The Almost Ideal Demand System: A Comparison and Application to Food Groups

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Abstract

This article presents estimates of the almost ideal demand system (AIDS) for four food groups and compares these estimates with the AIDS' own linear approximate version and the linear expenditure system The AIDS is indirectly nonadditive and has several desirable properties, making it a viable demand system for analyzing food commodities Its linear approximate version is a good first-order approximation to the complete system and is easy to estimate

Keywords

Demand, systems, food groups

Introduction[1]

Demand theory is concerned with the allocation of total expenditures among goods and services, given prices and consumer income The focus on total expenditures, rather than on expenditures for a single commodity, makes it possible to examine interdependencies among commodities Although single-equation demand functions have the advantage of modeling a commodity in isolation and of allowing far more flexibility in accounting for explanatory variables and specification of functional forms, the demand system approach accounts for interdependencies among commodities, includes theoretical restrictions, is often derived from a utility maximization process,[2] and describes the allocation of expenditures among a complete set of consumption categories that sum to total expenditures.

Given the parameters for a complete demand system, a researcher could simulate, for example, the effect of a sharp increase in housing or energy prices on food expenditures If such simulations are to be used by policymakers, however, they must emerge from systems with both plausible assumptions and results Economic Research Service economists have used several complete demand systems to examine food expenditures, but earlier stages in the development of complete systems have required them to use systems with some implausible assumptions This article examines food expenditures with a system which is more realistic than those used earlier and which, in its linear approximate form, is easy to estimate

The complete system approach was pioneered by Stone (*20*), who developed a system consistent with the assumptions of neoclassical demand theory and was able to estimate it with data for Great Britain by combining commodities into manageable groups In an interesting application of the linear expenditure system (LES), Stone assessed the effect of rationing in Great Britain by simulating desired expenditures at prices that existed under rationing However, Stone's system restricted the nature of the relationship of commodities by assuming that the underlying preference ordering was additive—that is, that the marginal utility provided by the consumption of one commodity was independent of the consumption of other commodities The results were that all goods were substitutes and inferior goods were excluded

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[1]For a more detailed treatment of complete demand systems, see (*2*) Italicized numbers in parentheses refer to items in the References at the end of this article

[2]Exceptions include the double logarithmic and other *ad hoc* systems

Strotz (*22*) extended the idea of exhaustive expenditures to stages In the first stage, the consumer is assumed to allocate expenditures to broad groups of commodities; then, in the second stage, the consumer is assumed to allocate expenditures within each of the broad groups to smaller groups This process can continue, but for most empirical analyses has been limited to two stages requiring the condition of weak separability—that is, the conditional ordering of goods based on the independence of marginal utilities of goods within one group from consumption of goods in other groups [a]

Deaton and Muellbauer (*10*) recently extended empirical research on demand systems by developing and estimating the almost ideal demand system (AIDS) The name stems from the properties associated with their system Deaton and Muellbauer (*10*, p 312) list the following advantages of their system (1) it gives an arbitrary first-order approximation to any demand system, (2) it satisfies the axioms of choice exactly, (3) it aggregates perfectly over consumers, (4) it has a functional form which is consistent with previous household budget data, (5) it is simple to estimate in its linear approximate form, and (6) it can be used to test for homogeneity and symmetry In addition, although Deaton and Muellbauer do not explicitly mention it, the AIDS is indirectly nonadditive, allowing consumption of one good to affect the marginal utility of another good, whereas, the linear expenditure system is directly additive, implying independent marginal utilities Thus, the AIDS, in addition to the listed desirable properties, does not impose the severe substitution limitations implied by additive demand models such as the LES

Our purpose here is to report results obtained from applying the new AIDS to a four-food (second-stage) commodity classification Thus, assuming weak separability, we can focus on the allocation of food expenditures among this particular set of nondurable goods This subsystem demand approach allows us to compare substitution possibilities among these food types These estimates account for restrictions imposed by theoretic demand formulations Although the system presented here could benefit from more disaggregation, it attempts to estimate a theoretically plausible, complete demand system for a major commodity group and is a first step toward understanding the relationship among commodities In addition, we make comparisons with a simplified linear approximation of the AIDS and with the LES The latter system, while admittedly somewhat inappropriate for use with such a highly refined food grouping, serves as a benchmark for evaluating the results from the more viable AIDS

Based on U S annual time series data for 1948-78, the findings of our analysis indicate that many commodities classified as luxuries in the LES because their income elasticities are greater than 1, are classified as necessities in the AIDS as their income elasticities are less than 1 The less restrictive AIDS does not reflect an approximate proportional relationship between income and price elasticities as is often found when one uses the LES (for example, see (*9*)).

Besides the properties of the AIDS described by Deaton and Muellbauer (*10*), we show the AIDS possesses the property that income elasticities become more inelastic for necessities (for example, food items) as their budget shares decrease The reverse is true for the LES. Thus, the AIDS is an attractive system for analyzing the demand for food commodities Excluding its linear-approximate version, one disadvantage is that it requires a large number of parameters to be estimated

Models

We chose the two demand systems, the LES and the AIDS, based on theoretical and empirical considerations Both these demand systems are complete, theoretically plausible systems and satisfy the properties of demand systems. However, the LES results are reported primarily to help us evaluate the results obtained from the AIDS We briefly describe the LES and give an indepth account of the AIDS because it is less well known than the LES

Linear Expenditure System (LES)

The LES, which can be derived from the Stone-Geary utility function, in budget share form, is given by

$$w_i = p_i\mu_i/Y + \theta_i(1 - \sum_k p_k\mu_k/Y) \text{ for } i,k = 1, \ldots, n \qquad (1)$$

[a]See (*11*, p 124) and (*6*, pp 287 88)

where the w_i's are budget shares, the p_i's are prices, the μ_i's are interpreted as minimum required subsistence quantities, the θ_i's are marginal budget shares, and Y is total expenditure (income) It can be shown (*12*) that the LES globally satisfies the adding up, homogeneity, and symmetry restrictions The LES is also described as an additive system because it is derived from an additive utility function [4]

To estimate the LES, we impose the condition that the marginal budget shares aggregate to 1 and impose cross-equation restrictions which are implied by theory If the quantities consumed are positive and greater than their minimum subsistence levels and the marginal budget shares are valued between zero and 1, the elasticities will have their typical pattern—that is, positive income elasticities, exclusion of inferior goods, and negative own-price elasticities Because of its additive form, the LES has been shown by Deaton (*9*) to imply an approximate proportional relationship between income elasticities and own-price elasticities, commonly referred to as the Pigou relationship

In addition to being a theoretically plausible demand system (that is, derived from a utility maximization process), having an intuitive economic interpretation, and being relatively easy to estimate, the LES has performed well in terms of goodness of fit, prediction, and so forth (*14*, *15*) in comparison with nonadditive systems

Almost Ideal Demand System (AIDS)[5]

The new demand system—AIDS—developed by Deaton and Muellbauer (*10*) builds upon a model by Working (*26*) and Leser (*16*) Their model expresses the ith budget share, w_i, as a function of log Y, that is

$$w_i = \alpha_i + \beta_i \log Y \qquad (2)$$

where w_i and Y are defined as above The Working-Leser model was extended by Deaton and Muellbauer to include the effect of prices The resultant demand system for the AIDS was derived, by use of duality concepts, from a particular cost or expenditure function defined as the minimum expenditure necessary to attain a specific level of utility at given prices Thus, it is also a theoretically plausible demand system Consider the cost function (*10*, p 313):

$$\log C(U,p) = \alpha_o + \sum_k \alpha_k \log p_k + 1/2 \sum_k \sum_j \gamma^*_{kj} \log p_k \log p_j + U\beta_o \prod_k p_k^{\beta_k} \qquad (3)$$

where C denotes the cost function, U represents the unobservable utility parameter, β_o is a nonestimable cost parameter, p_k's are prices, and α_k, γ^*_{kj}, and β_k are parameters to be estimated Deaton and Muellbauer chose the particular form in equation (3) to allow the cost function to be flexible, to represent preferences via the cost function that permit exact aggregation over consumers, and to obtain a system of demand functions with desirable properties By applying Shepard's Lemma, that is, by differentiating equation (3) with respect to prices, they obtain the Hicksian, or compensated demand functions Mathematically

$$\frac{\partial C(U,p)}{\partial p_i} = q_i (U,p) = q_i \qquad (4)$$

By multiplying both sides by $p_i/C(U,p)$, equation (4) becomes

$$\frac{\partial \log C(U,p)}{\partial \log p_i} = \frac{\partial C(U,p)}{\partial p_i} \cdot \frac{p_i}{C(U,p)} = \frac{p_i q_i(U,p)}{C(U,p)} = w_i(U,p) \qquad (5)$$

For the cost function given by equation (3), equation (5) becomes

$$w_i = \alpha_i + \sum_j \gamma_{ij} \log p_j + \beta_i U \beta_o \prod_k p_k^{\beta_k} \qquad (6)$$

where $\gamma_{ij} = 1/2(\gamma^*_{ij} + \gamma^*_{ji})$

Because $Y = C(U,p)$ in equilibrium, by substituting Y for C in equation (3), then by solving for U in terms of p and Y, and finally by substituting this expression into equation (6), we obtain the AIDS in budget share form

[4] A utility function is additive if there is a differentiable function F, $F' > 0$, and n functions $f_i(q_i)$, so that $F[f(q_1, \ldots, q_n)] = \sum_i f_i(q_i)$ The Stone-Geary utility function $U(q) = \sum_i \theta_i \log(q_i - \mu_i)$ satisfies this condition See (*19*, pp 57-58)

[5] As a point of interest, the first difference form of the AIDS is similar to the Rotterdam demand system The results from the estimation of a Rotterdam system were presented in this journal by Mann (*17*)

$$w_i = \alpha_i + \sum_j \gamma_{ij} \log p_j + \beta_i \log (Y/P), \quad (7)$$

$$\text{for } i,ji = 1, \ldots, n$$

where P is a price index defined by

$$\log P = \alpha_0 + \sum_k \alpha_k \log p_k + 1/2 \sum_k \sum_j \gamma^*_{kj} \log p_k \log p_j \quad (8)$$[6]

Deaton and Muellbauer (*10*) utilize Stone's (*21*) index ($\log P^* = \sum_k w_k \log p_k$), where $P \cong \xi P^*$, that is, P is assumed to be approximately proportional to P^*, and they apply ordinary-least-squares (OLS) estimation Thus, equation (7) is redefined as

$$w_i = \alpha_i^* + \sum_j \gamma_{ij} \log p_j + \beta_i \log (Y/P^*) \quad (9)$$

where $\alpha_i^* = \alpha_i - \beta_i \log \xi$. This equation will be referred to as the linear approximate/almost ideal demand system (LA/AIDS) and is often a good first-order approximation to the complete AIDS system, equation (7)

In this form, with P as a price index, the coefficients are easily interpreted The ith budget share is expressed in terms of prices and real income or expenditures, Y/P. The α_i is the intercept and represents the average budget share when all logarithmic prices and real expenditures are equal to 1 The γ_{ij} is equivalent to the change in the ith budget share with respect to a percentage change in the jth price with real expenditures or income held constant, that is, $\gamma_{ij} = \partial w_i / \partial \log p_j$ The β_i represents the change in the ith budget share with respect to a percentage change in real income or expenditures with prices held constant, that is, $\beta_i = \partial w_i / \partial \log (Y/P)$

The demand properties (commonly known as adding up, homogeneity, and Slutsky symmetry) can be shown to be satisfied for the AIDS First, for adding up, the budget shares sum to 1 if $\sum_i \alpha_i = 1$, $\sum_i \gamma_{ij} = 0$, and $\sum_i \beta_i = 0$ Second, the homogeneity condition holds if $\sum_j \gamma_{ij} = 0$ And, finally, the symmetry restriction holds if $\gamma_{ij} = \gamma_{ji}$ Deaton and Muellbauer rejected the latter conditions, and we test them in this analysis

[6]The term α_0 can be interpreted as the outlay required for a minimal standard of living when prices are equal to 1 as in a base year (*10*, p 316)

In the complete AIDS, equation (7), notice that there are $2n + n^2$ parameters to be estimated—n α_i's, n β_i's, and n^2 γ_{ij}'s The number of restrictions just mentioned totals $(n^2 + n + 4)/2$ [7] These restrictions reduce the number of free, unknown structural parameters to $(n^2 + 3n - 4)/2$. In any case, many parameters must be estimated in the AIDS As the number of commodities, n, increases, the total number of parameters to be estimated multiplies, and this could result in estimation problems [8] With this in mind, we chose four commodities for our analysis

With reference to the LES, there are only 2n structural parameters—n θ_i's and n μ_i's, and with one restriction, the $\sum_i \theta_i = 1$, there are $2n - 1$ unknown parameters

Both equations (1) and (7), the LES and AIDS in budget share form, are nonlinear, and full information maximum likelihood (FIML) procedures can be used for maximum efficiency in estimation Equation (9), the LA/AIDS, is linear because the log P^* term is an exogenous approximation, is estimated by OLS procedures, and is used to examine homogeneity [9] Homogeneity is tested by imposing the homogeneity condition ($\sum_j \gamma_{ij} = 0$) on equation (9) and by using an F test to compare the residual sum of squares before and after its imposition

Comparison of the LES and AIDS

Before reporting the empirical results, we briefly discuss some of the properties of the elasticities of the two demand systems The expenditure and uncompensated own-price elasticities for the LES are

$$\eta_i = \theta_i / w_i \quad (10)$$

[7]One of the adding up restrictions is redundant when the homogeneity and Slutsky symmetry conditions are imposed That is, if $\sum_i \gamma_{ij} = 0$ and $\gamma_{ij} = \gamma_{ji}$, then $\sum_i \gamma_{ij} = \sum_i \gamma_{ji} = \sum_j \gamma_{ij} = 0$

[8]For example, for 4 commodities, there are 12 unknown parameters, for 8 commodities, there are 42 unknown parameters, and for 12 commodities, there are 88 unknown parameters

[9]There is an econometric problem in the linear approximate version If log P^* is not treated exogenously, the dependent variable, w_i, appears on both sides of the equation and the resultant estimators will not necessarily possess desirable sampling properties However, following Deaton and Muellbauer (*10*), we ignore this econometric problem in obtaining parameter estimates

and

$$\epsilon_{ii} = -1 + (1 - \theta_i)p_i\mu_i/w_iY \quad (11)$$

respectively For the AIDS, the expenditure and uncompensated own-price elasticities are given by

$$\eta_i = 1 + \beta_i/w_i \quad (12)$$

and

$$\epsilon_{ii} = -1 + [\gamma_{ii} - \beta_i(\alpha_i + \sum_k \gamma_{ik} \log p_k)]/w_i \quad (13)$$

respectively With regard to changes in the expenditure elasticities corresponding to changes in the ith budget share, the LES reflects the property that expenditure elasticities become more elastic as the ith budget share decreases, that is, $\partial\eta_i/w_i^2 - \theta_i/w_i^2 < 0$, as marginal budget shares are always restricted to be positive The implication is that as the budget share for a necessary commodity, such as food, decreases (which it has over time), its expenditure elasticity increases (assuming no inferior goods) This hypothesis seems unrealistic However, the AIDS and the LA/AIDS—as neither restricts marginal budget shares to be positively valued—allow the expenditure elasticity to decrease with respect to a decrease in the budget shares for necessities ($\beta_i < 0$) Mathematically, $\partial\eta/\partial w_i = -\beta_i/w_i^2 > 0$ for $\beta_i < 0$ Thus, in this situation, the AIDS and LA/AIDS possess a more desirable property than the LES Concerning the properties of the own-price elasticities with respect to a change in w_i, in the LES, $\partial\epsilon_{ii}/\partial w_i = -(1 - \theta_i)p_i\mu_i/w_i^2Y < 0$, assuming $0 < \theta_i < 1$ and $\mu_i > 0$ Thus, as the ith budget share decreases, the own-price elasticity becomes more inelastic, as expected In the AIDS, the sign of $\partial\epsilon_{ii}/\partial w_i$ depends on the relative magnitudes of γ_{ii} and $\beta_i(\alpha_i + \Sigma\gamma_{ik} \log p_k)$ (see equation (13)) *A priori*, it is extremely difficult to assign a positive or negative value to the change in ϵ_{ii} with respect to a change in the budget share, w_i

Estimation of Models

To estimate the demand models, one must add an error term, e_{it}, to each equation The stochastic specification for the disturbance terms is assumed to have zero mathematical expectation, to be temporarily uncorrelated, and to have a contemporaneous variance-covariance matrix Ω Problems arise in both the LES and the AIDS because the sum of the budget shares equals 1 In this case, the variance-covariance matrix is singular If no autocorrelation is present, one can apply FIML procedures by arbitrarily deleting an equation (see (*1*, *4*))

We used the TSP program by Hall and Hall (*13*) and discussed in Berndt, and others (*3*) to obtain FIML estimators of the parameters for both the LES and the AIDS and OLS estimates for the LA/AIDS The term α_0 was assigned *a priori* to be the cost at base year prices This value was equal to $586 90 in the base year 1972 Also, following Deaton and Muellbauer (*10*, p 316), log P was approximated by Stone's index $\log P^* = \sum_k w_k \log p_k$ As already discussed, the use of this approximation simplifies the estimation procedure considerably, however, not without some cost

Data

We used annual U S time series data for 1948-78 to estimate the three models For the four food groups, the commodities are the following: meats (beef and veal, pork, fish, and poultry), fruits and vegetables, cereal and bakery products, and miscellaneous foods (dairy products, eggs, imported sugar, and some minor items) Manser (*18*) used similar commodity classifications

The primary source for these data is the U S Department of Agriculture (USDA) series called consumer expenditures on domestic farm food products bought by civilians (*23*, *24*, *25*) The USDA series is available for seven commodity groups and excludes fish and imported foods To obtain our meats group, we adjusted the USDA meat series which includes beef, veal, and pork to include fish and poultry by reconstructing these expenditures according to the method used by Christensen and Manser (*8*) Data for fruits and vegetables were taken directly from the USDA series Grain mill and bakery products were aggregated into the cereal and bakery products group Imported foods were a negligible component of both the fruits and vegetables and cereal and bakery products groups However, imports of sugar were found to be significant Imports of sugar along with the expenditure series for dairy products, (constructed) eggs, and USDA's other food products were combined into a catch-all miscellaneous foods group The price series are the published consumer price indexes for meat, poultry, and fish, fruits and vegetables, and cereal and bakery products We created an implicit price deflator for the miscellaneous foods group by dividing current dollar expenditures by their constant (1972) dollar counterpart (See (7) for a more detailed listing of these data sources)

Empirical Results

For the four food groups, we used FIML techniques to obtain estimates of the parameters of the LES and the AIDS, whereas we used the OLS technique to estimate the linear approximate AIDS using Stone's index Table 1 gives the results of the LES with food expenditure and own-price estimated elasticities reported in columns four to eight [10] The estimated food expenditure elasticities for the LES model indicate that two of the four commodities are relative luxuries, that is, food expenditure elasticities are greater than 1 for meats and miscellaneous foods Fruits and vegetables are relatively inferior, and cereal and bakery products are relative necessities The estimated own-price elasticities indicate relatively inelastic demand for all groups, except fruits and vegetables Referring to the Pigou relation, we observe the proportionality variable, ϕ, is approximately 0 7, implying that the estimated own-price elasticity is about 70 percent of the estimated expenditure elasticity We obtained these values by using the approximation formula, $\epsilon_{ii} \approx \phi\eta_i$

Table 2 reports estimates for the AIDS First, note that the estimated expenditure elasticities differ greatly between the AIDS and the LES Here, meats and fruits and vegetables are relative luxuries, and cereal and bakery products and miscellaneous foods are relative necessities All the estimated own-price elasticities indicate relatively inelastic demand Calculation of the Pigou relation for this system reveals that no approximate proportional relationship exists between price and expenditure elasticities These estimates appear more reasonable than their LES counterparts

Finally, table 3 contains results for the approximate version of the AIDS, with and without homogeneity imposed The magnitude of most of the intercept and expenditure coefficients is substantially higher This holds for the associated t-values as well F-values indicate that homogeneity is rejected for meats and miscellaneous foods

A comparison of the homogeneous nonsymmetric approximate (table 3, all columns with H boxheads) model results with the full AIDS system results

[10]The total income elasticities in table 1, column 4, are obtained by a simple conversion formula (see (5, p 26)) Similar (yet not so simple) concepts hold for price elasticities For meat, for example, the estimated income elasticity with respect to total expenditures or income is (0 435) (1 738) = 0 756, where 0 435 is the estimated income elasticity for food with respect to all expenditures from the first stage (by use of a LES system) and 1 738 is the estimated expenditure elasticity for meats with respect to total expenditures for food

Table 1—Linear expenditure system (LES): Estimates for four food groups

Food group i		Estimated coefficients[1]		Elasticities[2]						Pigou relationship ϕ
				Expenditure		Uncompensated price				
		Marginal budget share θ_i	Minimum subsistence level μ_i	Total[3]	Food	Meats	Fruits and vegetables	Cereal and bakery products	Miscellaneous foods	
Meats	(1)	0 537 [4](12 5)	−18 738 (− 7)	0 756	1 738	−1 049	−0 426	−0 100	−0 137	0 604
Fruits and vegetables	(2)	− 078 (−1 0)	143 443 (5 2)	− 169	− 389	− 013	319	022	031	820
Cereal and bakery products	(3)	117 (5 3)	31 602 (4 7)	379	871	029	− 219	− 614	− 071	705
Miscellaneous foods	(4)	424 (3 7)	44 063 (3 0)	520	1 196	040	− 304	− 071	− 867	725

[1]Coefficients are based on U S data from the years 1948 to 1978
[2]Elasticity formulas are calculated at mean (1948 78) values
[3]Based on first-stage expenditure elasticity for food of 0 435
[4]Values in parentheses are asymptotic t-statistics

Table 2—Almost ideal demand system (AIDS): Estimates for four food groups

Food group i		Estimated coefficients[1]					
		α_i	β_i	γ_{i1}	γ_{i2}	γ_{i3}	γ_{i4}
Meats	(1)	0 327	0 328	0 110	−0 140	−0 012	0 042
		[2](111 8)	(8 7)	(4 6)	(−9 3)	(−1 2)	(1 1)
Fruits and vegetables	(2)	209	052	− 140	160	− 004	− 016
		(88 2)	(1 3)	(−9 3)	(4 4)	(− 2)	(− 3)
Cereal and bakery products	(3)	129	− 078	− 012	− 004	017	− 001
		(82 3)	(−4 1)	(−1 2)	(− 2)	(1 0)	(− 0)
Miscellaneous foods	(4)	336	− 302	042	− 016	− 001	− 026
		(72 9)	(−4 5)	(1 1)	(− 3)	(− 2)	[3](− 3)

Food group i		Elasticities[4]						Budget share, 1948 78 average value	Pigou relationship ϕ
		Expenditure		Uncompensated price					
		Total[5]	Food	Meats	Fruits and vegetables	Cereal and bakery products	Miscellaneous foods		
Meats	(1)	0 897	2 062	−0 992	−0 672	−0 178	−0 220	0 309	0 481
Fruits and vegetables	(2)	055	1 260	− 780	− 263	− 053	− 170	202	209
Cereal and bakery products	(3)	183	421	098	090	− 800	190	134	1 900
Miscellaneous foods	(4)	064	147	399	131	109	− 787	355	5 354

[1]Coefficients are based on U S data for 1948 78
[2]Values in parentheses are asymptotic t statistics
[3]This is an approximate t-value as there are no covariance terms
[4]Elasticity formulas are calculated at mean (1948 78) values
[5]Based on first stage expenditure elasticity for food of 0 435

(table 2) reveals little diversity in the expenditure coefficients (β_i) and in some price coefficients, such as γ_{i1} and γ_{i4}, but large differences in the intercepts, α_i, and in the γ_{i2} and γ_{i3} estimates Because of the similarity in the β_i's, the food expenditure elasticity results are approximated exceedingly well by the linear version The own-price elasticities do not indicate such a high degree of similarity However, all but the fruits and vegetables own-price elasticities in the approximate version are nearly the same value as in the complete AIDS [11] Again, the Pigou relation is not evident in the LA/AIDS

Comparison of the results of either of these two models with the results of the LES indicates even greater differences First, one should note that the proportional relationship between the expenditure and own-price elasticities holds for all groups of the LES The AIDS does not possess this proportionality relationship and shows higher expenditure elasticities for all groups except cereal and bakery products and miscellaneous foods and shows lower own-price elasticities for all groups except fruits and vegetables and cereal and bakery products

Conclusions

This analysis demonstrates that the AIDS of Deaton and Muellbauer (*10, 11*) is a viable system for analyzing the demand for food commodities The AIDS avoids the unrealistic approximate proportionality relationship between income and own-price elasticities that the LES may exhibit The AIDS also has some advantages over the LES in that income elasticities can decrease as budget shares decrease for necessities such as food

As a first-order approximation to a complete demand system, the linear approximate version with homogeneity imposed performs reasonably well with respect to estimated magnitudes of elasticities The advantage of the approximate version is its ease of estimation, theoretically, however, no claims can be made with respect to the properties of its estimators

[11]The Stone index is a good approximation of log P

Table 3—Effects of relaxing the homogeneity condition in the static linear approximate almost ideal demand system ((LA/AID) (nonsymmetric): Estimates for four food groups

Food group i		Estimated coefficients[1]									
		α_i^*		β_i		γ_{i1}		γ_{i2}		γ_{i3}	
		H[2]	NH[3]	H	NH	H	NH	H	NH	H	NH
Meats	(1)	−1 763	−0 564	0 328	0 140	0 106	0 120	−0 118	−0 042	−0 048	−0 056
		[4](−6 1)	(−1 5)	(7 2)	(2 4)	(4 7)	(6 6)	(−2 3)	(−1 0)	(−1 1)	(−1 6)
Fruits and vegetables	(2)	− 191	230	062	− 004	− 131	− 127	126	153	030	028
		(− 9)	(7)	(1 8)	(− 1)	(−7 6)	(−7 4)	(3 3)	(3 7)	(9)	(9)
Cereals and bakery products	(3)	553	538	− 067	− 064	− 005	− 005	− 025	− 026	− 031	032
		(4 3)	(2 5)	(−3 3)	(−1 9)	(− 5)	(− 5)	(−1 1)	(−1 0)	(1 6)	(1 6)
Miscellaneous foods	(4)	2 424	787	− 328	− 070	030	011	020	− 084	− 013	− 003
		(6 8)	(1 9)	(−5 8)	(−1 1)	(1 0)	(7)	(3)	(−1 7)	(2)	(− 1)

Food group i		γ_{i4}		$\sum_j \gamma_{ij}$		Elasticities[5]					
						Expenditure		Uncompensated price			
						Food		Meat		Fruits and vegetables	
		H	NH	H	NH	H	NH	H	NH	H	NH
Meats	(1)	0 060	0 010	0	0 032	2 062	1 452	−1 006	−0 758	−0 594	−0 227
		(6)	(0 4)	0	(4 2)						
Fruits and vegetables	(2)	− 025	− 043	0	011	1 310	982	− 753	− 622	− 486	− 239
		(− 4)	(−1 7)	0	(1 6)						
Cereals and bakery products	(3)	− 001	− 001	0	0	515	522	125	114	− 084	− 094
		(− 1)	(− 1)	0	(1)						
Miscellaneous foods	(4)	− 037	032	0	− 043	087	802	388	096	388	197
		(− 3)	(1 0)	0	(−5 0)						

Food group i		Elasticities				Pigou relationship ϕ		Homogeneity test results
		Uncompensated price						
		Cereal and bakery products		Miscellaneous foods				F-value[6] critical value F(1,25) = 4 24
		H	NH	H	NH	H	NH	
Meats	(1)	−0 295	−0 239	−0 162	−0 124	0 488	0 522	17 40*
Fruits and vegetables	(2)	111	140	− 229	− 206	332	243	2 43
Cereal and bakery products	(3)	− 702	− 704	− 154	157	1 390	1 349	01
Miscellaneous foods	(4)	084	− 018	− 794	− 843	1 031	1 051	14 78*

[1] Coefficients are based on U S data for 1948-78

[2] H indicates results from the homogeneous model

[3] NH indicates results from the nonhomogeneous model

[4] Coefficients in parentheses are t values

[5] Elasticities are calculated at mean (1948-78) values

[6] * indicates rejection of the homogeneity hypothesis

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