Jordan Journal of Economic Sciences, Volume **9**, No.**1, 2022**

Application of the Almost Ideal Demand System (AIDS) Model in the Demand of the Household Commodity Group in Jordan

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ABSTRACT

In this study, we provide estimates of An Almost Ideal Demand System (AIDS), as reflected in the demand analysis for Jordan: the free, the homogeneous, the symmetric, and the restricted AIDS models were estimated. The evaluated total expenditure elasticities indicate that the demand for food and housing is inelastic concerning total expenditure (income), whereas the demand for all the other commodity groups is elastic. The uncompensated own-price elasticities indicate that demand for food and clothing items is inelastic and inelastic for all other commodity groups. One striking result was that the own-price elasticity for food seems to be relatively very large compared to the estimated for other countries. Based on the log-likelihood ratios, homogeneity and symmetry given homogeneity for the whole system were rejected. These findings suggest that the demand for aggregate commodity groups in Jordan is not consistent with the theory of demand

Keywords: Almost Ideal Demand System, Homogeneity, Symmetric, Price and Income Elasticities.

1. Introduction

Demand analysis focused primarily on a single-equation estimation until stone (1954) first estimated a system of demand equations derived explicitly from economic theory. Since then empirical demand analysis has tended to focus on a complete system approach-consistent with neoclassical demand theory. Many models have been proposed and applied to different sets of data. Apart from the Linear Expenditure System (LES) proposed by Klein and Rubin (1947) and applied by Stone (1954), few have been extensively used. Among these other models are the Rotterdam model (Theil, 1965,1975 and Barten 1967, 1969), the translog model (Christensen et al., (1975), and the AIDS (An Almost Ideal Demand System (Deaton and Muellbauer, 1980, Chesher and Rees, 1987 and Pashards, 1993). All of the three models have been estimated and have, in addition, been used to test the homogeneity and symmetry restrictions of demand theory. Numerous studies are analyzing the demands for expenditure groups in world countries.

Importance of the Study

The importance of the study stems from the fact that final demand plays a major role in economic development in any economy, which consists of two important sectors.

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Received on 1/8/2020 and accepted for publication on 27/1/2021.

The first being final demand and the second being the production sector. Household demand constitutes a very large percentage of the final demand for any country. For Jordan, it constitutes, on average, about 65 percent to 0 percent of the final demand (Central Bank of Jordan,2020). Therefore, the analysis and estimation of household demand is considered very important for national planners and decision-makers.

Objectives of the study

The main aim of the present study is to apply the AIDS model to Jordanian private expenditure (disaggregated into six broad categories, namely: food, clothing, housing, durables, transportation, and miscellaneous.

Therefore, the objectives of the study are :

1. Estimating the compensated and uncompensated price elasticities of demand for six commodities groups.
2. Testing the validity of the general restrictions implied by the theory of demand through applying the AIDS model to the Jordanian data.

A few studies are analyzing the demands for food or other commodity groups items that are as follows: (Şahinli and Fidan (2012), Deaton and Muellbauer (1980), Blanciforti and Green (1983), Blanciforti, et al. (1986), Hutasuhut et al. (2001).

The problem of the study

The economy of Jordan has been undergoing rapid structural changes for the past three decades. The role of consumer behavior in these structural changes I crucial. Any changing demand pattern might have important implications for trade and growth policies; therefore, economic planning should consider this change. The role of prices and appropriate pricing policies have been given considerable weight in setting strategies for economic development in Jordan. We know that the commodity composition of personal demand varies with price and income. Thus, it follows that policy decisions, especially concerning tax and subsidy reforms, require knowledge of price and expenditure elasticities. The Jordanian government has pursued various programs in the form of price and income policies to promote consumer welfare and other development objectives. Moreover, the government may wish to redistribute income and improve the general welfare. Such a change will affect the structure of aggregate consumer demand in ways that will be anticipated. In the absence of any systematic study of consumer behavior, these policies could not be based on any firm estimates of price and expenditure elasticities

The following hypotheses will be tested:

H_1: The demand is homogeneous of degree zero in total expenditure and prices.

H_2: The matrix of substitution effects is symmetric, that is $S_{ij} = S_{ji}$.

2. Literature review

Several studies have analyzed the demand of the household; Bopape and Myers (2007) investigate the expenditure patterns of South African households using detailed cross-sectional expenditure and price data, Linear expenditure system (LES) parameter estimates are used to calculate income and price elasticities for several product categories at different points of the income distribution. Results indicate differences in household consumption patterns in rural and urban areas and households at each income level. The research identified meat and fish as luxury items in all household income groups. Hoang (2009) Using the unit values of six food items calculated herein, the Quadratic Almost Ideal Demand System (QUAIDS) proposed by Banks, Blundell, and Lewbel (1997) has been estimated on Indian consumer expenditure data, and the overall and item-specific PPPs have been calculated at two-time points. Molina and Gil (2005) estimate a demographic version of the Quadratic Almost Ideal Demand System (QUAIDS) using one Peruvian cross-section from 1997. They find the income elasticities reveal that Transport and Leisure are luxury goods, while Tobacco, Health and Miscellaneous Goods are necessities. Faharuddin et al. (2015) applied QUAIDS to analyze food consumption

patterns in South Sumatra using data from the 2013 SUSENAS household survey. Results indicated that all food groups had positive income and negative price elasticity, consistent with demand theory.

By estimating elasticities of food demand through a Linear Approximated Almost Ideal Demand System (LA/AIDS) Wambua et al., (2010) found that urban poor are sensitive to variation in food prices and income and they should be cushioned against negative effects of a price increase to enhance their access to food and their food security. Dairy and dairy products and wheat and wheat products were identified as subsidy carriers that would improve the nutrition of the urban poor. Musyoka et al., (2014) by Employing a Quadratic Almost Ideal Demand System (QUAIDS) model, provide evidence on how food consumption relates to food prices, household food expenditure, and demographic and regional factors, while also evaluating the welfare impact of reduced import tariffs on three important kinds of cereal in Kenya. Authors find that expenditure elasticities are greater than the own-price elasticities in urban and rural areas. Increasing household income and food expenditure through income transfer and creation of on-farm and off-farm employment would improve household food access more than price policies. They find results broadly consistent with the demand theory but add that regional differences, the ratio of food expenditure to total income and the ratio of auto-consumption are statistically significant, and hence have a great impact on food consumption expenditure. Burger et al. (2017) in their research find substantial variation in the price and income elasticities of demand for items across the income distribution, with the bottom quartile being extremely sensitive to increases in the price of food and clothing items, and the top quartile being as sensitive as households in developed countries. Yustika and Purnomosidi (2019) attempt to analyze the Demand Elasticity for Food Commodities in Java Island. They find that the demand for quantity of rice is not elastic to income; the demand for quantity of fresh fish, shrimp, beef, and chicken meat is elastic to income; the budget elasticity of fresh fish, shrimp, beef, and chicken meat is also large, which means that households will increase the quantity and budget for these three commodities. Bayu et al. (2020) find income elasticities for all groups of animal-sourced food were categorized as normal goods. Moreover, all animal-sourced food groups except eggs are luxury goods. The own-price elasticity also showed meat as the most responsive commodity to price increases than fish, poultry milk, and eggs. The cross-price elasticity of most animal-sourced food commodity groups achieved negative elasticity values, which indicated that the related animal-sourced food commodity groups were complementary. In contrast, positive elasticity values indicate the related food commodities group as a substitute.

The Almost Ideal Demand System (AIDS) was also used in James et al. (2003), who estimated the U.S. import demand and the domestic demand for red wine. Keefe (2002) analyzed the U.S. demand for shrimp and shrimp products. Andrikopoulus and Loizides (2000) examined the demand for home-produced and imported alcoholic beverages in Cyprus. Vidyashankara et al. (1999) used the AIDS model to estimate the import demand for malt in different countries. The demand for salmon in the European Union was estimated by Ashe et al. (1998) model.

It is worth mentioning that the best knowledge of the researchers of the AIDS model has not been applied to Jordanian data. Moreover, increasing the understanding of the potential role of household socio-economic consumption, commodity groups prices and income in explaining demand in Jordan would improve any policy designed to improve commodity groups' security.

To achieve the objectives of the study, the AIDS model will be estimated and applied to the Jordanian data. Deaton and Muellauer (1980) proposed and applied the AIDS model to British data for the period 1954-1974. Since then, the AIDS model has been applied by many economics using a different set of data for several

countries; examples are those of Ray (1980) using time series data from the Indian National survey, Blauciforti (1983) using USA annual time series data, Anderson and Blundell (1983) using Canadian data, Ruwis et al. (2007) using Suadi Arabia data; Moore and Green (2007) evidence from India; He and et al. (2011) examined demand for fruit in the United States, Young et al. (2018) on data from Korean, this functional form is also used in Brannlund et al (2007); Chambwera and Folmer (2007); Farrell and Shields (2007); Hausman and Leonard (2007); Henning and Henningsen (2007); Huang et al (2007); Raknerud et al (2007); West and Williams (2007); and Xiao et al (2007), because it unifies almost all theoretically and empirically desirable properties. The Almost Ideal Demand System (AIDS) also has been used in James et al. (2003). They estimated the U.S. import demand and the domestic demand for red wine. Keefe (2002) analyzed the U.S. demand for shrimp and shrimp products. Andrikopoulus and Loizides (2000) examined the demand for home produced and imported alcoholic beverages in Cyprus. Vidyashankara et al (1999) was the AIDS model to estimate the import demand for malt in different countries. The demand for salmon in the European Union was estimated by Ashe et al. (1998) model.

The AIDS specification is the most popular approach used in modelling demand systems in the last 40 years. For example, during the period 1980-1991, Buse (1994) reports that 89 empirical applications used the AIDS in demand studies . Also, a number of studies have used the static AIDS specification (Jones, 1989; Nelson and Moran, 1995; Gao et al., 1995; Andrikopoulous, Box and Carvalho, 1997). The static AIDS specification ignores potential significant short-run elasticity measures that differ from the long-run estimates. Moreover, in the context of decision-makers, they are more likely to be more concerned with short-run elLsticity estimates and the speed to which these estimates reach their long-run level. The However, The Almost Ideal Demand System (AIDS) was selected for the study use because it has a functional form that is consistent with household budget data, and it can be easily used to tet homogeneity and symmety subjraints.

3. Methodology

3.1 The AIDS Model

The AIDS cost function is given by:

$$lnC(U,P) = \alpha_0 + \sum_k \alpha_k lnP_{kt} + {}^1\!/_2 \sum_j \sum_j \gamma_{kj} lnP_{kt}\, lnP_{jt} + \cup \beta_0 \prod_k \prod_j P_{kt}^{\beta_k} \ldots\ldots\ldots (1)$$

Where C(U,P) is the cost function, P_{it} is a price of commodity i at time t, and α_0 ,α_k, β_i and γ_{ij} are estimable parameters. The AIDS budget shares can be easily derived from (1) using shephard's Lemma and appropriate substitution of the unobservable utility variable μ.

$$\omega_{it} = \alpha_j + \sum \gamma_{ij} lnP_{jt} + \beta_i(\ln m_t - \ln P) \quad \ldots\ldots\ldots (2)$$

Where ω_{it} is the budget share of a commodity i at time t, m_t is total expenditure at time t and Pa price index defined as

$$\ln P = \alpha_0 + \sum \gamma_k \ln P_k + {}^1\!/_2 \sum_j \sum_k \gamma_{ij} \ln P_j P_k \quad \ldots\ldots\ldots (3)$$

The following restrictions are require for adding

$$\sum_i \alpha_i = 1$$
$$\sum_i \beta_i = 0$$

The homogeneity restriction requires

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

The price index defined in equation (3) makes the system of equations (2) nonlinear Therefore, Deaton and Muellbauer (1980) recommended the use of Stone's index to replace the exact index (3) in order to avoid nonlinear estimation. The Stone's price index is given as:

$$\ln P^* = \sum \omega_i \ln P_i \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

Deaton and Muellbauer showed empirically that it makes little difference if P^* is used instead of P. Assuming that $P \approx \emptyset P^*$ then equation 2 could be approximated as:

$$\omega_{it} = \alpha_i^* + \sum \gamma_{ij} \ln P_{jt} + \beta_i (\ln m_t - \ln P^*) \quad \ldots\ldots\ldots (5)$$

Where $\alpha_i^* = \alpha_i - \beta_i \ln \emptyset$

The model defined by (5) is linear in the parameters α_i^*, β and γ and the estimation can be performed using Ordinary Least Square (OLS).

The homogeneity can be imposed directly on (5) by using the price of one commodity as normalize. Accordingly, the homogenous AIDS model could be written as:

$$\omega_{it} = \alpha_i^* + \sum_{j=1}^{n-1} \gamma_{ij} \ln\left(\frac{P_{it}}{P_{kt}}\right) + \beta_i \ln\left(\frac{m_t}{P^*}\right) \quad \ldots\ldots\ldots\ldots\ldots (6)$$

The system of equations (6) was obtained from (5) after imposing the homogeneity restrictions by subtracting and deleting one equation from the system. The system of equations (6) can be estimated by OLS. But when symmetry is imposed, the system can't be estimated by OLS. This is because symmetry involves cross-equation restrictions and a maximum likelihood estimation is required. However, an iterative seemingly unrelated regressions technique using iterative leads to estimates that are equivalent to maximum likelihood estimates, Mergos and Donatos (1989).

3.2 The data

The main source of data is the Jordan Household Budget Survey (1990-2019), demand systems have been estimated with AIDS (Deaton and Mullbauer, 1980) for six commodity groups .

The AIDS Free System was applied to annual Jordanian time series data for the year 1990-2018. Six commodity groups were distinguished, namely food, clothing, housing, durables, transportation and miscellaneous. These commodity groups have been selected because they are the only commodity groups covered by the available price index.

Furthermore, the data contains only 29 observations which restricts the number of commodity groups which can be used to estimate a system of demand equations, such as the kinds and about functional forms (AIDS). Table (1) presents parameters estimates of the linear approximation of the AIDS model.

Table (1): Estimates of the Linear Approximation of the AIDS Model

Commodity group	α_i	Estimated Results of the free AIDS Model						β_i	R^2	DW
		Food	Clothing	Housing	Durables	Transportation	Miscell.			
Food	0.1289** (2.697)	0.0268** (3.381)	-0.0081 (-1.209)	-0.0357* (-1.881)	0.0444** (2.230)	0.1001* (1.916)	0.0176 (1.550)	-0.0108	0.725	1.65
Clothing	0.0554** (16.020)	-0.0019** (-3.268)	0.0006 (1.279)	0.0025* (1.804)	-0.0032** (-2.224)	-0.0007* (-1.861)	-0.0013 (-1.536)	0.0007	0.720	1.63
Housing	0.2335** (333.1)	0.0004** (3.651)	-0.0001 (-0.874)	-0.0006* (-2.008)	0.0006* (2.047)	0.0002* (2.002)	0.0003 (1.573)	-0.0002	0.726	1.87
Durables	0.0665**	-0.0026**	0.0007	0.0034*	-0.0040**	-0.0009*	-0.0016	0.001	0.731	1.74

Commodity group	α_i	Estimated Results of the free AIDS Model						β_i	R^2	DW
		Food	Clothing	Housing	Durables	Transportation	Miscell.			
	(15.001)	(-3.569)	(1.058)	(1.983)	(-2.184)	(-1.991)	(-1.577)			
Transportation	0.2898**	-0.0129**	0.0039	0.0171*	-0.0214**	-0.0048*	-0.0085	0.0052	0.724	1.65
	(12.593)	(-3.373)	(1.212)	(1.878)	(-2.231)	(-1.913)	(-1.547)			
Miscellaneous	0.2268**	-0.0099**	0.0030	0.0132*	-0.0164**	-0.0037*	-0.0065	0.0040	0.724	1.65
	(12.819)	(-3.371)	(1.213)	(1.877)	(-2.231)	(-1.912)	(-1.546)			

t-value are between two Parentheses

4. Empirical results

4.1 The free AIDS estimated results

The system of equations (5) was applied to annual Jfrom series data for the years 1990-2018. Table (1) presents parameter estimates of estimateapproximatbeta estimatesel. The estimates of β, classify food and housing as necessities while the other cosmmodity groups are luxu,ries. In the AIDS model negative $\beta_i's$ imply necessities while positive $\beta_i's$ indicate luxuries. These results provide an interesting contrast with the results of Mergos and Donatos (1989) results for similar groups of commodities in Greece. In their study, four of seven commodity groups were classified as necessities: food, housing, durables, and personal care. Whereas clothing, transportation, and other categories were found to be luxuries. On the other hand, Deaton and Mullbauer (1980) applied the AIDS model to British data and they found that six of eight commodity groups were classified as luxuries and only food and housing were found to be necessities. Pashardes (1993) using data drawn from the UK Family Expenditure Survey over the period 1970-1986 found that three out of seven commodities were classified as necessities. These groups are food, alcohol and fuel.

The main objective of estimating the AIDS in equation (6) is to obtain expenditure and price elasticities for commodity groups consumed by households in Jordan. In commenting statistically upon the estimated results in table (1) it can be seen that only twenty out of forty two parameter estimates are significantly different from zero at the five percent level of significance as indicated by the (t) value. Of the coeff,icients sixteen thirty-sixrty six have t-value absolutely larger than two. This is considered to be relatively moderate, since most of the previous empirical demand studies found only a small proportion of the estimated price coefficients were significant. Ray (1980) applied the AIDS to Indian data and found that 13 out of 81 of the price coefficients were significant, Blanciforti (1983 and 1986) applied the AIDS model to USA data and found that 42 out of 121 of the Price coefficients were significant. Furthermore, Deaton and Muellbauer (1980) found that only twenty two out of sixty four of the estimated coefficients had t-values greater than two in absolute value. Overall fit seems to be relatively high as indicated by the coefficient of determination, R^2, which exceeds 0.75 for all six equations in the system.

The value of the Durbin-Watson statistics indicates that there was no serial correlation in the residual of any equation of the system.

Based on the estimated results presented in table (1) it was found that the prices of clothing, transportation and miscellaneous seem to have no influence on either the value shares of clothing, transportation and miscellaneous or on that of other categories. This suggests that if the prices of clothing, transportation and miscellaneous change while other prices remain constant, the budget share of each commodity group will not change. In contrast, the price of food and the price of durables have a significant influence on the budget share of all categories.

Table (2): Free AIDS Estimates of Total Expenditure Price Elasticities

Commodity group		Elasticity Estimates W.R.T Price of						
	n_i	Food	Clothing	Housing	Durables	Transportation	Miscell.	e^*_{ii}
Food	0.967	-0.918	-0.025	-0.109	0.1360	0.3062	0.057	-0.602
Clothing	1.019	-0.046	-0.995	0.0049	-0.0779	-0.017	-0.0316	-0.943
Housing	0.999	0.0017	-0.0004	-1.0025	-0.0025	0.0025	0.0012	-0.767
Durables	1.021	-0.547	0.0147	0.0716	-1.085	0.0189	0.0336	-1.036
Transportation	1.027	-0.0663	0.02	0.0879	-0.11	-1.024	-0.0437	-0.824
Miscellaneous	1.026	-0.064	0.019	0.086	-0.11	0.024	-1.042	-0.88

Regarding the direct price coefficients, only the housing and durables coefficients were negative and statically significant at 5%. Only the food price coefficient was positive and significant at the five percent level of significance, whereas, the price of the coefficient of durables was negative and significant at 10%.

4.2. Elasticity estimates of the Free AIDS

Demand elasticities of the AIDS for the system of equations (5) are given as follows

$$e\_ii = \gamma\_ij/\omega\_i - 1$$

$$e\_ij = \gamma\_ij/\omega\_i - 1 \qquad n\_i = 1 + \beta\_i/\omega\_i$$

Where e_{ii}, e_{ij} and n_i are own-price elasticity of commodity i, the elasticity of demand for commodity I with respect to price of commodity j and the elasticity of total expenditure respectively and the other notations are as defined above.. Table (2) presents the uncompensated own-price, cross-price and total expenditure elasticity estimates for the system. Thus elasticity estimates were evaluated at the mean values of total expenditure, expenditure on each commodity group and prices. The final column of table (2) shows the compensated own-price elasticity estimates, which were as:

$$e^*_{ii} = e_{ii} + n_i\bar{\omega}_j$$

Where e^*_{ii} is the compensated own-price elasticity and the other notations are as defined above.

According to the evaluated total expenditure elasticities, the demand for food and housing are inelastic with respect to total expenditure. The demand for other commodity groups is elastic with respect to total expenditure This result is consistent with the β_i estimates.

The uncompensated own-price elasticities indicate that demand for each category is elastic for all commodity groups except for food and clothing items, which appear to be price inelastic. One striking result was that own-price elasticity for food seems to be relatively very large in comparison with that estimated for other countries using the same model. For example, Ray (1980) estimated (-0.331) for India, Banciforti and Green (1983) obtained about (-0.32) for USA; Mergos and Donatos (1989) reported about (-0.44) for, Greece and Pashardes (1993) obtained an even smaller estimate in absolute values than the previous studies for UK, about (-0.17).

This may suggest that the elasticity estimates for food seem to be overestimated, perhaps due to a bias in the estimated model resulting from omitting a relevant variable or variables from the estimated model.

All compensated own-price elasticity estimates were negative, which are consistent with *a priori knowledge*.

4.3. Homogeneous AIDS Results

The system of equations (6) was fitted to the Jordanian data after deleting one equation from the system: that is the housing equation. The parameters of the deleted equation

can be calculated by the adding-up condition.

Table (3) contains the parameter estimates of equation (6) together with the coefficients of determination, R^2, the value of Durbin Watson statistics and t-values. The t-values of the estimates indicate that none of them the estimates were significantly different from zero at the five percent level of significance. Considering the other parameters estimates $\alpha^*{}_i$ for food, durables, transportation and miscellaneous were significant. Whereas the β_i estimates found to be significant for all commodity groups.

Overall fit was relatively very low for all equations, the value of R^2 approximated between (0.64) to (0.70).

To test the validity of the homogeneity restriction on F-test was performed. The F-statistics for equation were calculated as follow:

$$F = \frac{(RSS_{H_O} - RSS_{H_A})/M}{RSS_{H_A}/T - K}$$

Where RSS_{H_O} and RSS_{H_A} are the residual sum square of restricted and non restricted equations respectively, M is the number of restrictions. T is the number of observations and K is the number of parameters in each equation.

Hence M, T and K are 1, 29 and 8 respectively. Accordingly, the degrees of freedom is 1 21. The critical value of F statistics at the 5% is $F_{1,21} = 4.35$. Therefore, the calculated F present in the table (4) shows the assumption of homogeneity can be rejected for all commodity groups except for durables and housing.

Table (3): Homogeneous AIDS Results

Commodity group	α	γ_{ij}	γ_{ij}	γ_{ij}	γ_{ij}	γ_{ij}	β_i	Res	R^2	$D.W$
Food	0.3521 (19.6)	0.0103 (1.02)	-0.0096 (-1.003)	-0.0267 (-0.0228)	-0.0015 (1.428)	0.0229 (1.428)	-0.0073 (-1.568)	0.000016	0.205	1.65
Clothing	0.0393 (0.49)	-0.007 (-0.94)	0.0007 (1.05)	0.00019 (1.3	0.0001 (0.257)	-0.0016 (-1.422)	0.000 (1.54)	0.000000319	0.201	1.63
Housing	0.2367 (0.08)	0.0002 (1.26)	0.00002 (0.06)	-0.0004 (-1.54)	-0.00001 (-0.13)	0.0003 (1.45)	-0.0001 (0.09)	0.000000013	0.213	1.87
Durables	0.045 (27.4)	-0.0011 (-1.15)	0.0008 (0.089)	0.0026 (1.47)	0.0001 (0.178)	-0.0021 (-1.44)	1.664 (1.67)	0.000000518	0.204	1.65
Transportation	0.1824 (21.1)	-0.005 (1.012)	0.0046 (1.006)	0.0128 (1.4)	0.0007 (0.228)	-0.011 (-1.43)	1.564 (0.132)	0.0000143	0.204	1.65
Miscellaneous	0.1442 (21.75)	-0.0038 (-1.01)	0.0036 (1.007)	0.0099 (1.399)	0.0006 (0.22)	-0.0083 (-1.43)	0.0027 (0.132)	0.00000843	0.22	1.87

t-value are between two Parentheses

Table (4): F-Statistics (Testing Homogeneity)

Commodity group	F- Ratio (calculated)
Food	29.22
Clothing	16.28
Housing	18.47
Durables	0.82

Commodity group	**F- Ratio (calculated)**
Transportation	1.75
Miscellaneous	38.8

A review of the results obtained in other applications of AIDS model indicates that there is a general pattern with respect to the hypothesis of homogeneity. In Deaton and Muellbauer (1980) homogeneity was rejected in four equations out of eight commodity groups. Since that study, homogeneity was also rejected by Blanciforti (1982) using American data, Mudbhary (1988) using the Nepalis data, Fulponi (1989) using French data, and Mergos and Donatos (1989) using Greek data. On the other hand, Ray (1980) using data from India did not reject homogeneity.

It is worth mentioning that it is has been observed by Deaton and Muellbauer (1980) that the imposition of homogeneity leads to a drop in the Durbin-Watson statistics; the drop being sharper in commodity groups where there is a strong rejection of the homogeneity property. This result was also confirmed by Blanciforti and Green (1983), by Mergos and Donatos (1989) and by the present study. The introduction of serial correlation through the imposition of homogeneity could be due to the omission of dynamic effect.

4.4. Symmetric AIDS

Imposing the symmetry restrictions (Slutsky equation) on the system of equation 5, the system was estimated as a whole by the means of Iterative Seemingly unrelated regressions (ISUR) which is equivalent to maximum likelihood estimation when it converges. Parameter estimates together with the coefficient of the determination R^2, $D.W$ and the t-values of the estimates are presented in Table(5).

Table (5): The Seemingly Unrelated Regressions (ISUR) Estimated for the Symmetry Restrictions (Slutsky Equation)

	α_i	γ_{i1}	γ_{i2}	γ_{i3}	γ_{i4}	γ_{i5}	γ_{i6}	β_i	R^2	DW
ω_F	0.101 (3021)	0.0322 (3024)	-0.0091 (-1.285	-0.0486 (-2.34)	0.0662 (3.24)	0.0481 (1.90)	-0.0425 (-6.48)	-0.0425 (-6.48)	0.721	0.84
ω_C	0.062 (16.2)		0.0008 (1.83)	0.0035 (2.22)	-0.0042 (-3.22)	-0.0091 (7.31)	-0.0022 (-2.01)	0.0006 (4.34)	0.815	0.82
ω_H	0.342 (332.4)			-0.0012 (-3.41)	0.0009 (2.36)	0.00081 (2.95)	0.0001 (2.11)	-0.0003 (-4.81)	0.693	1.21
ω_D	0.072 (16.23)				-0.0051 (-3.26)	-0.0010 (-1.99)	-0.0022 (-2.09)	0.0026 (4.22)	0.432	0.91
ω_T	0.221 (15.3)					-0.0098 (-2.40)	-0.0002 (-1.98)	0.0060 (4.63)	0.911	1.41
ω_M	0.202 (12.4)						-0.0053 (-4.56)	0.0334 (5.36)	0.892	1.52

t-value are between two Parentheses

The t-ratios indicate that $\alpha^*{}_i$ was significant at the five percent of significance for all commodity groups. This was also true for all the β_i. The t-ratios also suggest that four out of twenty one price coefficients γ_{ij} were

insignificant at the 5% significant level. Over all fit seems to be good for all equations in the system except for durables as indicated by R^2. The $D.W$ statistics, on the other hand, suggest there was serial correlation in the disturbances of the food, clothing and durable. It is worth mentioning that imposing symmetry resulted in a sharp drop of the $D.W$ statistics in all equations. Furthermore, the imposing of symmetry resulted also in obtaining different parameter estimates from those reported in Table (1) and Table (3). The symmetric AIDS for example provided different values of the γ_{ij} for most of the commodity groups.

4.5. Restricted AIDS

Imposing the homogeneity and symmetry restrictions on equation (5) yield a system of demand equations, which is consistent with the utility maximization hypothesis. All the properties of demand will be satisfied by the system, noting that the adding-up property is automatically satisfied. The whole system has been estimated by ISUR.

Table (6) contains the parameter estimates for the restricted AIDS together with the coefficients of determination, R^2, the standard errors of the estimates and DW statistics.

The t-ratios indicate the α_i parameter estimates were significantly different from zero for all commodity groups. This was also true for all the β_i, estimates. This however, differs from all the previous results. The t-ratios also indicate that all the price coefficients γ_{ij} were significant at the five percent level of significance.

The coefficient of determination, R^2 , indicated that overall fit was reasonable for all commodity groups. DW statistics indicate serial correlation in the residuals of transportation and miscellaneous commodity groups. This result contradicts with the results of the free system in this regard.

Table (6): Estimates for the Restricted AIDS

Commodity group	α_i	γ_{i1}	γ_{i2}	γ_{i3}	γ_{i4}	γ_{i5}	γ_{i6}	β_i	R^2	DW
Food	0.3169 (29.25)	0.6542 (209.9)	0.0823 (152.6)	0.4724 (456.9)	0.0964 (84.56)	0.390 (150.02)	0.3075 (154.7)	2.001 (590.9)	0.7993	1.8941
Clothing	0.0420 (15.88)	0.0823 (152.6)	0.0104 (32.1)	0.0597 (179.5)	0.0119 (14.18)	0.0491 (115.1)	0.0387 (104.7)	0.2525 (499.7)	0.7927	1.8881
Housing	0.2423 (83.7)	0.4724 (456.9)	0.0597 (179.5)	0.3431 (333.3)	0.067 (77.93)	0.2817 (402.3)	0.2228 (421.6)	1.448 (620.3)	0.7931	1.8648
Durables	0.0438 (6.022)	0.0964 (84.56)	0.0119 (14.18)	0.067 (77.93)	0.016 (6.461)	0.0571 (65.76)	0.0445 (56.06)	0.2923 (358.2)	0.7925	1.8911
Transportation	0.1995 (21.42)	0.390 (150.02)	0.0491 (115.1)	0.2817 (402.3)	0.0571 (65.76)	0.2323 (105.1)	0.1832 (108.9)	1.194 (538.5)	0.7875	1.8758
Miscellaneous	0.1587 (22.33)	0.3075 (154.7)	0.0387 (104.7)	0.2228 (421.6)	0.0445 (56.06)	0.1832 (108.9)	0.1447 (112.1)	0.9427 (540.8)	0.7948	1.8825

t-value are between two Parentheses

4.6. Testing the hypotheses

Having presented and discussed various estimated models of the AIDS system, it is necessary to test for the consistency of the general restrictions implied by theory.

In order to test the general restrictions, the log likelihood ratio will be used. The difference between twice the log likelihood of the unrestricted model is asymptotically distributed as x^2 with j degrees of freedom, where j is the number of restrictions imposed. Maddala and Kajalahiri (2009). Table 5 presents twice the log-likelihood value for the four various AIDS model. The figures in parentheses are the number of parameters which have been estimated.

Table (7):Twice the Log-likelihood for AIDS

MODELS	log-likelihood	D.F	5%	conclusion
Free AIDS	110.2 (40)	-	-	Rej.
Homogenous AIDS	108.1 (35)	5	11.1	Rej.
Symmetric AIDS	20.4 (30)	10	18.3	Rej.
Restricted AIDS	120.6 (25)	15	25.0	Rej.

Inspection of the log-likelihood values indicate that the homogeneity hypothesis is completely rejected. The rejection of homogeneity may be traced further by inspecting F-ratios for each of the commodity groups; these showed that homogeneity was rejected for all commodity groups except for housing and durables. The likelihood ratios indicate that the symmetry restriction was also rejected at 5% and was not rejected at 10%. But symmetry given homogeneity was clearly rejected. The failure of accepting the demand properties (implied by the theory) could be attributed to the neglect of dynamic effects.

5. Conclusions and policy implications

The AIDS demand model was applied to the Jordanian data during the period 1990-2018 in which six commodity groups were distinguished. The free, the homogeneous, the symmetric and the restricted AIDS models were estimated. The t-values of the parameter estimates were significantly different from zero at the five percent level of significance, while none of these parameters estimated were significant under the homogeneous system. Based on F-ratio homogeneity, it was rejected for each individual equation in the system except housing and durable equations.

Based on the evaluated total expenditure elasticities indicate that the demand for food and housing are inelastic with respect to total expenditure (income); whereas the demand for all the other commodity groups are elastic. The uncompensated own-price elasticities indicate that demand for food and clothing items is inelastic and inelastic for all other commodity groups. One striking result was that own-price elasticity for food seems to be relatively very large in comparison with the estimated for other countries using the same model. The compensated own price elasticities ranged from (-0.602) for food items to (-1.03) for durable items. Recommendation based on the results of the study was that, in relation to people's consumption patterns, the policy of increasing household income was less important than the policy of maintaining price stability.

Based on R^2 it was found that the free AIDS model gave better estimates than the homogeneous and the restricted models. Likewise, other studies' imposition of homogeneity had resulted in a sharp drop in Durbin Watson statistics in all equations. Based on the log-likelihood ratios homogeneity and symmetry given homogeneity for the whole system were rejected. These findings suggest that the demand for aggregate commodity groups in Jordan is not consistent with the theory of demand.

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تطبيق نموذج الطلب المثالي التقريبي (AIDS) على المجموعات السلعية للأسرة في الأردن

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ملخص

هدفت هذه الدراسة إلى تقدير دوال نموذج الطلب المثالي التقريبي **(AIDS)** لتحليل الطلب في الأردن، ومن هذا المنطلق فقد تم تقدير النموذج غير المقيد، والنموذج المتجانس، والنموذج المتماثل، إضافة الى النموذج المقيد، وبناء على ذلك فقد تم تقدير مرونات دوال الطلب للمجموعات السلعية؛ إذ تبين أن الطلب على الغذاء وعلى السكن غير مرن؛ في حين أن بقية المجموعات السلعية مرنة بالنسبة للدخل، وتبين أن مرونات الطلب السعرية للمجموعات السلعية؛ الغذاء والملابس غير مرنة، في حين أن بقية المجموعات السلعية مرنة، وقد أظهرت الدراسة أن مرونة الطلب للغذاء في حالة الأردن مرتفعة نسبياً بالمقارنة مع تقديرات مرونات الغذاء السعرية لدول أخرى، وبناءً على الاختبارات الإحصائية فقد تم رفض الطلب المتجانس والطلب المتماثل؛ ويشير ذلك إلى أن الطلب على المجموعات السلعية في الأردن لا ينسجم مع نظرية الطلب.

الكلمات الدالة: نموذج نظام الطلب المثالي التقريبي، التجانس، المتماثل، مرونات السعر والدخل.

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تاريخ استلام البحث 2020/8/1 وتاريخ قبوله 2021/1/27.