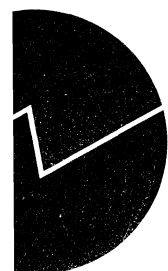


Jørgen Aasness and Bjart Holtsmark

Consumer Demand in MSG-5

Notater



Jørgen Aasness and Bjart Holtsmark

Consumer Demand in MSG-5

Abstract:

The paper gives a concise description of the consumer demand model of the general equilibrium model MSG-5. The model has the following specific features: (i) It is based on a three level utility tree. At the lower level there is little substitution between cars and petrol; at the intermediate level there is considerable substitution between public transport and private transport; and at the top level there are moderate possibilities for substitution between say transport and food. (ii) The utility tree is based on non-homothetic weak separability, taking account of the fact that for example the Engel elasticity of public transport is less than the Engel elasticity of private transport. There is perfect aggregation over goods in the utility tree, which makes it necessary to have more than one price index for commodity groups at the upper level. (iii) The utility functions are household specific and we use perfect aggregation across all households in Norway to derive the macro demand functions, in which the number of households, the number of children, and the number of adults are important variables. (iv) The model is calibrated exploiting both micro- and macroeconometrics, taking both random and systematic measurement errors into account.

Table of contents

1. Introduction.....	3
2. Recursive equation system of the demand model.....	5
3. Parameters and elasticities.....	8
4. Commodity classifications	13
5. List of symbols.....	14
References.....	16

List of tables

Table 1 Parameter values in the top level LES.....	8
Table 2 Parameters in the intermediate level LES for Transport.....	9
Table 3 Parameters in the bottom level CES for Energy	9
Table 4 Parameters in the bottom level CES for Private Transport.....	9
Table 5 Elasticities in the complete demand systema)	10
Table 6 Slutsky elasticities in the complete demand systema)	11
Table 7 Cournot elasticities in the complete demand systema)	12
Table 8 Commodity classifications in MSG-5 and MSG-EE	13

List of figures

Figure 1 The utility tree in the complete demand system in MSG-5	4
--	---

1. Introduction

This paper presents the system of consumer demand functions in the general equilibrium model MSG-5, developed at Statistics Norway. The model is derived from the system consumer demand in MSG-EE, which is a similar model but with a more detailed commodity classification with emphasis on Energy and Environment. The derivation is done by perfect aggregation of the demand functions across goods, assuming constant relative prices within the aggregated groups, with values as in the base year (1991). Aasness and Holtmark (1993) give a detailed documentation of the consumer demand model in MSG-EE, including theory, empirical work, and interpretations. It gives important documentation for the present model. Hence, in this paper we confine ourselves to give a stripped presentation of the model.

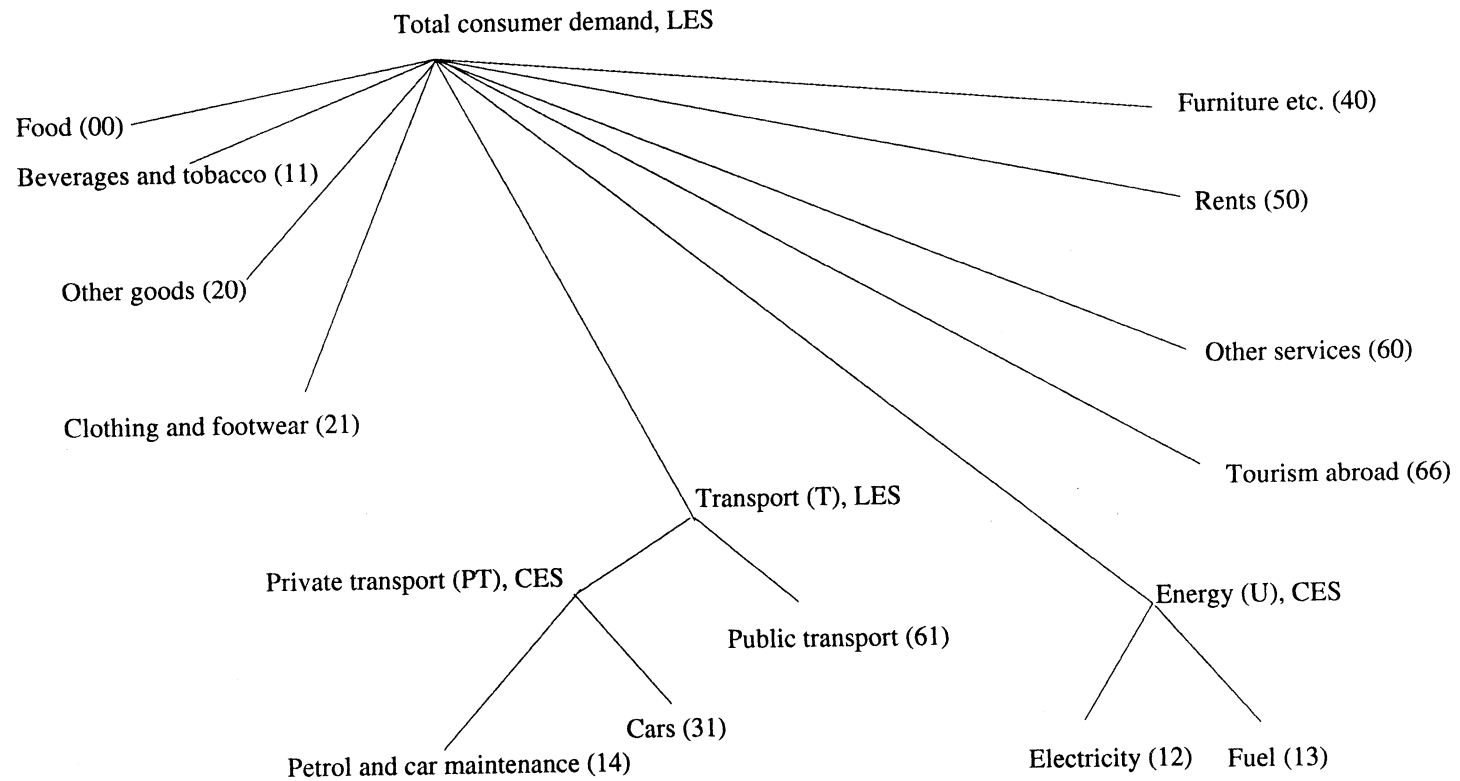
The basic structure of the model (MSG-5) can be found in Holmøy (1992). The consumption model in MSG-5 consists of demand functions for 13 goods, with the same commodity classification as used in MODAG (cf Cappelen (1992)) and in LOTTE-KONSUM (cf Aasness (1993a)). The present model can easily be compared, tested and/or implemented in relation to the latter models.

The model is calibrated using empirical information from several types of data sources and econometric studies, and in particular a microeconomic analysis similar to Aasness, Biørn and Skjerpen (1993). The calibration of the model is presented in Aasness and Holtmark (1993). The methods of this calibration procedure is developed in Aasness (1993b). The construction and application of the model can be considered as a step in a research program for developing and testing consumer demand models, as described in Aasness (1993c).

The demand model, in terms of a recursive equation system, is presented in section 2. The parameters of the model, and some basic demand elasticities, are given section 3. The commodity classification is presented in section 4 and the list of symbols in section 5.

Figure 1
The utility tree in the complete demand system in MSG-5

Commodity codes in parentheses



2. Recursive equation system of the demand model

In this section we present the equations of the recursive simulation model. Figure 1 gives an overview of the utility tree behind the demand model, where LES denotes a branch of utility with functional form corresponding to a Linear Expenditure System, and CES denotes a branch of utility with a Constant Elasticity of Substitution. The numerical values of the parameters are given in table 1-4. Elasticities of the complete demand system are given in table 5-7.

Price indexes

The price-index for the CES-aggregate for energy (U) in time period t, aggregating prices for electricity (12) and fuels (13), is defined by

$$P_{Ut} = \left\{ \omega_U P_{12t}^{(1-\sigma_U)} + (1-\omega_U) P_{13t}^{(1-\sigma_U)} \right\}^{\frac{1}{1-\sigma_U}}, \quad (1)$$

where σ_U is the elasticity of substitution between electricity and fuels and ω_U is a distribution parameter.

The price-index for the CES-aggregate for private transport (PT), aggregating prices for petrol and car maintenance (14) and user cost of cars (31), is given by

$$P_{PTt} = \left\{ \omega_{PT} P_{14t}^{(1-\sigma_{PT})} + (1-\omega_{PT}) P_{31t}^{(1-\sigma_{PT})} \right\}^{\frac{1}{1-\sigma_{PT}}}, \quad (2)$$

where σ_{PT} is the elasticity of substitution between petrol (14) and cars (31) and ω_{PT} is a distribution parameter.

The price index for the marginal utility of transport (T), in the intermediate LES-system for private transport (PT) and public transport (61)), is defined by

$$P_{Tt} = \prod_{j=PT,61} P_{jt}^{\beta_j}, \quad (3)$$

where β_j is the conditional marginal budget share of commodity group j.

The price index for foreigners consumption in Norway is

$$P_{70t} = a_{00} P_{00t} + a_{11} P_{11t} + a_{14} P_{14t} + a_{21} P_{21t} + a_{20} P_{20t} + a_{60} P_{60t} + a_{61} P_{61t}, \quad (4)$$

i.e. a Laspeyres price index which corresponds to a Leontief utility function with the following real consumption index $Q_{70t} = Y_{70t} / P_{70t}$, where Y_{70t} is foreigners consumption expenditure in Norway, and the values of the parameters are $a_{00}=0.1$, $a_{11}=0.04$, $a_{14}=0.15$, $a_{20}=0.08$, $a_{21}=0.08$, $a_{60}=0.49$, and $a_{61}=0.06$.

Minimum expenditures

At the intermediate level LES for transport (T), fixed minimum expenditure for each household (m_{T0t}) and marginal minimum expenditure for each person of different age groups (m_{Tit}) are given by

$$m_{Tit} = \sum_{j=PT,61} p_{jt} \gamma_{ji}, \quad i = 0,1,2, \quad (5)$$

where γ_{j0} is the fixed minimum consumption of commodity j for a household, γ_{j1} is the additional minimum consumption of commodity j for each child in the household, and γ_{j2} is the additional minimum consumption of commodity for each adult in the household.

The macro minimum expenditure of the intermediate level LES for transport is

$$M_{Tt} = m_{T0t} N_t + m_{T1t} A_{1t} + m_{T2t} A_{2t}, \quad (6)$$

where N_t is the number of households, A_{1t} is the number of children, and A_{2t} is the number of adults in Norway.

At the top level LES, the fixed minimum expenditure for each household (m_{0t}) and the marginal minimum expenditure for each person of different age groups (m_{it}) are given by

$$m_{it} = \sum_{j \in R} p_{jt} \gamma_{ji} + m_{Tit}, \quad i = 0,1,2, \quad (7)$$

where R is the commodity grouping at the top level, cf section 4, and the γ 's are analogous to those above. Note that for Transport there are two components of the minimum expenditures, $p_{Tt} \gamma_{Ti}$ from the top level and m_{Tit} from the intermediate level.

The macro minimum expenditure at the top level is

$$M_t = m_{0t} N_t + m_{1t} A_{1t} + m_{2t} A_{2t}, \quad (8)$$

analogous to equation (6).

The top level LES

The expenditure on transport:

$$Y_{Tt} = (m_{T0t} + p_{Tt} \gamma_{T0}) N_t + \sum_{i=1,2} (m_{Tit} + p_{Tt} \gamma_{Ti}) A_{it} + \beta_T (Y_t - M_t). \quad (9)$$

The utility aggregate of energy consumption:

$$Q_{Ut} = \gamma_{U0} \cdot N_t + \sum_{i=1,2} \gamma_{Ui} A_{it} + \beta_U \frac{Y_t - M_t}{P_{Ut}}. \quad (10)$$

Commodity demand of the other goods:

$$Q_{rt} = \gamma_{r0} \cdot N_t + \sum_{i=1,2} \gamma_{ri} A_{it} + \beta_r \frac{Y_t - M_t}{P_{rt}} - a_r Q_{T0t} + Q_{rt}^E, \quad \forall r \in R - \{U, T\}. \quad (11)$$

We have included a term $(-a_r Q_{70t})$ for foreigners consumption of commodity r in Norway. The parameter a_r is the share of foreigners consumption in Norway spent on good r , cf equation 4. The negative sign is due to the fact that foreigners consumption in Norway (Q_{70t}) is measured as a negative number using the conventions of the national accounts. The variable Q_{70t} is exogenously given in the model. Q_{jt}^E are exogenous variables. In the base year these can be interpreted as residuals, and are calibrated to make the model fit exactly to the national account data in the base year.

The intermediate level LES for transport

The demand for public and private transport:

$$Q_{PTt} = \gamma_{PT0} N_t + \sum_{i=1,2} \gamma_{PTi} A_{it} + \beta_{PT} (Y_{Tt} - M_{Tt}) / p_{PTt}, \quad (12)$$

$$Q_{61t} = \gamma_{610} N_t + \sum_{i=1,2} \gamma_{61i} A_{it} + \beta_{61} (Y_{Tt} - M_{Tt}) / p_{61t} - a_{61} Q_{70t} + Q_{61t}^E. \quad (13)$$

The bottom level CES for private transport

Commodity demand:

$$Q_{14t} = Q_{PTt} \omega_{PT} \left(\frac{p_{PTt}}{p_{14t}} \right)^{\sigma_{PT}} - a_{14} Q_{70t} + Q_{14t}^E \quad (14)$$

$$Q_{31t} = Q_{PTt} (1 - \omega_{PT}) \left(\frac{p_{PTt}}{p_{31t}} \right)^{\sigma_{PT}} + Q_{31t}^E. \quad (15)$$

The bottom level CES for energy

Commodity demand:

$$Q_{12t} = Q_{Ut} \omega_U \left(\frac{p_{Ut}}{p_{12t}} \right)^{\sigma_U} + Q_{12t}^E, \quad (16)$$

$$Q_{13t} = Q_{Ut} (1 - \omega_U) \left(\frac{p_{Ut}}{p_{13t}} \right)^{\sigma_U} + Q_{13t}^E. \quad (17)$$

Purchase of cars

The variable Q_{31t} should be understood as a stream of services from the households stock of cars. From Q_{31t} we have to calculate the purchase of cars, Q_{30t} . This is done as follows, using standard procedures for handling purchases of durables in MSG,

$$Q_{30t} = \frac{1}{K_{31}} [(1+\delta)Q_{31t} - Q_{31t-1}], \quad (18)$$

where δ is the depreciation rate of the stock of cars and K_{31} is a constant explained below.

The price index for the user cost of cars is determined by:

$$P_{31t} = \frac{1}{K_{31}} (\delta + R_{Bt}) \frac{P_{Kt}}{C_{30t}} [(C_{30t} - C_{K30t})P_{30t} + C_{K30t}P_{J40t}], \quad (19)$$

where R_{Bt} is an exogenous interest rate in the equilibrium model, P_{Kt} is an index reflecting changes in the average user cost of capital, P_{J40t} is a price index for used cars, C_{K30t} is the households purchase of used cars, and $K_{31} = (\delta + R_{B0})P_{K0}$ is a constant which normalizes the user cost of cars to 1 in the base year.

3. Parameters and elasticities

Figure 1 describes the main structure of the present consumer demand model. Table 1-4 present the values of the basic parameters of the model. Table 5-7 present the demand elasticities. The comments to the model in Aasness and Holtmark (1993) may help the reader to digest the results.

Table 1
Parameter values in the top level LES

Commodity group		Minimum consumption ^{a)}			Marginal budget share
		Fixed	Extra child	Extra adult	
Code	Name	γ_0	γ_1	γ_2	β
00	Food	6503	8776	10026	0,0621
11	Beverages and tobacco	3557	1389	1292	0,0701
U	Energy ^{b)}	7058	1082	1537	0,0175
T	Transport ^{c)}	-7841	2283	10613	0,1684
20	Other goods	1246	2927	3809	0,0989
21	Clothing and footwear	-1386	2836	3926	0,0626
40	Furniture etc.	1741	937	978	0,0802
50	Rents	8199	3689	-1171	0,1715
60	Other services	-895	2196	4339	0,1282
66	Tourism abroad	-2143	56	1102	0,1405
Sum		16039	26170	36452	1,000

a) Measured in 1991 kroner

b) A CES aggregate, see table 3

c) Based on the intermediate level LES in table 2 and the bottom level CES in table 4. Note that minimum consumption at the intermediate level comes in addition to those tabulated here.

Table 2
Parameters in the intermediate level LES for Transport

Commodity group		Minimum consumption ^{a)}			Marginal budget share
		Fixed	Extra child	Extra adult	
Code	Name	γ_0	γ_1	γ_2	β
PT	Private transport	-4100	1388	349	0,7754
61	Public transport	3498	-1070	-69	0,2246
Sum		-602	318	280	1,000

a) Measured in 1991 kroner

Table 3
Parameters in the bottom level
CES for Energy

Commodity group		Distribution parameter
Code	Name	ω
12	Electricity	0,865
13	Fuels	0,135
Sum		1,000
Elasticity of substitution		0,5

Table 4
Parameters in the bottom level CES
for Private Transport

Commodity group		Distribution parameter
Code	Name	ω
14	Petrol and car maintenance	0,456
31	User cost of cars	0,544
Sum		1,000
Elasticity of substitution		0,1

Table 5
Elasticities in the complete demand system^{a)}

Commodity group		Budget share	Engel elasticity	Household elasticity	Child elasticity	Adult elasticity	Direct Slutsky elasticity	Direct Cournot elasticity
Code	Name							
12	Electricity	0,054	0,279	0,571	0,123	0,178	-0,186	-0,201
13	Fuels	0,008	0,279	0,571	0,123	0,178	-0,451	-0,453
14	Petrol and Car Maintenance	0,046	1,290	-0,636	-0,037	0,468	-0,360	-0,420
31	Cars	0,055	1,290	-0,636	-0,037	0,468	-0,410	-0,481
61	Public transport	0,047	0,804	0,129	-0,415	0,246	-0,622	-0,659
00	Food	0,185	0,336	0,158	0,483	0,525	-0,157	-0,219
11	Beverages and tobacco	0,070	1,007	0,188	-0,084	-0,231	-0,467	-0,537
20	Other goods	0,100	0,988	-0,015	0,038	0,022	-0,444	-0,543
21	Clothing and footwear	0,069	0,905	-0,179	0,213	0,294	-0,423	-0,486
40	Furniture etc.	0,061	1,316	0,044	-0,244	-0,404	-0,603	-0,684
50	Rents	0,129	1,327	0,227	-0,083	-0,724	-0,548	-0,720
60	Other services	0,106	1,209	-0,143	-0,142	-0,044	-0,525	-0,653
66	Tourism abroad	0,069	2,030	-0,329	-0,663	-0,734	-0,870	-1,010
Sum ^{b)}		1,000	1,000	0,000	0,000	0,000	-	-

a)Elasticities for the average household and macro demands

b)The elasticities are weighted with the budget shares

Table 6
Slutsky elasticities in the complete demand system^{a)}

Commodity group															
Code	Name	s _{j12}	s _{j13}	s _{j14}	s _{j31}	s _{j61}	s _{j00}	s _{j11}	s _{j20}	s _{j21}	s _{j40}	s _{j50}	s _{j60}	s _{j66}	Sum b)
12	Electricity	-0,186	0,049	0,008	0,010	0,005	0,009	0,010	0,014	0,009	0,011	0,024	0,018	0,020	0,000
13	Fuels	0,314	-0,451	0,008	0,010	0,005	0,009	0,010	0,014	0,009	0,011	0,024	0,018	0,020	0,000
14	Petrol and Car Maint.	0,010	0,002	-0,360	-0,309	0,134	0,040	0,045	0,064	0,040	0,052	0,110	0,082	0,090	0,000
31	Cars	0,010	0,002	-0,260	-0,410	0,134	0,040	0,045	0,064	0,040	0,052	0,110	0,082	0,090	0,000
61	Public transport	0,006	0,001	0,132	0,157	-0,622	0,025	0,028	0,040	0,025	0,032	0,069	0,051	0,056	0,000
00	Food	0,003	0,000	0,010	0,012	0,006	-0,157	0,012	0,017	0,010	0,013	0,029	0,021	0,024	0,000
11	Beverages and tobacco	0,008	0,001	0,030	0,036	0,019	0,031	-0,467	0,050	0,031	0,040	0,086	0,064	0,070	0,000
20	Other goods	0,007	0,001	0,029	0,035	0,019	0,031	0,035	-0,444	0,031	0,039	0,084	0,063	0,069	0,000
21	Clothing and footwear	0,007	0,001	0,027	0,032	0,017	0,028	0,032	0,045	-0,423	0,036	0,077	0,058	0,063	0,000
40	Furniture etc.	0,010	0,002	0,039	0,047	0,025	0,041	0,046	0,065	0,041	-0,603	0,112	0,084	0,092	0,000
50	Rents	0,010	0,002	0,039	0,047	0,025	0,041	0,046	0,065	0,041	0,053	-0,548	0,085	0,093	0,000
60	Other services	0,009	0,001	0,036	0,043	0,023	0,037	0,042	0,060	0,038	0,048	0,103	-0,525	0,085	0,000
66	Tourism abroad	0,015	0,002	0,060	0,072	0,038	0,063	0,071	0,100	0,063	0,081	0,173	0,130	-0,870	0,000
	Sum c)	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000

a) Elasticities for the average household and macro demands in the base year (1991).

b) We apply that $\sum_j s_{ij}=0$, i.e. homogeneity of demands, for control.

c) We apply that $\sum_j w_i s_{ij}=0$, i.e. an adding up condition, for control

Table 7
Cournot elasticities in the complete demand system^{a)}

Commodity group															
Code	Name	ϵ_{j12}	ϵ_{j13}	ϵ_{j14}	ϵ_{j31}	ϵ_{j61}	ϵ_{j00}	ϵ_{j11}	ϵ_{j20}	ϵ_{j21}	ϵ_{j40}	ϵ_{j50}	ϵ_{j60}	ϵ_{j66}	Sum ^{b)}
12	Electricity	-0,201	0,047	-0,005	-0,005	-0,008	-0,043	-0,010	-0,014	-0,011	-0,006	-0,012	-0,012	0,000	0,000
13	Fuels	0,299	-0,453	-0,005	-0,005	-0,008	-0,043	-0,010	-0,014	-0,011	-0,006	-0,012	-0,012	0,000	0,000
14	Petrol and Car Maint.	-0,060	-0,009	-0,420	-0,380	0,073	-0,198	-0,045	-0,066	-0,049	-0,027	-0,056	-0,054	0,001	0,000
31	Cars	-0,060	-0,009	-0,319	-0,481	0,073	-0,198	-0,045	-0,066	-0,049	-0,027	-0,056	-0,054	0,001	0,000
61	Public transport	-0,038	-0,006	0,095	0,113	-0,659	-0,124	-0,028	-0,041	-0,031	-0,017	-0,035	-0,034	0,001	0,000
00	Food	-0,016	-0,002	-0,006	-0,007	-0,009	-0,219	-0,012	-0,017	-0,013	-0,007	-0,015	-0,014	0,000	0,000
11	Beverages and tobacco	-0,047	-0,007	-0,017	-0,020	-0,028	-0,155	-0,537	-0,051	-0,038	-0,021	-0,044	-0,042	0,001	0,000
20	Other goods	-0,046	-0,007	-0,016	-0,019	-0,028	-0,152	-0,034	-0,543	-0,038	-0,021	-0,043	-0,042	0,001	0,000
21	Clothing and footwear	-0,042	-0,007	-0,015	-0,018	-0,026	-0,139	-0,031	-0,046	-0,486	-0,019	-0,040	-0,038	0,001	0,000
40	Furniture etc.	-0,061	-0,010	-0,022	-0,026	-0,037	-0,202	-0,046	-0,067	-0,050	-0,684	-0,058	-0,055	0,001	0,000
50	Rents	-0,062	-0,010	-0,022	-0,026	-0,037	-0,204	-0,046	-0,067	-0,050	-0,028	-0,720	-0,056	0,001	0,000
60	Other services	-0,056	-0,009	-0,020	-0,024	-0,034	-0,186	-0,042	-0,061	-0,046	-0,025	-0,053	-0,653	0,001	0,000
66	Tourism abroad	-0,095	-0,015	-0,033	-0,040	-0,057	-0,312	-0,070	-0,103	-0,077	-0,043	-0,089	-0,086	-1,010	0,000
	Sum ^{c)}	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000

a) Elasticities for the average household and macro demands in the base year (1991).

b) We apply that $\sum_j \epsilon_{ij} + E_i = 0$, i.e. homogeneity of demands, for control.

c) We apply that $\sum_j w_i \epsilon_{ij} + w_i = 0$, i.e. an adding up condition, for control.

4. Commodity classifications

The 22 commodity groups in MSG-EE can be aggregated to the 13 commodity groups in MSG-5 and MODAG, cf table 8

In addition we have commodity aggregates corresponding to branches in the utility tree, namely U: Energy, PT:Private Transport and T:Transport. The set of commodities corresponding to these aggregates are denoted by $J_U=\{12,13\}$, $J_{PT}=\{14,31\}$ and $J_T=\{PT,61\}$, where the commodities within the sets are defined in table 8.

In the upper level LES in the empirical model we have a set R of commodities (cf table 8) and aggregates (U,T):

$$R = \{00,11,U,T,20,21,40,50,60,66\}.$$

Table 8
Commodity classifications in MSG-5 and MSG-EE

MSG-5 (1991)			MSG-EE (1988)		
Code	Names	Aggregating equation	Code	Names	NA-codes
00	Food		00	Food	0aa
11	Beverages and tobacco		11	Beverages and tobacco	11a+12a
21	Clothing and footwear		21	Clothing and footwear	21a+22a+23a
50	Rents		50	Rents	31a
12	Electricity		12	Electricity	321
13	Fuel		13	Fuel	32a-321
40	Furniture etc.	$C40=C41+C42$	41	Furniture etc.	41a+42a+43a
20	Other goods	$C20=C22+C23+C15$	22	Other household goods	44a+451+452
60	Other services	$C60=C64+C63+C65$	64	Various household services	453+454+461+471
30	Purchases of cars		30	Purchases of cars	61a
14	Petrol and Car Maintenance		14	Petrol and Car Maintenance	62a
			75	Bus transport,transport by taxi etc.	635+636+0.9*637
			76	Air transport	634
			77	Railway, tramway and subway transport	631+632
			78	Transport by boat and ferry	633+0.1*637
			79	Postage, telephone and telegram	64a
61	Public transport	$C61=C75+C76+C77+C78+C79$	42	Durable consumer goods	711+712+713+714
			63	Entertainment, education etc.	72a+74a
			23	Other goods for recreation activities	73a+715+716+717+718
			15	Other goods	81a+82a
			65	Other services	83a+84a+85a
66	Tourism abroad		66	Tourism abroad	991

5. List of symbols

TROLL-code	Symbol in the text	Comments
	a_r	Share of foreigners consumption in Norway spent on commodity r
BE.r	β_r	Marginal budget share of commodity r in the upper level LES
BE.j	β_j	Conditional marginal budget share of commodity group j in the intermediate level LES
CEj	Q_j	Exogenous consumption of commodity j
Cj	Q_j	Macro consumption of commodity j in fixed prices
CK40	C_{K40}	The households purchase of used cars
D.ELB	δ	Depreciation rate of the stock of cars
GA.jH0	γ_0	Fixed minimum consumption of commodity j for each household
GA.jZ1	γ_{j1}	Marginal minimum consumption of commodity j for one child
GA.jZ2	γ_{j2}	Marginal minimum consumption of commodity j for one adult
	J_x	Set of commodities in group x, x= PT,U,T, cf section 4
K.31	K_{31}	Constant in the equation for user cost of cars
NB0019	A_1	Number of children (age 0-19) in Norway
NB20	A_2	Number of adults (age 20 +) in Norway
NH	N	Number of households in Norway
O.PT	ω_{PT}	Distribution parameter in the demand for private transport
O.U	ω_U	Distribution parameter in the demand for energy
PCj	p_j	Price index for commodity j
PJ40	P_{J40}	Price index for used cars

TROLL-code	Symbol	Comments
PKJUST	P_K	Index reflecting average user costs of capital
	R	The set of commodity groups at the top level LES, cf table 1 and section 4.
RB	R_B	Exogenous interest rate
SU.PT	σ_{PT}	Elasticity of substitution between Petrol and Cars
SU.U	σ_U	Elasticity of substitution between Electricity and Fuels
VCB	-	Macro expenditure on consumption including purchase of cars Q_{30}
VCC	Y	Macro expenditure on consumption including services from stock of cars Q_{31}
VCMIN	M	Macro minimum expenditure
VCMINH0	m_0	Fixed minimum household expenditure at the top level LES (including minimum expenditure at the intermediate level LES for transport)
VCMINTH0	m_{T0}	Fixed minimum household expenditure at the intermediate level LES for transport
VCMINTZ1	m_{T1}	Marginal minimum expenditure for one child at the intermediate level LES for transport
VCMINTZ2	m_{T2}	Marginal minimum expenditure for one adult at the intermediate level LES for transport
VCMINZ1	m_1	Marginal minimum expenditure for one child at the top level LES
VCMINZ2	m_2	Marginal minimum expenditure for one adult at the top level LES
VCT	Y_T	Macro expenditure on transport

References

- Aasness, J. (1993a): "Fordelingsvirkninger av barnetrygd og matmoms - en analyse basert på LOTTE-KONSUM", *Økonomiske analyser 9/93*, 80-88, Statistisk sentralbyrå, Oslo.
- Aasness, J. (1993b): "An approach to modelling consumer demand", mimeo, Statistics Norway, Oslo.
- Aasness, J. (1993c): "Et forskningsprogram i konsumøkonometri", mimeo, Statistics Norway, Oslo.
- Aasness, J., E. Biørn, and T. Skjerpen (1993): "Engel functions, panel data, and latent variables", *Econometrica* 61, 1395-1422.
- Aasness, J. and B. Holtmark (1993): "Consumer demand in a general equilibrium model for environmental analysis", Discussion paper (forthcoming), Statistics Norway, Oslo.
- Cappelen, Å. (1992): "MODAG - A medium term macroeconomic model of the Norwegian economy", in: L. Bergman and Ø. Olsen (eds), *Economic modeling in the Nordic countries.*, Contribution to economic analysis no. 210, North-Holland, Amsterdam.
- Holmøy, E. (1992): "The structure and working of MSG-5, an applied general equilibrium model of the Norwegian economy". In: L. Bergman and Ø. Olsen (eds), *Economic modeling in the Nordic countries.* Contribution to economic analysis no. 210, North-Holland, Amsterdam.