent separable demand systems. However, the total increase in revenue of the 14 commodities is the same (9 percent) in the two systems.

3.4.3 - Comparison of weak and latent separable results

In order to compare the weak and latent separable estimates, we make three different exercises. In the first one, we simply compare the elasticities obtained under the two separability hypotheses. This is done looking at the results of Tables 3.1 and 3.3. As

[63]See Labeaga and López (1996) for details.

[64]These new shares are corrected by the share prediction error (see Baker, Mackay and Symons, 1990 or Labeaga and López, 1996).

pointed out above, we do not observe significant differences on income elasticities for the two non-exclusive group selections. Comparing these parameters with the income effects under weak separability, we observe that differences are statistically irrelevant, except for petrol and alcoholic beverages. Opposite, price effects come up as very different assuming weak separability or imposing latent separability. Notice that the results under weak separability fit much better with intuition, except once more, for petrol.

The second exercise consists of comparing the elasticity figures for the nine exclusive goods of the latent separable demand systems (Table 3.3) with those obtained after estimating a weakly separable model on these nine commodities plus a residual category which includes all other non-durable goods (Table 3.6). Now, the results appear as very similar independently on the selected goods. Again, the income elasticities are very similar to those obtained for the first estimation with all commodity groups. Price elasticities differ from those initial parameters. Nevertheless, differences are certainly lower than those detected when imposing latent separability, independently on the chosen exclusive goods.

Our final comparison is again based on simulation. We turn to face the weak and latent separability demand systems to the Value Added Tax (VAT) reform implemented in Spain in 1995 and briefly described in the above subsection. Again, there are minimum changes in total revenue corresponding to the 14 groups of commodities when comparing weak versus latent separability simulations. The reform predicts an overall increase of 9 percent for the three demand models (specifically from 8.7 to 9.2 percent). Of course, we observe changes when looking at figures for each of the groups composing the system.

Table 3.6 - ELASTICITIES (WEAKLY SEPARABLE RESTRICTED SYSTEM)

	Income elasticities	Price elasticities	Income elasticities	Price Elasticities
Communication	1,095	-2,044	1,105	-2,145
	(0,039)	(0,152)	(0,037)	(0,134)
Fuel	0,514	-0,243	-	-
	(0,064)	(0,124)		
House nond.	-	-	1,071	-0,821
			(0,042)	(0,072)
Leisure goods	1,415	-6,769	1,408	-6,300
	(0,155)	(1,716)	(0,122)	(1,747)
Alcoholic bev.	0,715	-2,263	0,728	-1,500
	(0,041)	(0,143)	(0,028)	(0,071)
Clothing	1,096	-0,069	1,105	-0,044
	(0,111)	(0,797)	(0,076)	(0,716)
Tobacco	0,575	-2,517	0,570	-1,922
	(0,048)	(0,234)	(0,062)	(0,140)
Housing	1,115	-0,600	1,116	-0,605
	(0,046)	(0,186)	(0,046)	(0,160)
Petrol	1,050	-0,090	1,039	-0,077
	(0,034)	(0,074)	(0,028)	(0,064)
Food	0,706	-0,621	0,712	-0,719
	(0,048)	(0,056)	(0,024)	(0,031)

Note: Standard errors are in parentheses

3.4.4 - Comparison of income and price elasticities

We finally compare income and price elasticities with those obtained in Chapter 2. As a general pattern, similarities in both income and price elasticities are higher when comparing rank 3 figures from chapter 2 with figures on the weakly separable system rather than elasticities under latent separability. As pointed out above, weak separability gives a better fit. However, it is worth to mention that elasticities are not directly comparable since rank 3 specifications in Chapter 2 are in first differences and take into account heterogeneity whereas estimations here are in levels and will be biased since we expect correlation between individual unobserved effects and total expenditure. Moreover, the specification and estimation does not set restrictions upon the expenditure parameters related to the rank of the system as we do in Chapter 2.

3.5. - CONCLUSIONS

We present in this chapter several sets of QUAIDS estimates under two alternative separability concepts. We first employ the usual weak separability to estimate a system of 14 non-durable commodities. We, then, use the new latent separability concept and apply it to the estimation of a complete demand model for the 14 non-durable goods. After testing for the number of exclusive goods, we derive the parameters of two latent separable systems with nine exclusive groups. The unique difference between them is in choosing the five non-exclusive goods and both sets only differ in one of these goods.

It is very difficult to decide the best-estimated demand model on the basis of the empirical research in this chapter. First, the tests clearly reject weak separability. There are relationships amongst goods which are hidden in the weak separable demand models. Moreover, the effects of the price of non-exclusive on exclusive commodities seem to be reasonable. However, we make several comparisons of the weakly and latently separable results based both on estimation and simulation. When comparing the results on intuitive grounds, we would opt for the weak separable demand system. But, there are not differences when making comparisons at the light of simulation figures. Thus, it is necessary more research in this field in order to be able to discriminate whether latent separability has practical implications or is simply a theoretical curiosity.

REFERENCES

BANKS, J., BLUNDELL, R.W. and LEWBEL, A. (1997): "Quadratic Engel curves and consumption demand". *The Review of Economics and Statistics*, 79, 527-539.

BLACKORBY, C., PRIMONT, D. and R.R. RUSSELL (1978): *Duality, Separability and Functional Structure: Theory and Economic Applications*. North-Holland, New York.

BLUNDELL, R.W. (1988): "Consumer Behaviour: Theory and Empirical Evidence. A Survey". *The Economic Journal*, 98, 16-65

BLUNDELL, R. W., PASHARDES, P. and WEBER, G. (1993): "What Do We Learn About Consumer Demand Patterns From Micro-Data?". *American Economic Review*, 83, 570-97.

BLUNDELL, R.W. and ROBIN, J.M. (1997a): "Latent separability: grouping goods without weak separability". Mimeo. *University College London.*

BLUNDELL, R.W. and ROBIN, J.M. (1997b): "Estimation in large and disaggregated demand systems: An estimator for conditionally linear systems". Discussion Paper 97-01, *University College London.*

BROWNING, M. and MEGHIR, C. (1991): "The Effects of Male and Female Labour Supply on Commodity Demands". *Econometrica*, 59, 925-951.

BROWNING, M., F. BOURGUIGNON, P.A. CHIAPPORI y V. LECHENER (1994), "Income and outcomes. A structural model of intrahousehold allocation". *Journal of Political Economy*, 102, 1068-1096.

CHIAPPORI, P.A. (1988): "Rational household labor supply". *Econometrica*, 56, 63-90.

CHIAPPORI, P.A. (1992): "Collective labor supply and welfare". *Journal of Political Economy*, 100, 437-467.

DEATON, A.S. (1974): "A Reconsideration of the Empirical Implications of Additive Preferences". *The Economic Journal*, 84, 338-348.

DEATON, A.S. and MUELLBAUER, J.N.J. (1980a): *Economics and Consumer Behaviour*. Cambridge University Press. Cambridge.

DEATON, A.S. and MUELLBAUER, J.N.J. (1980b): "An Almost Ideal Demand System". *American Economic Review*, 70, 312-326.

GORMAN, W.M. (1981): "Some Engel Curves", in Deaton, A.S. (ed.), *Essays in the Theory and Measurement of Consumer Behaviour*, Cambridge University Press. Cambridge.

HAUSMAN, J.A., NEWEY, W.K. and POWELL, J.L. (1995): "Nonlinear Errors in Variables. Estimation of Some Engel Curves". *Journal of Econometrics*, 65, 205-233.

INE (1985): *Encuesta Continua de Presupuestos Familiares. Metodología*. Instituto Nacional de Estadística. Madrid.

JONES, A., LABEAGA, J.M. and A. LOPEZ (1998): "Individual heterogeneity and censoring in panel data estimates of tobacco expenditure by Spanish households". Mimeo.

KEEN, M. (1986): "Zero Expenditures and the Estimation of Engel Curves". *Journal of Applied Econometrics*, 1, 277-286.

LABEAGA, J.M. and LOPEZ A. (1996): "Flexible demand system estimation and the Revenue and Welfare Effects of the 1995 Vat Reform on Spanish households". *Revista Española de Economía*, 13, 181-197.

LABEAGA J.M. and LOPEZ A. (1997): "A study of petrol consumption using Spanish panel data". *Applied Economics*, 29, 795-802.

LABEAGA, J.M., PRESTON, I. and J. SANCHIS-LLOPIS (1998): "Children and demand patterns: evidence from Spanish panel data". Mimeo.

LEE L.F. and PITT M.M. (1986): "Microeconomic demand systems with binding non- negativity constrains: The dual approach". *Econometrica*, 54, 1237-42.

LOPEZ, A. (1993): "An assessment of the Encuesta Contínua de Presupuestos Familiares (1985-89) as a source of information for applied research". Working Paper 53, *Universitat Pompeu Fabra*.

ROBIN, J.M. and R.J. SMITH (1994): "Tests of rank". Mimeo. *CREST, Paris*.

WALES, T.W. and WOODLAND, A.D. (1986): "Estimation of Consumer Demand Systems with Binding Non-Negativity Constraints". *Journal of Econometrics*, 21, 263-85.

APPENDIX B.1 - DESCRIPTIVE STATISTICS

We summarize a statistical description on the sample we use in this chapter for the all the involved variables through Tables B.1.1, B.1.2. and B.1.3

First of all, Table B.1.1 presents a descriptive analysis of the dependent variables, that is the budget shares of the different categories of expenditure. The table reports the mean budget share and the standard deviation. It also presents the incidence of zeros considering all the observations (second column) and the percentage of zeros which may be associated to non participation. For the latter, we drop those households that report any non zero observation for the considered period. Recall that we require participation on tobacco and petrol and also non zero expenditure on food along the 6 quarters for all households.

Table B.1.2 pictures the distribution of both income, non-durable and total expenditure in nominal terms for the whole analyzed period. Since income is distributed below total expenditure, we can assess evidence on the underreporting of income for the ECPF.

Finally, Table B.1.3 presents the distribution of households according to their characteristics. The family profile is characterized in terms of the composition and household type and, age, socioeconomic position, labor position and education level of the head of the household.

Table B.1.1 - BUDGET SHARE DESCRIPTION

	budget share Std. deviation	% zeros	% non-particip.
Food out & leisure services	0,092 (0,079)	4,8	0,4
Educ & health services	0,054 (0,047)	25,7	5,5
Fuel	0,058 (0,038)	0,7	0,2
Transport	0,043 (0,061)	29,3	3,5
Communication	0,011 (0,012)	34,1	24,4
House nondurables	0,025 (0,030)	20,8	2,2
Leisure goods	0,026 (0,032)	23,9	5,2
Alcoholic beverages	0,012 (0,018)	39,8	11,3
Clothing & food wear	0,111 (0,093)	8,4	0,2
Tobacco	0,023 (0,021)	16,7	-
Housing	0,168 (0,103)	0,5	0,0
Petrol	0,051 (0,048)	27,4	-
Food	0,325 (0,115)	-	-

Note: Standard errors are in parentheses

Table B.1.2 - INCOME AND EXPENDITURE STATISTICS

	INCOME	NON-DURABLE EXPENDITURE	TOTAL EXPENDITURE
MEAN	395082	368959	417120
Std. Deviation	197689,4	153533,7	211955,7
1st. Quartile	263196	258712	280468
2nd Quartile	360401	347853	381066
3rd Quartile	488001	454607	508708
4th Quartile	3370960	1134452	3016131

Note: The income variable refers to all the possible sources of earnings for all members of the household.

Table B.1.3 - SOCIOECONOMIC VARIABLES DESCRIPTION

	VARIABLES	% OBS.
Quarterly distribution	first quarter	0,243
	second quarter	0,271
	third quarter	0,243
	fourth quarter	0,244
household type	single person	0,101
	couple and children	0,316
	others	0,582
head of household age	<=25	0,023
	>25 and <=35	0,221
	>35 and <=45	0,246
	>45 and <=55	0,241
	>55 and <=65	0,188
	>65	0,081
socioeconomic position	selfumployed	0,161
	unskilled	0,159
labor position	non-active	0,193
education level	no studies	0,293
	primary education	0,553
	secondary education	0,081
	university education	0,066

	VARIABLES	MEAN/STD
family composition	# members	3,990
		(1,387)
	# members <14	0,980
		(1,185)
	# earners	1,730
		(0,857)

Note: First part of the table presents information related to variables which enter as dummies in the specification. Second part of the table refers to quantitative socioeconomic variables.