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

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ABSTRACT

Objectives: The main aim of this study is to estimate the Jordanian aggregate consumption function using the 'Almost Ideal Demand System (AIDS)' and to test whether Jordanian consumers maximize their utility. This can be assessed by examining whether the data is consistent with the properties of demand. Additionally, the study seeks to provide efficient estimates of own-price and cross-price elasticities of Jordanian demand.

Methods: An iterative seemingly unrelated regressions (SUR) technique and maximum likelihood estimation were applied to the AIDS model.

Results: Total expenditure (income) elasticities indicate that the demand for food and housing is inelastic with respect to total expenditure (income), whereas the demand for all other commodity groups is elastic. The uncompensated own-price elasticities show that the demand for food and clothing items is inelastic, while the demand for all other commodity groups is elastic. One striking result is that the own-price elasticity for food appears to be significantly larger compared to estimates from other countries.

Conclusion: Based on the log-likelihood ratios, both homogeneity and symmetry (given homogeneity for the whole system) were rejected. The study suggests that the demand for aggregate commodity groups in Jordan is not consistent with demand theory.

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

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

1. Introduction

Demand analysis primarily focused on 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 adopt a complete system approach, consistent with neoclassical demand theory. Many models have been proposed and applied to different data sets. Apart from the Linear Expenditure System (LES), proposed by Klein and Rubin (1947) and applied by Stone (1954), few models have been extensively used. Other notable models include the Rotterdam model (Theil, 1965, 1975; Barten, 1967, 1969), the translog model (Christensen et al., 1975), and the Almost Ideal Demand System (AIDS) (Deaton and Muellbauer, 1980; Chesher and Rees, 1987; Pashardes, 1993). All three models have been estimated and used to test the homogeneity and symmetry restrictions of demand theory. Numerous studies have analyzed the demands for expenditure groups in countries worldwide.

1.1. Importance of the Study

The importance of the study stems from the fact that final demand plays a major role in economic development, consisting of two crucial sectors: final

demand and the production sector. Household demand constitutes a significant portion of final demand in any country. For Jordan, it constitutes, on average, about 65 percent of final demand (Central Bank of Jordan, 2020). Therefore, analyzing and estimating household demand is considered very important for national planners and decision-makers.

1.2. Objectives of the study

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

The objectives of the study are:

1. To estimate the compensated and uncompensated price elasticities of demand for the six commodity groups.
2. To test the validity of the general restrictions implied by the theory of demand by applying the AIDS model to Jordanian data.

A few studies have analyzed the demand for food or other commodity groups, including: Şahinli and Fidan (2012), Deaton and Muellbauer (1980), Blanciforti and Green (1983), Blanciforti et al. (1986), and Hutasuhut et al. (2001).

1.3. The problem of the study

The economy of Jordan has been undergoing rapid structural changes over the past three decades. The role of consumer behavior in these structural changes is crucial. Any changes in demand patterns might have significant implications for trade and growth policies; therefore, economic planning should account for these changes. The role of prices and appropriate pricing policies has been given considerable weight in setting strategies for economic development in Jordan.

It is known that the commodity composition of personal demand varies with price and income. Consequently, policy decisions, especially those concerning tax and subsidy reforms, require knowledge of price and expenditure elasticities. The Jordanian government has implemented various programs involving price and income policies to promote consumer welfare and other development objectives. Furthermore, the government may wish to redistribute income and improve general welfare. Such changes will affect the structure of aggregate consumer demand in ways that need to be anticipated. In the absence of a systematic study of consumer behavior, these policies cannot be based on 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 household demand.

Bopape and Myers (2007) investigated the expenditure patterns of South African households using detailed cross-sectional expenditure and price data. Linear Expenditure System (LES) parameter estimates were used to calculate income and price elasticities for several product categories at different points in the income distribution. The results indicated differences in household consumption patterns between rural and urban areas and across different income levels. The research identified meat and fish as luxury items in all household income groups.

Hoang (2009) estimated the Quadratic Almost Ideal Demand System (QUAIDS) proposed by Banks, Blundell, and Lewbel (1997) using unit values of six food items calculated from Indian consumer expenditure data. The overall and item-specific Purchasing Power Parities (PPPs) were calculated at two time points.

Molina and Gil (2005) estimated a demographic version of the QUAIDS using a Peruvian cross-section from 1997. Their findings revealed 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. The results indicated that all food groups had positive income and negative price elasticities, consistent with demand theory.

Wambua et al. (2010) estimated elasticities of food demand through a Linear Approximated Almost Ideal Demand System (LA/AIDS). They found that the urban poor are sensitive to variations in food prices and income. To enhance their access to food and food security, they should be cushioned against the negative effects of price increases. Dairy and dairy products, as well as wheat and wheat products, were identified as subsidy candidates to improve the nutrition of the urban poor.

Musyoka et al. (2014), using a Quadratic Almost Ideal Demand System (QUAIDS) model, provided evidence on how food consumption relates to food prices, household food expenditure, and demographic and regional factors. They also evaluated the welfare impact of reduced import tariffs on three important types of cereal in Kenya. The authors found that expenditure elasticities were greater than own-price elasticities in both urban and rural areas. Increasing household income and food expenditure through income transfers and the creation of on-farm and off-farm employment would improve household food access more than price policies. Their results were broadly consistent with demand theory but highlighted that regional differences, the ratio of food expenditure to total income, and the ratio of auto-consumption had a significant impact on food consumption expenditure.

Burger et al. (2017) found substantial variation in the price and income elasticities of demand for items across the income distribution. The bottom quartile was extremely sensitive to increases in the price of food and clothing items, while the top quartile was as sensitive as households in developed countries.

Yustika and Purnomosidi (2019) analyzed the demand elasticity for food commodities on Java Island. They found that the demand for rice quantity is inelastic with respect to income, while the demand for fresh fish, shrimp, beef, and chicken meat is elastic. The budget elasticity for these commodities is also large, indicating that households will increase both the quantity and budget for these items.

Kharisma et al. (2020) found that income elasticities for all groups of animal-sourced foods were categorized as normal goods. Moreover, all animal-sourced food groups, except eggs, were considered luxury goods. Meat was identified as the most responsive commodity to price increases compared to fish, poultry, milk, and eggs. The cross-price elasticity values for most animal-sourced food commodity groups were negative, indicating that these commodities were complementary. Positive elasticity values indicated that related food commodities were substitutes.

The Almost Ideal Demand System (AIDS) was used

by James et al. (2003) to estimate U.S. import demand and domestic demand for red wine. Keefe (2002) analyzed U.S. demand for shrimp and shrimp products. Andrikopoulos 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. Ashe et al. (1998) estimated the demand for salmon in the European Union using the AIDS model.

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

To achieve the objectives of the study, the AIDS model will be estimated and applied to Jordanian data. Deaton and Muellbauer (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 economists using various data sets from several countries. Examples include Ray (1980) using time series data from the Indian National Survey, Blundell (1983) using U.S. annual time series data, Anderson and Blundell (1983) using Canadian data, Ruwis et al. (2007) using Saudi Arabian data, Moore and Green (2007) providing evidence from India, and He et al. (2011) examining the demand for fruit in the United States. Young et al. (2018) used data from Korea. The functional form has also been used in studies by 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), due to its ability to unify nearly all theoretically and empirically desirable properties.

The AIDS specification has been the most popular approach for modeling demand systems over the past 40 years. For example, during the period 1980-1991, Buse (1994) reported that 89 empirical applications used AIDS in demand studies. Several studies have utilized the static AIDS specification (Jones, 1989; Nelson and Moran, 1995; Gao et al., 1995; Andrikopoulos, Box, and Carvalho, 1997). However, the static AIDS specification ignores potentially significant short-run elasticity measures that differ from long-run estimates. In decision-making contexts, stakeholders are often more concerned with short-run elasticity estimates and the speed at which these estimates reach their long-run levels. Nonetheless, the AIDS model was selected for this study because its functional form is consistent with household budget data and it can easily be used to test homogeneity and symmetry.

3. Methodology

3.1. The AIDS Model

The AIDS cost function is given by:

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

Where C(U, P) is the cost function, P_{it} is the price of commodity i at time t, and, 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.

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

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

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

The following restrictions are required 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) to avoid nonlinear estimation. The Stone's price index is given as:

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

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:

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

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 normalized. Accordingly, the homogenous AIDS model could be written as:

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

The system of equations (6) was derived from (5) by imposing the homogeneity restrictions, which involved subtracting and removing one equation from the system. Equation system (6) can be estimated using Ordinary Least Squares (OLS). However, when symmetry is imposed, the system cannot be estimated by OLS due to the cross-equation restrictions required by symmetry. Instead, a maximum likelihood estimation is needed. An iterative seemingly unrelated regressions (SUR) technique can be used, which, when iteratively applied, produces estimates equivalent to those obtained from maximum likelihood estimation, as demonstrated by Mergos and Donatos (1989).

3.2. The data

The primary data source for this study is the Jordan Household Budget Survey (1990-2019). The Almost Ideal Demand System (AIDS), as proposed by Deaton and Muellbauer (1980), was used to estimate demand systems for six commodity groups. The AIDS model was applied to annual Jordanian time series data from 1990 to 2018. The six commodity groups analyzed are food, clothing, housing, durables, transportation, and miscellaneous. These groups were selected because they are the only ones covered by the available price index.

Additionally, the dataset includes only 29 observations, which limits the number of commodity groups that can be included in the demand system estimation, such as those required for the AIDS model. Table 1 presents the parameter estimates for 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**	0.0268**	-0.0081	-0.0357*	0.0444**	0.1001*	0.0176	-0.0108	0.725	1.65
	(2.697)	(3.381)	(-1.209)	(-1.881)	(2.230)	(1.916)	(1.550)			
Clothing	0.0554**	-0.0019**	0.0006	0.0025*	-0.0032**	-0.0007*	-0.0013	0.0007	0.720	1.63
	(16.020)	(-3.268)	(1.279)	(1.804)	(-2.224)	(-1.861)	(-1.536)			
Housing	0.2335**	0.0004**	-0.0001	-0.0006*	0.0006*	0.0002*	0.0003	-0.0002	0.726	1.87
	(333.1)	(3.651)	(-0.874)	(-2.008)	(2.047)	(2.002)	(1.573)			
Durables	0.0665**	-0.0026**	0.0007	0.0034*	-0.0040**	-0.0009*	-0.0016	0.001	0.731	1.74
	(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 is between two Parentheses

4. Empirical results

4.1 The free AIDS estimated results

The system of Equation (5) was applied to annual Jfrom series data for the years 1990-2018. Table (1) presents parameter estimates. The estimates of β, classify food and housing as necessities while the other commodity groups are luxuries. In the AIDS model, negative $\beta_i's$ implies necessities while positive $\beta_i's$ indicates luxuries. These results present an interesting contrast to those of Mergos and Donatos (1989) for similar commodity groups in Greece. In their study, four of seven commodity groups were classified as necessities: food, housing, durables, and personal care. In contrast, clothing, transportation, and other categories were classified as luxuries. Conversely, Deaton and Muellbauer (1980) applied the AIDS model to British data and found that six of eight commodity groups were classified as luxuries, with only food and housing considered necessities. Similarly, Pashardes (1993), using data from the UK Family Expenditure Survey over the period 1970-1986, identified food, alcohol, and fuel as necessities among the seven commodity groups analyzed.

The main objective of estimating the AIDS model in equation (6) is to obtain expenditure and price elasticities for the commodity groups consumed by households in Jordan. Examining the estimated results presented in Table 1, it is observed 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-values. Among the price coefficients, only fourteen have a t-value greater than two, which is relatively moderate. This is consistent with previous empirical demand studies where only a small proportion of estimated price coefficients were significant. For instance, Ray (1980) applied the AIDS model to Indian data and found that 13 out of 81 price coefficients were significant. Similarly, Blanciforti (1983 and 1986) applied the AIDS model to USA data and found that 42 out of 121 price coefficients were significant. Deaton and Muellbauer (1980) reported that only twenty-two out of sixty-four estimated coefficients had t-values greater than two in absolute value. Overall, the model fit is 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 statistic indicates that there is no serial correlation in the residuals of any

equation in the system.

Based on the estimated results presented in Table 1, it was found that the prices of clothing, transportation, and miscellaneous items do not significantly influence the budget shares of these categories or those of other categories. This suggests that changes in the prices of clothing, transportation, and miscellaneous items, while other prices remain constant, will not affect the budget share of each commodity group. In contrast, the prices of food and durables have a significant impact on the budget shares of all categories.

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

Commodity group		Elasticity Estimates W.R.T Price of						e^*_{ii}
	n_i	Food	Clothing	Housing	Durables	Transportation	Miscell.	
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 coefficients for housing and durables were negative and statistically significant at the 5% level. The coefficient for food was positive and significant at the 5% level. Additionally, the price coefficient for durables was negative and significant at the 10% level.

4.2. Elasticity estimates of the Free AIDS

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

$$\text{e\_ii} = \gamma\_ij/\omega\_i \; - 1$$

$$\text{e\_ij} = \gamma\_ij/\omega\_i \; - 1 \qquad n\_i = 1 + \beta\_i/\omega\_i$$

Where e_{ii}, $e_{ij,}$ and n_i are the own-price elasticity of commodity I, the elasticity of demand for a commodity I with respect to the 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 is 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 the 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 the 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 is 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 α^*_i for food, durables, transportation and miscellaneous were significant. Whereas the β_i estimates were 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, F-test was performed. The F-statistics for the equation were calculated as follows:

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

Where RSS_{H_O} and RSS_{H_A} are the residual sum squares of restricted and nonrestricted 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 are 1 21. The critical value of F statistics at the 5% is $F_{1,21} = 4.35$. Therefore, the calculated F present in 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 is 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
Transportation	1.75
Miscellaneous	38.8

A review of the results obtained from other applications of the AIDS model indicates a general pattern regarding the hypothesis of homogeneity. In Deaton and Muellbauer (1980), homogeneity was rejected in four out of eight commodity groups. Since then, homogeneity has also been rejected by Blanciforti (1982) using American data, Mudbhary (1988) using Nepali 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 noting that Deaton and Muellbauer (1980) observed that the imposition of homogeneity leads to a drop in the Durbin-Watson statistics, with the drop being more pronounced in commodity groups where homogeneity is strongly rejected. This finding has also been confirmed by Blanciforti and Green (1983), Mergos and Donatos (1989), and the present study. The introduction of serial correlation through the imposition of homogeneity may be due to the omission of dynamic effects.

4.4. Symmetric AIDS

Imposing the symmetry restrictions (Slutsky equation) on the system of equation 5, the system was estimated as a whole using 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 is 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. Overall 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 a serial correlation in the disturbances of the food, clothing, and durables. 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) yields 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 indicated that the 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 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 is 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 the

theory. 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 models. The figures in parentheses are the number of parameters that 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 indicates that the homogeneity hypothesis is completely rejected. Further examination of the F-ratios for each commodity group shows that homogeneity was rejected for all groups except housing and durables. The likelihood ratios reveal that the symmetry restriction was also rejected at the 5% level but not at the 10% level. However, symmetry, given homogeneity, was rejected. The failure to accept 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 equation in the system except housing and durable equations.

The AIDS demand model was applied to Jordanian data from 1990 to 2018, distinguishing six commodity groups. The free, homogeneous, symmetric, and restricted AIDS models were estimated. The t-values of the parameter estimates were significantly different from zero at the 5% level, while none of the parameters were significant under the homogeneous system. Based on the F-ratio, homogeneity was rejected for each equation in the system except for housing and durables.

The evaluated total expenditure elasticities indicate that the demand for food and housing is inelastic with respect to total expenditure (income), whereas the demand for all other commodity groups is elastic. The uncompensated own-price elasticities show that demand for food and clothing items is inelastic, while demand for all other commodity groups is elastic. A striking result is that the own-price elasticity for food is relatively very high compared to estimates from other countries using the same model. The compensated own-price elasticities ranged from -0.602 for food items to -1.03 for durable items. Based on these results, the study recommends that, given people's consumption patterns, increasing household income is less important than maintaining price stability.

The R^2 values indicate that the free AIDS model provided better estimates than the homogeneous and restricted models. Additionally, other studies have found that imposing homogeneity resulted in a sharp drop in Durbin-Watson statistics in all equations. Log-likelihood ratios show that homogeneity and symmetry, given homogeneity, were rejected for the whole system. These findings suggest that the demand for aggregate commodity groups in Jordan is not consistent with demand theory.

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

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ملخص

الأهداف: تهدف هذه الدراسة إلى تقدير دوال الطلب الاستهلاكي من خلال نموذج الطلب المثالي التقريبي **(AIDS)** في الأردن، واختبار فيما إذا كان المستهلك الأردني يقوم بتعظيم منفعته؛ واختبار فيما إذا توافقت البيانات مع خصائص الطلب. كما تهتم الدراسة بتقدير مرونة الطلب السعرية والتقاطعية للطلب الأردني.

المنهجية: تم استخدام تقنيات الانحدارات غير المرتبطة ظاهريا **(SUR)** ؛ وطريقة الإمكان الأعظم في تقدير دوال الطلب ونموذج الطلب المثالي التقريبي.

النتائج: تبين نتائج تقدير مرونات الانفاق الكلي (الدخل) أن الطلب على الغذاء وعلى السكن غير مرن؛ في حين أن بقية المجموعات السلعية مرنة بالنسبة للدخل، وتبين النتائج أن مرونات الطلب السعرية للمجموعات السلعية؛ الغذاء والملابس غير مرنة، في حين أن بقية المجموعات السلعية مرنة. ومن اللافت للنظر أن مرونة الطلب للغذاء في حالة الأردن مرتفعة نسبياً بالمقارنة مع تقديرات مرونات الغذاء السعرية لدول أخرى.

الخلاصة: بناءً 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.