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Estimating an ECM-AIDS Model for Urban-Area's Household Expenditure: The Case of Iran

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Abstract

This paper represents static and dynamic specifications of the Almost Ideal Demand System (AIDS) based on cointegration techniques and error correction models. Based on Iranian urban-area's household expenditure data over the period 1984-2004, it was found that the proposed formulation for dynamic specification performs well on both theoretical and statistical grounds as the theoretical properties of homogeneity and symmetry are supported by the data. Moreover, with computing short- run and long-run elasticities, it was found that food, clothing and housing are complements, regardless of time horizon.

Key words: ECM-AIDS, Household Expenditure, ISUR, Cointegration, Iran

1- Introduction

The Almost Ideal Demand System (AIDS), developed by Deaton and Muellbauer (1980), is by far the most commonly used demand system specification in the last 20 years. Until recently, the AIDS has been estimated with conventional econometric techniques, i.e. OLS, SUR and MLE, without paying any attention to either the statistical properties of the data or the dynamic specification arising from time series analysis.

Recently though, according to the developments in econometric theory and methods, the cointegration demand systems are estimated in various ways. Some examples are Attfield (1997), Balacombe and Davis (1996) and Karagianis et al (2000, 2002). Based on the time series properties of the data and as long as cointegration between the dependant and a linear combination of independent variables is ensured, an ECM for the AIDS can be established and

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econometrically estimated with an iterative seemingly unrelated regression (ISUR) procedure. Moreover, given the structure of an ECM, short- and long-run demand responses can be analyzed.

Econometric studies of household expenditure enjoy considerable importance because of the usefulness of the estimated demand parameters in several policy issues. These range from the purely behavioral aspects of demand forecasting, to welfare issues of poverty. Furthermore, meaningful discussion of tax design and tax reform also requires reliable estimates of consumer behavioral patterns. Therefore, there is rich literature on it. For example, Selvanathan and Selvanathan (2003) studied consumer demand in South Africa, Michelini (1997), using Almost Ideal Demand System, studied New Zealand household consumption pattern and Maki (1992) estimated consumer demand system in Japan.

This paper builds on previous work by Ghaderi (2001) and to some extend expands it. Besides implementing an ECM-AIDS, in the applied counterpart, the paper provides empirical evidence and measures of short- and long-run elasticity for household expenditure demand in urban areas of Iran over the period 1984-2004.

The rest of this paper is organized as follows. The theoretical model and empirical results are presented in the following two sections, respectively. Elasticity estimates are reported in section 4. Final section is concluding remarks.

2- Theoretical model

A linear formation of the AIDS is used in budget-share form:

$$S_{it} = \alpha_i + \sum \gamma_{ij} \ln p_{jt} + \beta_i \ln(m_t/P_t) + \varepsilon_t \qquad (1)$$

Where S_i is the budget-share of the ith good, p_j is the price of jth good, m represents total expenditure and P is an aggregate price index.

In the above equation, linearity arises from the way of specifying the aggregate price index. Most often the aggregate price index is approximated by the stone's price index, the use of which causes inconsistency in parameter estimates (Pashardes, 1993). These inconsistencies are more serious in micro

rather than aggregate data (Pashardes, 1993). Recently, Asche and Wessells (1997), have shown that the AIDS and linearized AIDS representations are identical at the point of approximation as long as the prices in the system are normalized to one.

In order to be able to formally assess whether the long-run demand relationships are economically meaningful or merely spurious, First of all it is necessary to investigate the time-series properties of data used in Eq. (1) before specifying the most appropriate dynamic form. Initially, the number of unit roots should be identified for each individual time-series (i.e. the order of integration). This may be implemented by using either the Dickey-Fuller, the Augmented Dickey-Fuller (ADF), the Philips- Perron or the Johanson test. A shortcoming of the Johnson procedure in the case of applied consumer demand analysis, Whenever more than one cointegrated vector is found, is that there is no a priori information to exclude some vectors, Theoretically. For this, the use of other three tests is recommended.

Whenever both Sit and the vector of explanatory variables are integrated on same order, cointegration can establish for all equations. However, it is also possible to have a cointegrated regression even though the variables of interest have different time-series properties and thus, a different order of integration. According to Granger representation theorem (Engel and Granger, 1987), a linear combination of series with different order of integration may consist a cointegrated regression. Therefore, ultimate time-series properties are not a necessary condition to proceed further. If, however, cointegration cannot be established for at least one share equation, we can not proceed further and more likely a different functional specification may be used or the data set should be enlarged.

After cointegrated regression established, an ECM version of the AIDS can be set up and estimated using a seemingly unrelated regression (SUR) procedure.

3- Empirical results

In the empirical analysis, annual time-series data on household expenditures are obtained from Central Bank of Islamic Republic of Iran. Household expenditures are aggregated into 8 categories: 1- food, 2- clothing, 3-

housing, 4-furniture, 5- medical, 6- transportation, 7- recreation and 8- miscellaneous by Central Bank. However, groups that are investigated in this paper are: 1- food, 2- clothing, 3- housing and 4- *others.* The *others* contains other 5 groups. Its price computed by PM = $\sum SiPi$ for i = 4, 5, 6, 7 and 8 in which i corresponds the number of group in Central Bank classification. Finally, prices are normalized to one based on 1997.

The results related to the time-series properties of data are reported in table 1. Based on ADF test, the hypothesis that all the variables in Eq. (1) contain a unit root cannot be rejected at the 10% significance level. When first differences are used, unit root, non-stationarity, was rejected at the same level of significance. This means that all tested variables have same order of integration, i.e. They are I(1), Therefore it is possible to have cointegration vector.

Functional form which was used in this stage (static specification) is:

$$S_{it} = \alpha_i + \sum \gamma_{ij} \ln p_{jt} + \beta_i \ln(m_t/P_t) + G_i S_{it-1} + \varepsilon_t \qquad (2)$$

Representing habit effects, S_{it-1} is lagged expenditure-share of group i. This variable has been used by other economists (Karagianis et al 2000). Since the hypotheses of homogeneity and symmetry were rejected, final estimation, reported in table (2), was with imposition of homogeneity and symmetry restrictions. To implement it further, a budget-share equation, which in this case is that of *others,* should be excluded (Greene, 1993). Moreover, since SUR is sensitive to the excluded equation, the procedure should be iterated. The process of iteration ensures that the obtained estimates asymptotically approach to those of the MLE method (judge et al, 1980). Parameters of excluded equation obtained by means of adding up property, i.e. $\sum S_{it} = 1$.

Hypotheses of the habit formation cannot be rejected. Nevertheless, habits seem to be of low importance in explaining cloth consumption pattern.

Table 1: Unit root tests on first difference of variables

	Shfo	**Shcl**	**Shho**	**Lnpf**	**Lnpc**	**Lnph**	**Lnpm**	**Lnri**
Test Statistic	-2.72	-2.48	-3.48	-2.76	-6.12	-3.36	-2.74	-2.68
Critical value	-1.62	-1.62	-1.62	-2.66	-3.28	-2.66	-2.66	-1.66

Notes: the econometric package was Eviews 3.0 and critical values are obtained from Mackinon table

Table 2: Estimated parameters of static model

Group\parm	αi	γi1	γi2	γi3	γi4	βi	Gi	R^2	D-W
FOOD	0.411 (2.453)	0.196 (8.743)	-0.025 (-3.448)	-0.026 (-1.625)	-0.144 (-7.294)	-0.035 (-2.554)	0.496 (6.515)	0.97	2.23
CLOTHING	0.248 (3.031)	-0.025 (-3.448)	0.043 (5.382)	0.007 (1.211)	-0.025 (-7.602)	-0.016 (-2.339)	0.124 (1.221)	0.96	1.89
HOUSING	0.166 (0.970)	-0.026 (-1.625)	0.007 (1.211)	0.015 (0.884)	0.003 (0.329)	-0.001 (-0.130)	0.471 (2.808)	0.49	2.37
OTHERS	0.175	-0.144	-0.025	0.003	0.165	0.052			

Notes: the econometric package was Microfit 4.0

The next step is to test for cointegration between the variables of Eq. (2) using the Engel and Granger methodology[1] . According to the result reported in the table 3 all budget-share are cointegrated with group prices and real expenditure at a 1% significance level. Cointegration ensures that shocks affecting group prices or real expenditure will be reflected on different expenditure shares in a similarly way showing that these variables are moving together in the long-run.

Having established that all the variables in Eq. (2) are I(1)[2] process and cointegrated, the estimated ECM form of the AIDS is given as:

$$\Delta S_{it}=\alpha_i \Delta S_{it-1}+\sum \gamma_{ij} \Delta \ln p_{jt}+\beta_i \Delta \ln \quad (M_t/P) \quad +\lambda_i \varepsilon_{it-1}+U_t \qquad (3)$$

In Eq. (3), Δ refers to the difference operator, ε_{it-1} are the estimated residuals from Eq. (2), and $\lambda i < 0$.

The hypotheses of homogeneity and symmetry cannot be rejected. This suggests that the empirical results are theoretically consistent and valid for this specification (dynamic specification). However, reported parameters shown in table 4 estimated under restrictions of homogeneity and symmetry, to estimated elasticities be reliable.

1- more information are presented in Greene

2- When Si is I(1), accordingly, S_{it-1} is I(1)

The estimated parameters of error correction terms, λ_i, are all statistically significant and have the correct signs.

The hypothesis of habit formation cannot be rejected. Nevertheless, like static specification, habits seem to be of low importance in explaining cloth consumption pattern.

4- Elasticity estimates

The estimates of the own-price Marshallian and expenditure elasticities are reported in table 5. these estimates refer to the point of normalization, i.e. to 1997. As shown by Asche and Wessells (1997), there are no differences in formulas used to calculate price and expenditure elasticities between the AIDS and linearized AIDS as long as calculations are made at the point of normalization. Consequently, since Linearized AIDS is used here, elasticites are projected in the point of normalization i.e. 1997. The Marshallian price and expenditure elasticities are measured respectively by (Karagiannis, 2000):

$$E_{ij(m)} = -\delta + (\gamma_{ij} / S_{it}) - (\beta_i / S_{it}) S_{jt} \quad (4)$$

$$\eta_i = 1 + (\beta_i / S_{it}) \quad (5)$$

Where δ is the Kronecker delta. The Hicksian elasticities are then obtained through Slutsky equation in elasticity form, namely, $E_{ij(h)} = E_{ij(m)} + \eta_i S_{it}$, as follows:

$$E_{ij(h)} = -\delta + (\gamma_{ij} / S_{it}) + S_{jt} \quad (6)$$

Estimates of short-run elasticities are obtained by using the above formulas and the estimated parameters of (3), while their long-run counter-parts are measured by using the same formulas and the estimated parameters of the equation (2) (Johnson, 1992).

Both in short- and long-run, own-price Marshallian elasticities are found to be negative (table 5). All of them are less than unit; consequently, all groups have price inelastic demands. While house has greatest own-price elasticities in both short- and long-run, *others* and food have smallest price elasticities in

short- and long-run, respectively. Ignoring small difference between short-run own-price Marshallian elasticity of food with that of long-run, all groups have long-run own-price Marshallian elasticity greater than that of short-run. Indicating, the Lechatelier principle holds.

As expected, all expenditure elasticities are positive. Regardless of time horizon, the group of *others* is luxury. Except for Food, all other groups have short-run expenditure elasticity greater than that of long-run so the Lechatelier principle does not hold in this case.

Table 3: Unit root tests on level of estimated residuals of static model

	ε1	**ε2**	**ε3**
Test statistic	-4.783	-1522.15	-3.296
Critical value	-2.70	-2.70	-2.70

Table 4 : Estimated parameters of dynamic model

Group\param	**αi**	**γi1**	**γi2**	**γi3**	**γi4**	**βi**	**λi**	**R^2**	**D-W**
Food	0.383 (4.857)	0.181 (8.626)	-0.013 (-1.825)	-0.027 (-1.626)	-0.140 (-7.828)	-0.066 (-4.232)	-1.091 (-5.267)	0.83	1.93
Clothing	0.102 (0.752)	-0.013 (-1.825)	0.049 (6.123)	-0.011 (0.008)	-0.023 (-2.943)	-0.009 (-1.317)	-0.840 (3.467)	0.86	2.23
Housing	0.163 (0.744)	-0.027 (-1.626)	-0.011 (-1.478)	0.039 (1.622)	0.000 (-0.754)	0.021 (1.254)	-1.169 (-3.647)	0.60	2.02
Others		-0.141	-0.025	0.000	0.164	0.054			

Tabe 5 : Marshallian Own-price and expenditure elasticities

	Marshallian Own-price elasticity		**Expenditure elasticity**	
	Short-run	**Long-run**	**Short-run**	**Long-run**
Food	-0.33	-0.31	0.78	0.89
Clothing	-0.44	-0.50	0.90	0.82
Housing	-0.87	-0.94	1.08	0.99
Others	-0.12	-0.58	1.15	1.14

Table 6 : Hicksian Elasticities

	Short-run				**Long-run**			
Group\price	**Food**	**Clothing**	**Housing**	***Others***	**Food**	**Clothing**	**Housing**	***Others***
Food	-0.09	0.04	0.17	-0.11	-0.04	0.006	0.17	-0.13
Clothing	0.15	-.036	0.13	0.09	0.02	-0.43	0.33	0.07
Housing	0.19	0.04	-0.59	0.35	0.20	0.11	-0.68	0.36
Others	-0.10	0.01	0.26	-0.18	-0.11	0.01	0.26	-0.17

Table 7 : Marshallian Elasticities

	Short-run				**Long-run**			
Group\price	**Food**	**Clothing**	**Housing**	**Others**	**Food**	**Clothing**	**Housing**	**Others**
Food	-0.34	-0.01	-0.008	-0.39	-0.33	-0.05	-0.04	-0.43
Clothing	-0.11	-0.44	-0.09	-0.22	-0.19	-0.54	-0.02	-0.19
Housing	-0.09	-0.04	-0.9	-0.02	-0.07	-0.01	-0.96	-0.001
Others	-0.44	-0.06	-0.03	-0.59	-0.44	-0.06	-0.02	-0.59

own-price Hicksian elasticities in both short- and long-run are negative (table 6). It ensures that the computed budget-shares satisfy monotonicity and concavity of the underlying expenditure function, consequently the corresponding Slutsky matrix is negative semi-definite showing reliability of the model. Elasticities reported in table (7) show that Food, Clothing and Housing are complement to each other, regardless of time horizon.

Comparing to previous findings by Ghaderi, own-price Marshallian elasticities of Food in long-run are identical in both works. But, while all other parameters are different, main difference is in expenditure elasticities of clothing which he found it to be luxury. These differences may be due to different time periods.

Finally, policy makers should consider results obtained here. Firstly it was found that the both models represented here are statistically consistent with theory, And, secondly, as mentioned before household consumption pattern have considerable importance in several policy issues.

5- Conclusion

This paper represents both dynamic and static specifications of the AIDS based on recent developments on cointegration techniques and error correction models. The AIDS is adjusted accordingly to give rise to an ECM-AIDS. Based on the Iranian urban-area's household expenditure data over the period of 1984-2004, it was found that the proposed formulation for dynamic specification performs well in both theoretical and statistical grounds. In particular, the theoretical properties of homogeneity and symmetry are supported by the data and thus the obtained elasticities (in short-run) are valid and accurate for policy issues analysis.

The proposed model has also the ability to provide estimates of both short- and long-run demand elasticities, a feature that significantly enlarges the alternatives for policy simulations. Moreover, it was found that habits seem to be of low importance in explaining Clothing consumption pattern, And Food, Clothing and Housing to be complement to each other, in both short- and long-run.

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