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Abstract

This paper uses data on consumption expenditure and price levels from the European Comparison Project (ECP) 1996 for the analysis of demand structures in a cross-section of 52 countries. The paper describes the patterns of consumption expenditures, price levels and relative prices for four groups of countries (ranked by their expenditure levels). This is done at different levels of aggregation for three, six, and eight groups of consumption goods. This descriptive analysis shows, first, the dependence of consumption patterns on the level of expenditures and, second, broad patterns of price levels and price structures. Poorer countries tend to have lower absolute price levels in all groups of goods examined. It turns out that e.g. the relative price of food tends to be higher the lower the per capita income of a country is. On the other hand, services tend to be relatively cheaper in low income countries.

Two models of demand are tested econometrically. The Workings model uses only expenditure levels as the independent variable to explain the patterns of consumption. It is shown especially for some goods that this sole explanatory variable gives a surprisingly good fit in explaining the consumption structures across countries. Further the Almost Ideal Demand System (AIDS), which is a quite flexible framework for estimating consumption structures and includes also prices as explaining variables, is tested econometrically for various aggregates of consumption goods (three and six commodity groups) in a cross-country analysis. The results given in this paper derived from the non-linear as well as a linearised version of the model confirms the results from other studies using time-series data (especially the results found by Deaton and Muellbauer, 1980a).

The results in general show that a large proportion of the variation in consumption patterns across countries can be explained by expenditure (income) levels and prices.

JEL-Classification: C31, C52, D12, O57

Keywords: consumption patterns, demand analysis, price levels, price structures, demand systems

EXPENDITURE LEVELS, PRICES, AND CONSUMPTION PATTERNS IN A CROSS-SECTION OF COUNTRIES

Robert Stehrer[1]

1 Introduction

This paper focuses on the consumption patterns in a cross-section of 52 countries. For an explanation of these patterns merely two variables are used: income levels and prices. These two variables explain the observed patterns of consumption fairly well for a wide range of commodity groups. The main part of the paper is devoted to report results of an econometric analysis for different groupings of commodities and various assumptions concerning the estimated demand systems.

Section 2 of the paper introduces the data and variables used in the analysis in the further sections. Section 3 gives a very short overview of expenditure and demand systems and introduces the basic structure of two well-known models.

Sections 4 and 5 report result of the estimation of the Almost Ideal Demand System. In section 6 we use six commodity groups, although one has to take into account the severe constraint of the number of observations.

2 Data set

2.1 Classification scheme of the ECP data

For this research we use data from the European Comparison Project (ECP) for 1996. This data set includes 52 mainly European and some important non-European countries. The countries and abbreviations used in the paper are listed in the appendix (table A.1; see also table 2.2 for a listing of the average final consumption levels per capita).

The ECP data distinguish between several consumption items which are listed in table 2.1. Final consumption by the ECP data (item 1) is the sum of items 2, 15, 18, 21, 26, 27, 32, 37 and 40. GDP (item 53 in the ECP data) is then the sum of final consumption and items 41, 43, 47, 51 and 52. In this paper we use final consumption as the sum of items 2, 15, 18, 21, 26, 27, 32 and 37; thus we do not include item 40 (net purchases abroad).

2.2 Variables

From this data set nominal expenditure per capita NV_i^c and the purchasing power parity P_i^c are used in this paper. All nominal values in the ECP data set are expressed in national

[1]A first draft of the paper was written as part of the COUNTDOWN project 'EU Enlargement: The Effects on Patterns of Trade in Consumer Goods, Relative Prices and the Gaps between Exchange Rates and Purchasing Power Parities'.

AGG III		AGG II		AGG I	
4	Bread and cereals	3	Food	2	FOOD, BEVERAGES, TOBACCO
5	Meat				
6	Fish				
7	Milk, cheese and eggs				
8	Oils and fats				
9	Fruits, vegetables, potatoes				
10	Other food				
12	Non-alcoholic beverages	11	Beverages		
13	Alcoholic beverages				
		14	Tobacco		
		16	Clothing	15	CLOTHING and FOOTWEAR
		17	Footwear		
		19	Gross rents (incl. indoor repair)	18	GROSS RENTS, FUEL and POWER
		20	Fuel and power		
		22	Furniture	21	HOUSEHOLD EQUIPMENT and OPERATION
		23	Household textiles		
		24	Appliances		
		25	Other household goods and services		
				26	MEDICAL CARE
		28	Transport equipments	27	TRANSPORT and COMMUNICATION
		29	Operation of equipments		
		30	Purchased transport services		
		31	Communication		
		33	Equipment for recreation	32	RECREATION, CULTURE, EDUCATION
		34	Recreational, cultural services		
		35	Books, newspapers, magazines		
		36	Education		
		38	Restaurants, cafes, hotels	37	MISCELLANEOUS GOODS and SERVICES
		39	Other goods and services (+NPI nec)		
				40	NET PURCHASES ABROAD
				41	COLLECTIVE SERVICES of GOVERNMENT
		44	Residential buildings	43	CONSTRUCTION
		45	Non-residential buildings		
		46	Other construction, etc.		
		48	Transport equipment	47	MACHINERY and EQUIPMENT
		49	Non-electrical machinery		
		50	Electrical machinery		
				51	CHANGES in STOCKS
				52	BALANCE of IMPORTS and EXPORTS
				42	GROSS FIXED CAPITAL FORMATION

Table 2.1: ECP-classification

currency units (NCU). The purchasing power parities and the exchange rate are expressed relative to the Austrian Shilling (ATS). Thus Austria is used as the base country.

As mentioned above the data set includes 52 countries. These countries can be ranked by their real expenditure levels $Y^c = \sum_i RV_i^c$. These real expenditure levels are calculated at the AGGI level for 8 analytical categories as mentioned above. Table 2.2 shows the countries included in the data set and their levels of final consumption per capita expressed in Austrian Shilling (ATS), respectively. Final consumption per capita Y^c is thus calculated as

$$Y^c = \sum_i^8 RV_i^c$$

where $RV_i^c = \frac{NV_i^c}{P_i^c}$ is the per capita expenditure in ATS in consumption category i, $i = 2, 15, 18, 21, 26, 27, 32, 37$ in 1996. NV_i^c denotes the nominal value of consumption of category i in country c in national currency units (NCU) in 1996 and P_i^c is the price level relative to Austria

(expressed in number of units of NCU per 1 ATS) for this particular item.[2] Further we divided the sample into four quartiles. The upper part of table 2.2 presents the absolute income levels expressed in ATS. The last two rows in the upper part show the average expenditure level per capita and the Coefficient of Variation (CoV) of each quartile. The lower part of the table presents the expenditure in percentage of the US, which turns out to be the country with the highest consumption expenditure levels per capita.[3] The expenditure levels per capita range from 6726 ATS in Tajikistan (TAJ) to 295746 ATS at the maximum in the US. This means that people in the poorest country (TAJ) have reached an expenditure of only 2.3 % compared to the US. The first quartile of countries has had a level of 27000 ATS or only about 10 % of the US level.

2.3 Aggregation of PPP rates

Below we use different groupings of commodities for which the PPP's have to be aggregated. This aggregation was calculated by the following procedure (Fisher index): The Fisher index is defined as

$$P_j^c = \left(I_{Lj}^c I_{Pj}^c\right)^{\frac{1}{2}}$$

which is the (unweighted) geometric mean of the Laspeyers and the Paasche index. P_j^c denotes the purchasing power parity of the aggregated consumption item $j = 1, \ldots J$ in country c. I_{Lj}^c denotes the Laspeyers index

$$I_{Lj}^c = \frac{\sum_{i \in I_j} P_i^c NV_i^{AUT}}{\sum_{i \in I_j} P_i^{AUT} NV_i^{AUT}} = \frac{\sum_{i \in I_j} P_i^c NV_i^{AUT}}{\sum_{i \in I_j} NV_i^{AUT}} = \sum_{i \in I_j} P_i^c w_i^{AUT}$$

[2]For clarification we give an example. When spending one ATS on bread and cereals in Austria, one gets the same bundle for 0.1493 DM in Germany and for 0.04453 £in Great Britain. Per capita expenditure on this item in Austria is ATS 3822, in Germany 592 DM = $\frac{592}{0.1493}$ = 3965.17 ATS, and in Great Britain 130 £= $\frac{130}{0.04453}$ = 2919.38 ATS.

[3]For countries marked with * no data at the AGGII or AGGIII level are available.

1		2		3		4	
Country	**Y^c**	**Country**	**Y^c**	**Country**	**Y^c**	**Country**	**Y^c**
Levels in ATS							
TAJ	6726	BLR	53687	SVN	129639	UKD	201623
MON	9792	LVA	58274	CZE	131680	NOR	202034
TRM	14544	BGR	59861	GRC	139343	BEL	204922
AZR	22077	TUR	60992	PRT	144004	DEU	208035
KYR	23406	RUS	61401	SPA	151027	AUT	209998
UZB	23517	LTU	64089	IRL	157171	AUS*	213787
ARM	23576	HRV	65518	ISR	163568	JAP*	218208
MDA	27505	ROM	68297	FIN	171290	CAN*	223820
ALB	29370	MEX*	74175	NZL*	177240	CHE	228256
GEO	33626	POL	76924	SWE	183319	DNK	231210
UKR	39865	EST	83327	NLD	188016	ISL	237606
FYR	49849	SVK	88189	ITA	198145	LUX	282192
KAZ	49959	HUN	99357	FRA	200386	USA*	295746
Mean	27216		70315		164218		227495
CoV	0.496		0.191		0.148		0.130
Relative to US							
TAJ	0.023	BLR	0.182	SVN	0.438	UKD	0.682
MON	0.033	LVA	0.197	CZE	0.445	NOR	0.683
TRM	0.049	BGR	0.202	GRC	0.471	BEL	0.693
AZR	0.075	TUR	0.206	PRT	0.487	DEU	0.703
KYR	0.079	RUS	0.208	SPA	0.511	AUT	0.710
UZB	0.080	LTU	0.217	IRL	0.531	AUS*	0.723
ARM	0.080	HRV	0.222	ISR	0.553	JAP*	0.738
MDA	0.093	ROM	0.231	FIN	0.579	CAN*	0.757
ALB	0.099	MEX*	0.251	NZL*	0.599	CHE	0.772
GEO	0.114	POL	0.260	SWE	0.620	DNK	0.782
UKR	0.135	EST	0.282	NLD	0.636	ISL	0.803
FYR	0.169	SVK	0.298	ITA	0.670	LUX	0.954
KAZ	0.169	HUN	0.336	FRA	0.678	USA*	1.000
Mean	0.092		0.238		0.555		0.769

Table 2.2: Countries and income levels

$i \in I_j$ represents the set of goods i which are included in the composite good j. This index[4] is thus the weighted mean of the PPP rates, the weights being the Austrian expenditure shares $w_i^{AUT} = \frac{NV_i^{AUT}}{\sum_{i \in I_j} NV_i^c}$. I_{Pj}^c is the Paasche-Index

$$I_{Pj}^c = \frac{\sum_{i \in I_j} NV_i^c}{\sum_{i \in I_j} \frac{NV_i^c}{P_i^c}} = \frac{\sum_{i \in I_j} NV_i^c}{\sum_{i \in I_j} RV_i^c} = \left(\sum_{i \in I_j} \frac{P_i^{AUT} w_i^c}{P_i^c} \right)^{-1} = \left(\sum_{iin I_j} \frac{w_i^c}{P_i^c} \right)^{-1}$$

The Paasche index is thus a weighted harmonic mean of the price levels, the weights being the nominal expenditure shares $w_i^c = \frac{NV_i^c}{\sum_{i \in I_j} NV_i}$.[5]

3 Expenditure and demand systems

For analysing the consumption patterns and demand systems and their dependence on income levels and prices, a number of approaches has been developed in the literature (for an excellent survey see, Deaton and Muellbauer, 1980b). For empirical and econometric analysis there exists a range of models, such as the Linear Expenditure system, the Rotterdam model, the Stones approach, the translog demand system, etc. In this paper we analyse a model which is more flexible than the models mentioned above and has proven to be very fruitful in analysing consumption patterns over time and, as we shall show below, also in cross-section studies. The model is the so-called Almost Ideal Demand System (AIDS), which was introduced by Deaton and Muellbauer (1980a). The structure of the model will be introduced below.

But first, to emphasize the impact of income levels (or expenditure levels) on consumption structures, we introduce a model which only uses income levels as the explaining factor of different consumption patterns in a cross-section of countries.

3.1 Working's model

The model used here as a first step was introduced by Working (1943) and used also by Leser (1963, 1976). Further it is shown that the Almost Ideal Demand System implies the same Engel curves as proposed in Working's model. This simple model only relates the nominal share of expenditure to the logarithm of income:

$$w_i^c = \alpha_i + \beta_i \ln Y^c \tag{3.1}$$

Of course, this model is a very special case as it does not take the effect of differences in prices into account. Nonetheless, it may serve in a first step as a guideline on the importance of income or expenditure levels for consumption patterns. Further one can quite easily work out the income elasticities ϵ_{mi} which are

$$\epsilon_{mi} = 1 + \frac{\beta_i}{w_i^c}$$

[4] This formula results from the fact that by definition $P_i^{AUT} = 1$.

[5] Again one has to notice that $P_i^{AUT} = 1$ by definition.

Thus the income elasticities are lower than 1 if $\beta_i < 0$ and larger than 1 in the case $\beta_i > 0$. If the expenditure share of a necessary good is falling when income rises the income elasticity is less than one and can even become negative. For a luxury good the income elasticity is above 1 when the share spent on this good is rising with income.

Table 3.1 shows the estimation results of equation 3.1. These estimations were done at the AGGII level (see table 2.1) and thus for 22 consumption items. As we estimate across countries, the nominal consumption expenditures $\sum_i NV_i^c$ have to be adjusted by PPP rates. These PPP rates have been calculated (aggregated) according to the procedure described above using the 22 items at the AGGII level in table 2.1. Thus the estimated equation has the form

$$w_i^c = \hat{\alpha}_i + \hat{\beta}_i \ln \frac{Y^c}{P^c} + \epsilon_i^c$$

where P^c denotes the PPP rate for total expenditures (again aggregated by the procedure described above). The regression was run for each item separately. This means that the fact that $\sum_i w_{i,t}^c = 1$ was not taken into account at this stage. Further one has to note that at this level of aggregation data are available only for 46 countries (see table 2.2 above). The interpretation of this model is quite simple. The parameter β_i classifies the

Item	Nomenclature	β_i	$p < \|t\|$	α_i	$p < \|t\|$	R^2
3	Food	-0.176	0.000	2.258	0.000	0.855
17	Footwear	-0.005	0.000	0.069	0.000	0.282
26	Medical care	-0.115	0.005	1.474	0.001	0.133
30	Purchased transport services	-0.006	0.004	0.095	0.000	0.152
11	Beverages	0.001	0.766	0.022	0.452	-0.021
16	Clothing	-0.004	0.168	0.093	0.007	0.021
20	Fuel and power	0.000	0.868	0.032	0.266	-0.022
24	Other household goods and services	0.001	0.570	0.002	0.891	-0.015
14	Tobacco	0.004	0.002	-0.029	0.040	0.180
19	Gross rents	0.046	0.000	-0.427	0.000	0.643
22	Furniture	0.006	0.000	-0.048	0.000	0.401
23	Household textiles	0.001	0.007	-0.010	0.058	0.133
25	Appliances	0.004	0.002	-0.024	0.084	0.180
28	Transport equipments	0.012	0.000	-0.105	0.000	0.436
29	Operation of equipments	0.015	0.000	-0.131	0.000	0.531
31	Communication	0.002	0.000	-0.015	0.023	0.268
33	Equipment for recreation	0.010	0.000	-0.088	0.000	0.584
34	Recreational, cultural services	0.012	0.000	-0.117	0.000	0.463
35	Books, newspapers, magazines	0.003	0.000	-0.030	0.000	0.462
36	Education	0.011	0.003	-0.056	0.170	0.165
38	Restaurants, cafes, hotels	0.024	0.000	-0.225	0.000	0.368
39	Other goods and services	0.014	0.014	-0.081	0.184	0.111

Table 3.1: Working's model

consumption items as either necessities ($\beta_i < 0$), unit income elasticity goods ($\beta_i = 0$), or luxury goods for $\beta_i > 0$. (In this model the income elasticity becomes lower than zero when the expenditure shares w_i^c becomes lower than the coefficient β_i; see formula above.) According to this classification four goods can be characterized as necessities: food (3), footwear (17), medical care (26), and purchased transport services (30). Another four goods show a β_i which is not statistically different from zero, namely beverages (11), clothing (16), fuel and power (20), and appliances (24). Further one should note the

partly high adjusted goodness-of-fit values ($\bar{R}^2$), which for example explains 85 % of the variation in nominal expenditure shares for food.

Finally, we calculate the income elasticities as given in the formula above for the four quartiles. The expenditure shares and implied elasticities are given in table 3.2. One

Item	Good	w_i^1	w_i^2	w_i^3	w_i^4	ϵ_{mi}^1	ϵ_{mi}^2	ϵ_{mi}^3	ϵ_{mi}^4
3	Food	0.511	0.291	0.136	0.106	0.656	0.396	-0.293	-0.667
17	Footwear	0.021	0.018	0.012	0.008	0.760	0.723	0.591	0.382
26	Medical care	0.059	0.148	0.173	0.381	-0.954	0.225	0.334	0.698
30	Purchased transport services	0.033	0.031	0.022	0.020	0.820	0.804	0.721	0.696
11	Beverages	0.023	0.047	0.024	0.029	1.043	1.021	1.041	1.035
16	Clothing	0.050	0.047	0.046	0.046	0.919	0.914	0.913	0.912
20	Fuel and power	0.035	0.047	0.034	0.032	1.000	1.000	1.000	1.000
24	Other household goods and services	0.008	0.014	0.009	0.010	1.125	1.073	1.112	1.097
14	Tobacco	0.011	0.016	0.019	0.019	1.359	1.250	1.207	1.211
19	Gross rents	0.033	0.093	0.131	0.143	2.376	1.494	1.351	1.321
22	Furniture	0.007	0.013	0.016	0.023	1.815	1.475	1.379	1.263
23	Household textiles	0.003	0.004	0.006	0.005	1.381	1.231	1.155	1.202
25	Appliances	0.014	0.019	0.026	0.023	1.286	1.213	1.152	1.174
28	Transport equipments	0.012	0.019	0.034	0.040	1.982	1.618	1.352	1.300
29	Operation of equipments	0.022	0.040	0.052	0.055	1.693	1.375	1.286	1.271
31	Communication	0.008	0.013	0.014	0.013	1.248	1.157	1.146	1.149
33	Equipment for recreation	0.007	0.020	0.025	0.030	2.428	1.504	1.401	1.328
34	Recreational, cultural services	0.008	0.019	0.035	0.035	2.573	1.617	1.342	1.344
35	Books, newspapers, magazines	0.004	0.010	0.012	0.012	1.710	1.309	1.261	1.255
36	Education	0.057	0.068	0.079	0.079	1.194	1.162	1.140	1.139
38	Restaurants, cafes, hotels	0.016	0.041	0.082	0.065	2.518	1.583	1.292	1.371
39	Other goods and services	0.063	0.053	0.082	0.100	1.223	1.263	1.171	1.139

Table 3.2: Expenditure shares and income elasticities for country groups

can see that the implied elasticities are below one for the first group of goods (food, footwear, medical care, and purchased transport services). For this group, the income elasticities are even below zero in three cases. In the second group (beverages, clothing, fuel and power, and other household goods) the income elasticities are about one, and for the remaining goods are higher than one. Further, it is remarkable that the income elasticities are in general higher in the low-income countries. Remarkably are the high elasticities for gross rents (19), equipment for recreation (33), recreational and cultural services (34) and restaurants, cafes and hotels (38) which are fairly larger than two in the low-income countries.

This exercise, when using only income levels as an explaining variable, is of limited relevance if (relative) prices have an impact on expenditure patterns.

3.2 The Almost Ideal Demand System

From the Almost Ideal Demand System the following demand functions can be derived (see Deaton and Muellbauer, 1980a):

$$w_i^c = \alpha_i + \sum_j \gamma_{ij} \ln P_j^c + \beta_i \ln \frac{x^c}{P^c}$$

with

$$\ln P^c = \alpha_0 + \sum_k \alpha_k \ln P_k^c + \frac{1}{2} \sum_j \sum_k \gamma_{kj} \ln P_k^c \ln P_j^c$$

w_i^c denotes the nominal consumption share of consumption category i in country c, P_i^c the price and x^c is total expenditure per capita in nominal terms. The restrictions on the parameters are

$$\sum_i^n \alpha_i = 1; \sum_i^n \gamma_{ij} = 0; \sum_i^n \beta_i = 0;$$

These restrictions are adding up restrictions which ensure that $\sum_i^n w_i^c = 1$. These restrictions cannot be tested econometrically. But there are two other restrictions which can be tested empirically. The first is the assumption of homogeneity imposed by

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

and the second the Slutsky symmetry

$$\gamma_{ij} = \gamma_{ji}$$

The coefficients γ_{ij} represent the effects of changes in relative prices on the budget shares with $\frac{x^c}{P^c}$ held constant. Changes in real expenditures work through the β_i coefficient. The β_i is positive for luxuries and negative for necessities.

The system of equations to be estimated is

$$w_i^c = \hat{\alpha}_i^* + \sum_j \hat{\gamma}_{ij} \ln P_j^c + \hat{\beta}_i \left(\ln x^c - \sum_k \hat{\alpha}_k \ln P_k^c - \frac{1}{2} \sum_k \sum_j \hat{\gamma}_{kj} \ln P_k^c \ln P_j^c \right)$$

where $x^c = \frac{\sum_i NV_i^c}{\sum_i NV_i^{AUT}}$, i.e. the nominal expenditures per capita relative to Austria, and $\alpha_i^* = \alpha_i - \beta_i \alpha_0$. This last term results from the expression of P^c above. In the applied regression model below the value for α_0 has to be predetermined. As a first step we assumed $\alpha_0 = 0$.[6]

4 Estimation results for three broad consumption groups

4.1 Descriptive analysis

First we present the results for three broadly defined consumption groups. The three groups consist of the aggregations of the AGGI level in table 2.1:

1. 2 and 15

[6] We have not yet specified the structure of the error terms as this is done implicitely by choosing an estimation procedure discusses below.

2. 18, 21, and 27

3. 26, 32, and 37

Commodity group $j = 1$ broadly consists of basic goods (food, beverages, tobacco, clothing and footwear), group $j = 2$ consists of household goods, rents, fuel, transportation and communication items and, finally, group $j = 3$ are more or less service goods (medical care, recreation, culture, and education).

The PPP rates for aggregated consumption items are calculated from the ECP data applying the procedure desribed above. Table 4.1 presents the mean, the standard deviation (SD), and the coefficient of variation (CoV) of the expenditure shares for the three consumption groups and the four country groups in table 2.2.

$$w_i^c = \frac{NV_i^c}{\sum_i^3 NV_i^c}$$

Item 1 (basic goods) comprises a large share of expenditure in the low-income coun-

	Country Group			
	1	**2**	**3**	**4**
Item	**Mean**			
1	0.62	0.41	0.23	0.20
2	0.18	0.30	0.35	0.37
3	0.21	0.29	0.42	0.44
Item	**Standard Deviation**			
1	0.12	0.08	0.05	0.03
2	0.06	0.08	0.04	0.02
3	0.09	0.06	0.03	0.03
Item	**Coefficient of Variation**			
1	0.20	0.21	0.21	0.14
2	0.36	0.26	0.11	0.06
3	0.42	0.19	0.08	0.07

Table 4.1: Summary statistics of expenditure shares

tries (about 60 %). The share for these expenditures declines for higher-income countries to about 20 %, which clearly shows the Engel effects (non-homethetic preferences). Expenditure shares for item 2 are between 18 % and 37 %. Item 3, which can be seen as services, has the highest share in the high-income countries (44 %) and about 20 % in the low-income countries. The expenditure shares for the medium-income countries (groups 2 and 3) are lying in between the two other country groups for each consumption item. Further it can be seen that the least developed countries have the largest variation in consumption patterns whereas the Coefficient of Variation (CoV) becomes lower for the more advanced countries - which is due to the fact that the variation in income levels (see table 2.2) and the variation in price levels (see table 4.2 below) are lower.

Table 4.2 presents the comparative price level index ($CPLI_i^c$) and some summary statistics for the four country groups and the three items. The $CPLI_i^c$ was calculated as

$$CPLI_i^c = \frac{P_i^c}{EXR^c}$$

where $EXR^c \equiv P^c_{52}$ (see table 2.1). Table 4.2 presents the mean, the standard deviation and the coefficient of variation for each country group. First it can be seen that the

	Country Group			
	1	**2**	**3**	**4**
Item	**Mean**			
1	0.39	0.50	0.92	1.06
2	0.16	0.29	0.81	0.98
3	0.14	0.25	0.73	0.92
Item	**Standard Deviation**			
1	0.08	0.14	0.19	0.25
2	0.07	0.10	0.23	0.21
3	0.07	0.10	0.23	0.20
Item	**Coefficient of Variation**			
1	0.20	0.29	0.20	0.23
2	0.44	0.34	0.29	0.21
3	0.51	0.38	0.31	0.22

Table 4.2: Comparative price level index (CPLI)

average price level of all three items is lower in the lower-income countries. The variation of the price levels within the groups are almost equal for item 1, but higher for items 2 and 3 the lower the

income level. Further relative prices are quite different. For example the relative price of food $\frac{p_1}{p_3}$ in the lower-income countries is about 2.79, whereas the ratio in the highest-income countries is 1.15. (See also Bhagwati (1984) on this issue.)

4.2 Estimation results

In this section we present the estimation of the unconstrained and constrained model.[7] Table 4.3 presents the results of the unconstrained model (i.e. without the assumptions on homogeneity and symmetry). The terms in brackets denote the p-values. First one has to note that the goodness-of-fit, as measured by the R^2, is very high with 90 and 80 %. Further, the first item is clearly a necessary good as the coefficient β_i is significantly lower than zero, whereas the second item turns out to be a luxury. Further the parameters γ_{ij} are all significant with the exception of γ_{i3}. The own price effects γ_{ii} are all positive. Evidence on cross price effects are mixed. For instance, a rise in the price of item 2 lowers the expenditure share for item 1, but raises the expenditure share for good 3.

This unconstrained estimation allows the testing of the homogeneity and symmetry constraints mentioned above. The testing procedure is a test on linear constraints. Table 4.4 presents the test statistics. The test on homogeneity failed when applied to each individual item (which confirms the results by Deaton and Muellbauer, 1980a) but is

[7] For estimating this system of nonlinear equations a non-linear SUR estimator was used. Particularly, we used the NLSUR command in the econometric package LIMDEP. This programme also allows to test linear constraints quite easily. Further we also used another programme, EViews. In this programme two procedures are available: first, again a SUR estimator, and a FIML estimator. Both yielded similar, although quantitatively slightly different results. For technical details of these estimators and the iteration procedure we refer to the programme manuals.

Good	α_i	β_i	γ_{i1}	γ_{i2}	γ_{i3}	$\sum_j \gamma_{ij}$	R^2
1	0.189	-0.124	0.161	-0.176	0.021	0.006	0.909
	(0.000)	(0.000)	(0.001)	(0.014)	(0.865)		
2	0.379	0.040	-0.119	0.149	-0.029	0.001	0.794
	(0.000)	(0.033)	(0.004)	(0.000)	(0.464)		
3	0.432	0.085	-0.042	0.027	0.008	-0.009	

Log	-52.000
R^2	0.837
N	52

Table 4.3: Parameter Estimates: Unconstrained AIDS

Restrictions	χ^2	P-value
Tests on homogeneity		
$\sum_j \gamma_{1j} = 0$	1.94	0.164
$\sum_j \gamma_{2j} = 0$	0.38	0.537
$\sum_j \gamma_{ij} = 0,\ i = 1, 2$	6.16	0.046
Tests on symmetry		
$\gamma_{12} = \gamma_{21}$	0.51	0.476
$\gamma_{13} = \gamma_{31}$	0.64	0.424
$\gamma_{23} = \gamma_{32}$	0.48	0.486
$\gamma_{ij} = \gamma_{ji},\ \forall i \neq j$	7.58	0.055

Table 4.4: Tests on restrictions

confirmed when applied simultaneously. A similar pattern can be found for the symmetry constraint, which again cannot be rejected when applied simultaneously, but is rejected when applied individually.

Table 4.5 presents the results with the homogeneity $\sum_j \gamma_{ij} = 0$ constraint imposed. The results turn out to be quite similar (and statistically the same) as in the unconstrained

Good	α_i	β_i	γ_{i1}	γ_{i2}	γ_{i3}	R^2
1	0.188	-0.126	0.164	-0.194	0.030	0.900
	(0.000)	(0.000)	(0.000)	(0.007)		
2	0.379	0.039	-0.118	0.147	-0.029	0.793
	(0.000)	(0.032)	(0.005)	(0.000)		
3	0.433	0.087	-0.046	0.047	0.001	

Log	-52.000
R^2	0.826
N	52

Table 4.5: Parameter Estimates: AIDS with homogeneity restriction

model. In this case only a test on the symmetry restriction can be calculated. The result is presented in table 4.6. Again symmetry cannot be confirmed. (The other constraints $\gamma_{13} = \gamma_{31}$ and $\gamma_{23} = \gamma_{32}$ cannot be tested as these parameters result from the additivity and the homogoneity constraint.)

Table 4.7 presents the results of the estimations for three groups of commodities. In these estimates the adding-up restriction, the homogeneity and the symmetry restrictions are imposed. In this case the model represents a system of demand functions with the

Restrictions	χ^2	P-value
Tests on symmetry		
$\gamma_{12} = \gamma_{21}$	0.83	0.364

Table 4.6: Test on symmetry restriction (given homogeneity)

Good	α_i	β_i	γ_{i1}	γ_{i2}	γ_{i3}	R^2
1	0.182	-0.121	0.172	-0.138	-0.034	0.898
	(0.000)	(0.000)	(0.000)	(0.000)		
2	0.384	0.030	-0.138	0.131	0.007	0.790
	(0.000)	(0.056)		(0.001)		
3	0.434	0.091	-0.034	0.007	0.027	

Log	-52.000
$\mathbf{R^2}$	0.822
N	52

Table 4.7: Parameter estimates with homogeneity and symmetry constraints

following properties: (a) the shares add up to total expenditure, (b) the functions are homogeneous of degree zero in prices and total expenditures taken together and (c) satisfy the Slutsky symmetry. Again the results are similar to the results obtained above. Only the coefficient β_2 becomes less significant.

4.2.1 Linear approximation of the Almost Ideal Demand System

Deaton and Muellbauer (1980a) used an approximation of the variable P with a price index P^*

$$\ln P^{c*} = \sum_k w_k^c \ln P_k^c$$

as suggested by Stone (1953); for a justification see also Deaton and Muellbauer (1980a). This assumption simplifies the estimation procedure, which must be applied in this case to a linear regression or a system of linear equations if one takes the homogeneity and the symmetry constraints into account.

$$w_i^c = \alpha_i + \sum_j \gamma_{ij} \ln P_j^c + \beta_i \ln \frac{x^c}{P^{c*}}$$

With this approximation the system can be estimated separately for each good by *unconstrained* OLS estimation as suggested by Deaton and Muellbauer (1980a) or as a system of linear equations. In case the unobserved features of the countries are correlated or there are some cross-equation restrictions this set of equations forms a system of *seemingly unrelated regressions* (SUR-system), as pointed out by Zellner (1962).

First, the 'goodness of fit' of these approximated values can be shown graphically. Figure 4.1 graphs the approximated variable (Plin) P^{c*} against the variable P^c evaluated at the estimated values (ePlin) given in table 4.7 (i.e. with homogeneity and symmetry constraints). Figure 4.1 shows that this approximation is fairly good (the coefficient of

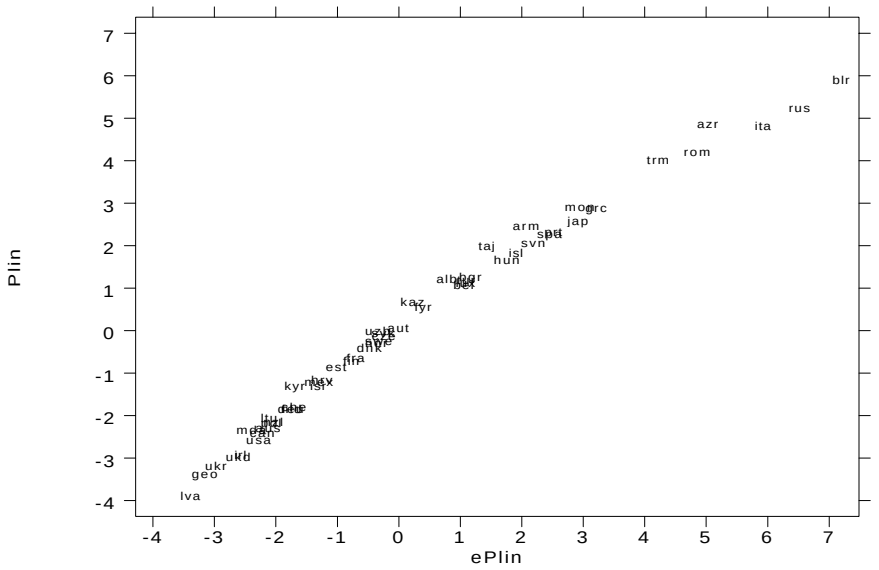

Figure 4.1: Linear approximation of P

correlation between the two variables is 0.9911). Table 4.8 presents the results of the SUR-estimations on the approximated linear system with homogeneity and symmetry constraints imposed.

Good	α_i	β_i	γ_{i1}	γ_{i2}	γ_{i3}	$\bar{R}^2$
1	0.191	-0.127	0.113	-0.118	0.005	0.917
	(0.000)	(0.000)	(0.029)	(0.001)		
2	0.381	0.034	-0.118	0.127	-0.009	0.801
	(0.000)	(0.018)		(0.001)		
3	0.428	0.093	0.005	-0.009	0.004	

Log	-52.000
$\mathbf{R^2}$	0.852
N	52

Table 4.8: Parameter estimates of the approximated linearized AIDS model with homogeneity and symmetry constraints

Again the results are quite similar to the results reported above and the goodness-of-fit measure is similarly high.

4.2.2 Testing for outliers

This linear approximation of the system allows for some econometric tests on outliers and differences between country subgroups. The linearized system can be tested for outliers using a formal procedure first introduced by Belsley et al. (1980). For a discussion on this and other tests on influential observations and leverages see also Davidson and MacKinnon (1993). The countries with the highest leverages in each country group were Mongolia

(MON), Mexico (MEX), Tajikistan (TAJ), and Azerbaijan (AZR). But dropping these observations did not qualitatively change the result reported above; there have been only some minor quantitative changes in parameter values or test statistics.

5 Estimation results for three broad consumption groups - alternative aggregates

Second, we tried another aggregation of consumption items. The three groups listed below were aggregated from the AGGII level in table 2.1:

1. 3, 11, and 14

2. 16, 17, 22-25, 28, and 33

3. 19-20, 26, 29-31, 34-36, and 38-39

For the AGGII level data for Mexico, New Zealand, Australia, Japan, Canada, and the United States are not available. Thus 46 observations (countries) are remaining.[8]

5.1 Descriptive statistics

Table 5.1 gives the summary statistics of the shares. Further table 5.2 presents the CPLI's for this classification of goods. By comparing this kind of aggregation to the

	Country Group			
	1	**2**	**3**	**4**
Item	**Mean**			
1	0.55	0.35	0.18	0.15
2	0.12	0.15	0.17	0.19
3	0.33	0.49	0.65	0.66
Item	**Standard Deviation**			
1	0.12	0.08	0.04	0.02
2	0.04	0.04	0.02	0.04
3	0.12	0.08	0.05	0.05
Item	**Coefficient of Variation**			
1	0.22	0.22	0.22	0.12
2	0.32	0.25	0.14	0.20
3	0.37	0.16	0.08	0.07

Table 5.1: Summary statistics of expenditure shares

consumption groups defined in section 4 above (see tables 4.1 and 4.2) we can draw the same conclusions.

[8] Although this would change the groupings of countries according to their income level, we stick to the same grouping and only dropped the six countries from the sample.

	Country Group			
	1	2	3	4
Item	**Mean**			
1	0.41	0.51	0.91	1.14
2	0.42	0.59	0.95	1.03
3	0.12	0.22	0.74	1.00
Item	**Standard Deviation**			
1	0.07	0.14	0.21	0.21
2	0.10	0.14	0.13	0.11
3	0.07	0.08	0.25	0.19
Item	**Coefficient of Variation**			
1	0.17	0.28	0.23	0.18
2	0.23	0.23	0.13	0.11
3	0.57	0.36	0.34	0.19

Table 5.2: Comparative price level index (CPLI)

5.2 Estimation results

For the constrained model the results are not very satisfactory as especially the coefficients β_i are not significant. Further the R^2 for the second consumption item is very low. Using the same procedure as described above (i.e. linearizing the system and making tests on influential observations) we dropped in a next step the countries Mongolia (MON), Tajikistan (TAJ), Belarus (BLR), Azerbaijan (AZR), and Turkmenistan (TRM). These five countries show the highest leverage effects for all three consumption items. Further we dropped the five countries with the highest normalized squared residuals, namely Armenia (ARM), Albania (ALB), Turkey (TUR), Kazakhstan (KAZ), and Kyrgyzstan (KYR). By these two criteria we thus dropped eight countries from the first quartile and two countries from the second quartile. Using the remaining 36 countries yields the results presented in table 5.3 for the unconstrained model and in table 5.4 for the constrained model.[9]

Good	α_i	β_i	γ_{i1}	γ_{i2}	γ_{i3}	$\sum_j \gamma_{ij}$	R^2
1	0.131	-0.058	0.098	0.058	-0.157	-0.001	0.940
	(0.000)	(0.010)	(0.170)	(0.299)	(0.000)		
2	0.181	0.056	-0.037	0.066	-0.024	0.006	0.711
	(0.000)	(0.016)	(0.387)	(0.091)	(0.539)		
3	0.688	0.003	-0.061	-0.124	0.181	-0.004	

Log	-36.000
R^2	0.910
N	36

Table 5.3: Parameter Estimates: Unconstrained AIDS (36 countries)

The parameter values in both models are again quite similar with the exception of the parameter γ_{i1}, which becomes significant in the constrained model.

[9] We do not present here test statistics on homegeneity and symmetry, which yield the same conclusions as above.

Good	α_i	β_i	γ_{i1}	γ_{i2}	γ_{i3}	R^2
1	0.132	-0.067	0.153	-0.002	-0.151	0.936
	(0.000)	(0.002)	(0.024)	(0.973)		
2	0.177	0.081	-0.002	0.066	-0.065	0.599
	(0.000)	(0.000)		(0.069)		
3	0.691	-0.014	-0.151	-0.653	0.216	

Log	-36.000
R^2	0.898
N	36

Table 5.4: Parameter estimates with homogeneity and symmetry constraints (36 countries included)

6 Estimation results for six commodity groups

In a next step the same procedure was used for estimation of the model with six commodity groups: the six groups listed below were aggregated from the AGGII level in table 2.1 in the following way:

1. Food: 3
2. Alcohol and tobacco: 11 and 14
3. Apparel: 16 and 17
4. Cars: 28
5. Remaining: 22-25 and 33
6. Services: 19-20, 26, 29-31, 34-36, and 38-39

Thus in this aggregation scheme we separated the first aggregate in section 5 in item 3 (food) and items 11 and 14 (beverages and tobacco). Further the second item in 5 was separated in apparel (16 and 17), cars (28), and a composite item 'remaining' (22-25, and 33). The last item, 'services', is the same as above.

6.1 Descriptive statistics

First, we show the summary statistics of shares and the CPLI for the four country groups (including 46 countries). Items 1 and 6 have the highest expenditure shares in all groups of countries: the low-income countries have the highest share in item 1 with 51 % and the high-income countries only a share of 11 %. In services (6) the shares are 33 % in the low-income countries compared with 66 % in the high-income countries. The other items show a share between 1 and 10 % in all groups of countries. The expenditure share is rising with income for items 4 (cars) and 5 (remaining) and slightly shrinking with income for item 3 (apparel). For the variation within country groups the same conclusion as above can be drawn with the variation being higher in the low-income country group.

Further the CPLI's are shown in table 6.2 for the six commodity groups. The average

	Country Group			
	1	**2**	**3**	**4**
Item	**Mean**			
1	0.51	0.29	0.14	0.11
2	0.03	0.06	0.04	0.05
3	0.07	0.06	0.06	0.05
4	0.01	0.02	0.03	0.04
5	0.04	0.07	0.08	0.09
6	0.33	0.49	0.65	0.66
Item	**Standard Deviation**			
1	0.13	0.07	0.03	0.01
2	0.01	0.02	0.01	0.02
3	0.03	0.02	0.02	0.01
4	0.02	0.01	0.01	0.01
5	0.02	0.02	0.01	0.02
6	0.12	0.08	0.05	0.05
Item	**Coefficient of Variation**			
1	0.25	0.25	0.23	0.14
2	0.42	0.27	0.32	0.36
3	0.44	0.31	0.31	0.20
4	1.37	0.40	0.36	0.30
5	0.59	0.36	0.16	0.20
6	0.37	0.16	0.08	0.07

Table 6.1: Summary statistics of shares

	Country Group			
	1	**2**	**3**	**4**
Item	**Mean**			
1	0.42	0.50	0.87	1.10
2	0.38	0.57	1.02	1.27
3	0.31	0.49	0.94	1.07
4	0.61	0.91	1.04	1.05
5	0.49	0.61	0.92	1.01
6	0.12	0.22	0.74	1.00
Item	**Standard Deviation**			
1	0.08	0.14	0.18	0.19
2	0.15	0.19	0.40	0.40
3	0.10	0.19	0.19	0.14
4	0.23	0.11	0.15	0.29
5	0.11	0.12	0.13	0.11
6	0.07	0.08	0.25	0.19
Item	**Coefficient of Variation**			
1	0.19	0.28	0.20	0.17
2	0.40	0.33	0.40	0.31
3	0.32	0.39	0.21	0.13
4	0.39	0.12	0.15	0.27
5	0.23	0.19	0.15	0.11
6	0.57	0.36	0.34	0.19

Table 6.2: Comparative price level index (CPLI)

price levels for all items are lower in the low-income countries and again the CoV is higher for this group of countries.

6.2 Estimation results

The estimation results of the system for six commodity groups are given in table 6.3. In

Good	α_i	β_i	γ_{i1}	γ_{i2}	γ_{i3}	γ_{i4}	γ_{i5}	γ_{i6}	R^2
1	0.098	-0.065	0.234	-0.047	-0.014	-0.000	-0.035	-0.139	0.960
	(0.000)	(0.000)	(0.000)	(0.000)	(0.375)	(0.982)	(0.043)		
2	0.038	0.011	-0.047	0.046	0.013	0.003	0.014	-0.030	0.520
	(0.000)	(0.141)		(0.000)	(0.097)	(0.510)	(0.045)		
3	0.049	0.012	-0.014	0.013	0.037	0.010	-0.013	-0.032	0.062
	(0.000)	(0.224)			(0.014)	(0.163)	(0.183)		
4	0.036	0.013	-0.000	0.003	0.010	-0.002	-0.006	-0.005	0.414
	(0.000)	(0.059)				(0.715)	(0.461)		
5	0.088	0.047	-0.035	0.014	-0.013	-0.006	0.064	-0.025	0.781
	(0.000)	(0.000)					(0.001)		
6	0.691	-0.019	-0.139	-0.030	-0.032	-0.005	-0.025	0.230	
N	36								

Table 6.3: Parameter estimates with homogeneity and symmetry constraints

a next step we dropped the parameters γ_{ij} where no significant impact on consumption shares was found, i.e. $|p| > 0.05$. Table 6.4 reports the results of this estimation exercise. The coefficient β_i is significantly lower zero for items 1 (food) and 6 (services), significantly

Good	α_i	β_i	γ_{i1}	γ_{i2}	γ_{i3}	γ_{i4}	γ_{i5}	γ_{i6}	R^2
1	0.096	-0.066	0.221	-0.038			-0.039	-0.143	0.959
	(0.000)	(0.000)	(0.000)	(0.000)			(0.014)		
2	0.039	0.007	-0.038	0.048			0.013	-0.022	0.414
	(0.000)	(0.377)		(0.000)			(0.079)		
3	0.051	0.014			0.034			-0.034	0.175
	(0.000)	(0.036)			(0.007)				
4	0.037	0.013							0.411
	(0.000)	(0.000)							
5	0.087	0.047	-0.039	0.013			0.055	-0.028	0.705
	(0.000)	(0.000)					(0.000)		
6	0.689	-0.016	-0.143	-0.022			-0.028	0.227	
N	36								

Table 6.4: Parameter estimates with homogeneity and symmetry constraints $\gamma_{ij} = 0$ for selected variables

higher zero for items 3 (apparel) and 4 (cars) and not significantly different from zero for item 2 (alcohol and tobacco). Here the negative coefficient for services is surprising, although one has to take into account that these include commodity group 26 (medical care) and commodity group 30 (purchased transport services), which have turned out to be necessities (see table 3.1). In this second estimation (table 6.4) all the parameters γ_{ij} are significantly different from zero (γ_{25} only at a lower level of significance). The

magnitude of the estimated parameters is also in line with other studies (see especially the results given in table 1 in Deaton and Muellbauer, 1980a). This should especially be noticed as in this paper we estimate a cross-section of countries and not time-series as e.g. in Deaton and Muellbauer (1980a).

7 Conclusion

The paper has shown a variety of empirical descriptions and econometric tests on the influence of income levels and prices on expenditure shares for a variety of countries. The results are in line with other existing studies, although in these studies the results are mainly derived from time-series analysis (e.g. Deaton and Muellbauer, 1980a). In addition, the Almost Ideal Demand System was tested in several settings where it turned out that a high proportion of the variance of budget shares can be explained by this model. This leads to the conclusion that this model also works quite well in cross-section studies as the sample includes a great variety of countries with expenditure levels as low as only about 2 % relative to the richest country US. Further, common assumptions on consumers' behaviour and decisions which are imposed on the theoretical models have been tested and only mixed evidence was found for these assumptions. Here especially the failure of homogeneity, which was found in other studies as well, must be mentioned.

A List of countries

Quartile	Abbreviation	Name	Quartile	Abbreviation	Name
1	ALB	Albania	2	BGR	Bulgaria
1	ARM	Armenia	2	BLR	Belarus
1	AZR	Azerbaijan	2	EST	Estonia
1	FYR	FYROMacedonia	2	HRV	Croatia
1	GEO	Georgia	2	HUN	Hungary
1	KAZ	Kazachstan	2	LTU	Lithuania
1	KYR	Kyrgyzistan	2	LVA	Latvia
1	MDA	Moldova	2	MEX	Mexico
1	MON	Mongolia	2	POL	Poland
1	TAJ	Tajikistan	2	ROM	Romania
1	TRM	Turkmenistan	2	RUS	Russia
1	UKR	Ukraine	2	SVK	Slovakia
1	UZB	Uzbekistan	2	TUR	Turkey
3	CZE	Czech Republic	4	AUS	Australia
3	FIN	Finland	4	AUT	Austria
3	FRA	France	4	BEL	Belgium
3	GRC	Greece	4	CAN	Canada
3	IRL	Irland	4	CHE	Switzerland
3	ISR	Israel	4	DEU	Germany
3	ITA	Italy	4	DNK	Denmark
3	NLD	Netherlands	4	ISL	Island
3	NZL	New Zealand	4	JAP	Japan
3	PRT	Portugal	4	LUX	Luxembourg
3	SPA	Spain	4	NOR	Norway
3	SVN	Slovenia	4	UKD	United Kingdom
3	SWE	Sweden	4	USA	USA

Table A.1: List of countries

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