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COMPARISON AND DISCRIMINATION OF ALTERNATIVE SPECIFICATIONS OF THE CONSUMPTION FUNCTION : AN ECONOMETRIC STUDY USING SAUDI ARABIAN DATA

BY:
Dr. Mohamed A. S. A. Enany
Department of Islamic Economics
Faculty of Islamic Law
Imam Muhammad Ibn Saud Islamic University
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1. Introduction:

Several specifications of the consumption function have been proposed and used in econometric work such as the simple Keyensian model, the simple lag income model and the simple lag consumption model. Different models generally lead to different results and since the best specification is not obvious apriori, one has to pay a great deal of attention to the choice of the appropriate model for the practical problem in concern, and to the specification of the functional form on which statistical estimation and testing are based. Unfortunately, economic theory often lacks sufficient precision to provide the econometrician with a framework on which he can rely. He must always have a highly critical attitude when choosing his model.

The main objective of this paper, therefore, is to compare and discriminate on economic and empirical grounds among alternative specifications of the consumption function using different discrimination criteria with the purpose of choosing the best form to be adopted and employed in econometric applications.

One criterion used in this study is to choose the model which confirms to the economic theory with respect to the sign and magnitude of the parameter estimates. Another criterion applied is to use the nested testing procedure to choose among alternative specifications of the consumption function embedded within a general composite model against which they can be tested as specialisations. Finally, the discrimination problem is treated as a choice between non-nested hypotheses. In this respect, test statistics are used based on those given by Cox (1961, 1962) and

introduced to the economic literature by Pesaran (1974).

In section 2, we present alternative models of the consumption function and outline the basic features of each model together with the implied short-term and long-term effects. Section 3 considers a general composite model which contains some commonly used specifications of the consumption function as special cases. This enables the nested testing procedure to be used to select a specific model within the general one. In section 4, we describe the data used for estimation and testing of the alternative specifications. Section 5 is devoted to some econometric aspects regarding the estimation techniques and the different testing procedures. In section 6, we report the empirical results for estimation and testing. Finally, section 7 is devoted to summary and conclusions.

2- Alternative Specifications of the Consumption Function:

There are a wide variety of alternative specifications of the consumption function. Some models add other variables like liquid assets to income as a determinant of consumption; others distinguish separate components of aggregate income like wages and profits, and thus allow for variations in the income distribution. However, we disregard these obvious developments as well as variations in the form of the function and consider only the role of income in a linear consumption function. Even within this limited field there are several alternative views, some of which are the following:

i- The Simple Keyensian Model:

In Keynes' view the consumption is a relation between current consumption and current income as,

$$C_t = B_o + B_1 y_1 + u_t \tag{2.1}$$

where $B_o > 0$, $0 < B_1 < 1$, and u_t is a random disturbance term. Here C/Y, the share of consumption in income or average propensity to consume (apc), decreases as income rises. However, this formulation neither distinguishes between short-run and long-run marginal propensities — B_1 is the mpc- nor does it incorporate wealth effect. (1)

ii- <u>The Simple Lag Income Model:</u>

An obvious improvement of the simple function (2.1) is to introduce last year's income as a determinant of current consumption along with current income. For many consumers, especially among the self-employed, current income is not actually known until after the year's close, and several income components like profit , while established on an annual basis, are paid with considerable delay. This makes for an institutional time-lag between income generation as recorded in the national income accounts and the actual receipt and spending of the earnings concerned. The simple lag income specification is, therefore, given by

$$C_t = B_o + B_1 y_t + B_2 y_{t-1} + u_t \tag{2.2}$$

In (2.2) , we may expect that B_1 , $B_2 > 0$; $B_1 > B_2$ hence the short-term mpc is always less than the long-term one given, respectively, by B_1 , $B_1 + B_2$.

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(1) See Wallis, K.F. (1973).

iii- <u>The Simple Lag Consumption Model:</u>

A slightly different formula has been proposed[2] to accord with the view that consumption must depend on current income and on habits of consumption which were established in the past, that is, on previous levels of consumption. The consumption function, therefore would be of the form,

$$C_t = B_o + B_1 Y_t + B_2 C_{t-1} + u_t \quad \text{with } 0 < B_2 < 1 \tag{2.3}$$

In this case C_{t-1} is assumed to represent consumption habits as they are at the beginning of period t. According to (2.3), B_1 would measure the short-term marginal propensity to consume; that is the effect on consumption of a unit increase in income in the same period. Also this modification of the consumption function obeys Keyensian requirement that the short-run mpc, B_1, is less than the long-run mpc, $B_1/(1-B_2)$, which measures the increase in the equilibrium level of consumption in response to a unit increase in the level of income.

iv- <u>The Previous High Income Model:</u>

It has been argued that consumers attach different weights to the highest income level they have ever previously experienced and the deviation from it that currently obtains, see Modigliani (1949) and Duesenberry (1952). Thus consumption will be higher than that predicted by the sample linear form when income falls. The consumption-income ratio depends on current income measured relative to the peak previous income, Y^o, say, and a linear approximation gives,

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(2) See Brown, T.M. (1952).

$$C_t = B_o + B_1 Y_t + B_2 \overset{o}{Y}_t + u_t \qquad (2.4)$$

where $\overset{o}{Y}_t = \max(Y_{t-j})$ for $j \geqslant 1$, with $B_1, B_2 > 0$

Then, if income is increasing over time, the peak previous income is always the last period's income. However, if income falls, $\overset{o}{Y}_t$ remains unchanged. The short-term and long-term mpc would be the same as in (2.2), that is, B_1 and $B_1 + B_2$, respectively.

v- <u>The Previous High Consumption Model:</u>

A precisely equivalent exposition can be given in terms of previous peak consumption, $\overset{o}{C}_t$, rather than income. In this case, the model is given by,

$$C_t = B_o + B_1 Y_t + B_2 \overset{o}{C}_t + u_t \qquad (2.5)$$

where $\overset{o}{C}_t = \max(C_{t-j})$ for $j \geqslant 1$, with $B_1, B_2 > 0$

The formula (2.5) is equivalent to (2.3) when consumption grows from one year to the next and is always above previous levels. It is different from (2.3) in periods of depression when the volume of consumption decreases. Again as in (2.3), the short-term and the long-term mpc are given, respectively, by B_1, $B_1 / (1 - B_2)$.

vi- <u>The Distributed Lag Income Model — (Koyck Model):</u>

An obvious generalisation of the simple lag income model (2.2) is to replace it by a more complex equation of the form,

$$C_t = B_o + B_1 Y_t + B_2 Y_{t-1} + B_3 Y_{t-2} + \dots\dots + u_t \qquad (2.6)$$

Which contains infinite lag income. Assuming that the B's apart from the constant term, are all of the same sign, Koyck assumes that they decline geometrically as follows:

$$B_k = B_1 \lambda^{k-1} , \quad k = 1, 2, \ldots.. \qquad (2.7)$$

Where λ, such that $0 < \lambda < 1$ is the rate of decline, or decay, of the distributed lag and $1 - \lambda$ is known as the speed of adjustment.

Equation (2.7) postulates that each successive B_k coefficient is numerically less than each preceding one (this follows since $\lambda < 1$), implying that as one goes back into the distant past, the effect of that lag on consumption becomes progressively smaller, which is a quite plausible assumption. After all, current and recent past incomes are expected to affect current consumption expenditure more heavily than income in the distant past. Moreover the Koyck scheme ensures that the sum of the B_k, in (2.7) which gives the long-run multiplier, is a finite amount, namely

$$\sum_{k=1}^{\infty} B_k = B_1 \left(\frac{1}{1-\lambda} \right) \qquad (2.8)$$

As a result of (2.7), the infinite distributed lag model (2.6) may be written as

$$C_t = B_o + B_1 Y_t + B_1 \lambda Y_{t-1} + B_1 \lambda^2 Y_{t-2} + \ldots.. + u_t \qquad (2.9)$$

Lagging (2.9) by one period gives

$$C_{t-1} = B_o + B_1 Y_{t-1} + B_2 \lambda Y_{t-2} + B_1 \lambda^2 Y_{t-3} + \ldots. + u_{t-1} \qquad (2.10)$$

Then multiplying (2.10) by λ and substracting from (2.9), we get

$$C_t - \lambda C_{t-1} = B_o (1 - \lambda) + B_1 Y_t + (u_t - \lambda u_{t-1})$$

or rearranging

$$C_t = B_o(1-\lambda) + B_1 Y_t + \lambda C_{t-1} + \nu_t \qquad (2.11)$$

$$\nu_t = u_t - \lambda u_{t-1}$$

which is an autoregressive model.

In equation (2.11), we have to estimate only three unknowns, B_o, B_1 and λ. In addition, there is no reason to expect multicollinearity which is resolved by replacing Y_{t-1}, Y_{t-2}..... by a single variable, C_{t-1}. But for the composite disturbance term, (2.11) is fully equivalent to the earlier specification (2.3) involving last year's consumption as a reflection of habit formation.

vii- The Permanent or Expected Income Model– Friedman's Model) (3)

The final specification of the consumption function we consider is the permanent or expected income model which, by using the same simplification mentioned above, may be written as,

$$C_t = k\gamma Y_t + (1-\gamma) C_{t-1} + \zeta_t \qquad (2.12)$$

Where γ is the coefficient of expectation, $1 \geq \gamma > 0$,

$$\zeta_t = (u_t - (1-\gamma) u_{t-1})$$

This is indistinguishable from (2.11) but for the absence of a constant term. Note also that like Koyck's model (2.11), the expected income model is autoregressive and its error term is similar to the Koyck error term. But the expected income model has a much stronger theoretical base than the Koyck model, see Gujarati (1978). The short-term mpc is k and the long-term mpc is $k\gamma / 1-(1-\gamma) = k$.

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(3) Friedman, M. (1957).

In Table 1, the various specifications of the consumption function reviewed above are brought together and the implied short-term and long-term effects shown. It should be noted that in the end there are basically five different functions; Friedman's model is treated as a variant of the other specifications from which it can be obtained by suppressing the constant term.

Table 1

Alternative Specifications of the Consumption Function

Model	Consumption Function	Effect of Income Change	
		Short-term	Long-term
1- Simple Keyensian	$C_t = B_o + B_1 Y_t + u_t$	B_1	B_1
2- Simple lag Income	$C_t = B_o + B_1 Y_t + B_2 Y_{t-1} + u_t$	B_1	$B_1 + B_2$
3- Previous high Income	$C_t = B_o + B_1 Y_t + B_2 Y_t^o + u_t$	B_1	$B_1 + B_2$
4- Previous high Consumption	$C_t = B_o + B_1 Y_t + B_2 C_t^o + u_t$	B_1	$B_1/(1-B_2)$
5- Simple lag Consumption	$C_t = B_o + B_1 Y_t + B_2 C_{t-1} + u_t$	B_1	$B_1/(1-B_2)$
Distributed lag income	$C_t = B_o(1-\lambda) + B_1 Y_t + \lambda C_{t-1} + \nu_t$	B_1	$B_1(1-\lambda)$
5' - Permanent or expected Income	$C_t = k\gamma Y_t + (1-\gamma) C_{t-1} + \xi_t$	$k\gamma$	k

A final word concerns restrictions on the parameters. All the parameters B_1, B_2, λ, k, γ must be non-negative and not larger than one. In addition, the short-term and the long-term effects, being themselves propensities to consume, must lie within this range.

3- The General Composite Model and Its Special Cases:

Let the consumption function be written as [4]

$$C_t + B_o + B_1Y_t + B_2Y_{t-1} + B_3C_{t-1} + u_t \qquad (3.1)$$

Equation (3.1) states that consumption in any period depends on income in that period and in the immediately preceding period, and in addition, on habits of cunsumption on previous level of consumption.

It is clear from (3.1) that this model can be used to generate three commonly used specialisations of the consumption function; the simple lag consumption model given by (2.3), the simple lag income model given by Equation (2.2), and the simple Keyensian model expressed in (2.1) , as special cases by restricting the parameters B_2, B_3 and both to zero, respectively.

Case I By letting B in (3.1) equals to zero, we have the simple lag consumption model as,

$$C_t = B_o + B_1Y_t + B_3C_{t-1} + u_t \qquad (2.3)$$

Case II By letting B_3 in (3.1) equals to zero, we have the simple lag income model as,

$$C_t = B_o + B_1Y_t + B_2Y_{t-1} + u_t \qquad (2.2)$$

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(4) See Malinvaud, E.(1966), p. 135.

Case III By letting both B_2 and B_3 in (3.1) equal to zero, we have the simple Keyensian model as,

$$C_t = B_o + B_1 Y_t + u_t \qquad (2.1)'$$

The composite model of consumption (3.1) provides, therefore, a framework to test for the three specifications (2.3)', (2.2)', and (2.1)' simply by testing for the restrictions involved in each case, i.e., by testing for $B_2 = 0$, $B_3 = 0$, and $B_2 = B_3 = 0$, respectively. The nested testing procedure can, therefore, be used to select a specific model within the general one. In addition, the non-nested testing technique proposed by Cox (1961, 1962) is also applied to discriminate between the two non-nested models given by (2.3)' and (2.2)'.

4- Data Description:

The empirical results for estimation and testing of alternative functional forms of the consumption function are based on annual time-series data, (1970-1982), on aggregate private consumption expenditure and gross domestic product, (GDP), for the Kingdom of Saudi Arabia. Since the saving-consumption decisions are assumed independent of the aggregate price index, therefore, the variables of the consumption function, including in addition, exports, government consumption and net government investment, are all entered in real rather than nominal terms, that is, all variables included in the macro-economic model of the Saudi economy, are expressed in constant prices, (1970 prices). This is done by deflating the current values of the observed variables by an appropriate price index obtained by dividing the current values of the GDP by the GDP values in 1970 prices for the period considered.

The choice of this particular period was governed by the availability of time series data suitable for the econometric work.

The period also coincides with the rapid growth in income and consumption due to the expansion in the production of oil and the rise in its prices since late 1973.

5- Econometric Considerations:

In this section we discuss: the estimation methods of alternative specifications of the consumption function, the nested testing propocedure and the technique of testing non-nested hypotheses.

5.1 The Estimation Methods:

Instead of regarding the consumption function as a single equation model and estimating its parameters by the ordinary least-squares method, we have put the function in the context of the macro-economic determination because this is where it belongs.(5)
Any realistic version of this model will of course be much more elaborate and allow for taxes, government expenditure and foreign trade. The parameters of alternative specifications of the consumption function are, therefore, estimated by appropriate simultaneous equation methods such as indirect least squares (ILS) and two-stage least squares (2SLS), since the interdependence among the endogenous variables in such systems makes it inappropriate to apply OLS method to an individual equation in the system because the estimators obtained in this case will be inconsistent.

Each form of the consumption function reviewed in section (2) is supplemented by the identity

$$Y_t = C_t + R_t \qquad (5.1.1)$$

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(5) See Cramer, J.S. (1975).

Where the variable $R_t = Y_t - C_t$, is defined as a remainder. Regarding R as a predetermined variable, the estimation problem is easily solved by the use of indirect least squares method.[6] Taking, first the simple consumption function (2.1), the complete system consists of two equations and contains two jointly dependent variables, C and Y, and one predetermined variable, R. Upon eliminating the identity (5.1.1) and either C or Y the reduced form is found to consist of a single equation with the remaining dependent variables and the predetermined variable, R, viz.

$$Y_t = \Pi_o + \Pi_1 R_t + v_t \qquad (5.1.2)$$

or alternatively

$$C_t = \Pi_o + \Pi_2 R_t + v_t \qquad (5.1.3)$$

With $\Pi_o = \frac{B_o}{1 - B_1}$, $\Pi_1 = \frac{1}{1-B_1}$, $\Pi_2 = \frac{B_1}{1 - B_1}$, and

$$v_t = \frac{B_1}{1 - B_1} u_t$$

If u_t satisfies the standard assumptions of least squares regression theory, the v_t will do so too, and least-squares estimates Π_1 and Π_2 can be derived from (5.1.2) and (5.1.3); the parameters of (2.1) can then be derived from the estimates of Π_1 and Π_2 of (5.1.2) or from the estimates of Π_o and Π_2 of (5.1.3).

The same argument applies to other consumption functions of Table 1. They all include a lagged variable which we denote by z_t and treat it if it were predetermined. The system therefore consists of two equations; the consumption function

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(6) See Cramer, J.S. (1975), for more details of the methods of estimation employed.

$$C_t = B_o + B_1 Y_t + B_2 z_t + u_t \qquad (5.1.4)$$

and the same identity (5.1.1) . Solving for C, we obtain the reduced from equation,

$$C_t = II_o + II_1 R_t + II_2 z_t + v_t \qquad (5.1.5)$$

With $II_o = \frac{B_o}{1-B_1}$, $II_1 = \frac{B_1}{1-B_1}$, $II_2 = \frac{B_2}{1-B_1}$, and

$$v_t = \frac{1}{1-B_1} u_t$$

As before, the parameters of the structure equations can be easily derived from the estimates of the reduced form. To establish the variance of the structural coefficients, we employ the following approximation, [7]

Let $\hat{B} = \phi(\hat{II}_1, \hat{II}_2, \hat{II}_3)$, then

$$\begin{aligned} Var(\hat{B}) &= \left(\frac{\partial \phi}{\partial \hat{II}_1}\right)^2 Var(\hat{II}_1) + \left(\frac{\partial \phi}{\partial \hat{II}_2}\right)^2 Var(\hat{II}_2) + \\ &\left(\frac{\partial \phi}{\partial \hat{II}_3}\right)^2 Var(\hat{II}_3) + 2\left(\frac{\partial \phi}{\partial \hat{II}_1}\right)\left(\frac{\partial \phi}{\partial \hat{II}_2}\right) \\ &Cov(\hat{II}_1, \hat{II}_2) + 2\left(\frac{\partial \phi}{\partial \hat{II}_1}\right)\left(\frac{\partial \phi}{\partial \hat{II}_3}\right) Cov(\hat{II}_1, \hat{II}_3) \\ &+ 2\left(\frac{\partial \phi}{\partial \hat{II}_2}\right)\left(\frac{\partial \phi}{\partial \hat{II}_3}\right) Cov(\hat{II}_2, \hat{II}_3) \end{aligned} \qquad (5.1.6)$$

In actual computation, the reduced-form (5.1.5) has been fitted by least-squares regression for all specifications of Table 1 with the variable z suppressed in specification 1. The Durbin-Watson statistic being constructed shows significant positive autocorrelation. We have therefore recast all equations in terms of first differences and repeat estimating the different models in this form.

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(7) Cramer (1975), p. 96.

Next, instead of closing the consumption function by the familiar national income identity, we regard the consumption functions of Table 1 each in turn as part of a much larger model of the Saudi Arabian economy. This model can be left unspecified but for the predetermined variables that enter into it. As such we have selected three expenditure categories, viz (i) exports, (ii) government consumption and (iii) net government investment. The reduced-form equation relating the variable Y to these three variables is estimated by least squares regression, and the estimated values, Y , obtained are substituted for Y in the second stage least-squares regression analysis of the equation,

$$C_t = B_0 + B_1 Y_t + B_2 z_t + u_t \qquad (5.1.7)$$

This procedure has again been carried out in terms of the first differences of all variables, so that the analysis is in this respect comparable to the indirect least-squares estimation. The change to differences suppresses all constant terms and removes the distinction between the models 5 and 5 of Table 1.

5.2 The Nested Testing Procedure:

The consumption functions outlined in section 3 have the property of being nested, that is one form can be obtained from the other by the imposition of suitable restrictions. In a sequence of nested hypotheses, assumed to be in increasing order of restrictiveness, each hypothesis is tested against the one immediately preceding it, and not against the maintained hypothesis as the alternative. The test terminates when we encounter a rejection of the null hypothesis. In this case, all preceding hypotheses must be accepted and all succeeding ones must be rejected,[8] i.e., no more tests have to be performed. An important consideration of the sequential testing procedure is the choice of Type I error probabilities for each test. If the number of hypotheses, apart from the maintained one, in the ordered

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(8) See Mizon, G: (1977).

for the implicit test of the most restricted hypothesis against the maintained one of α , then a possible scheme for choosing the level of significance for the ith test is,

$$\varepsilon_i = \varepsilon \quad \forall\ i, i=1, 2, \ldots\ldots k \qquad (5.2.1)$$

where $\varepsilon = \alpha / k$

This choice for ε_i means that all the hypotheses in the nested sequence are treated symmetrically.

Statistical inference for the nested tests is based on the F statistic given by,

$$F_c = \frac{(e_R' e_R - e' e)/g}{e' e/N-k}, \qquad (5.2.2)$$

where

$e_R' e_R$, $e' e$ are the restricted and unrestricted residual sums of sqaures, g is the number of restrictions being tested.

5.3 The Technique of Testing Non-Nested Hypotheses:

In another attempt to choose between the simple lag income, and the simple lag consumption model given respectively by (2.2) and (2.3), we treat the discrimination problem as a choice between non-nested hypotheses.

For this reason, we use statistics based on those developed by Cox (1961, 1962) for separate families of hypotheses and extended by Pesaran (1974) and by Pesaran and Deaton (1978). We confine ourselves here to the final expression of the test statistics, leaving the details to be read in Appendix A.

If H_o is taken as the true hypothesis, the test statistic is given by,

$$N_o = \frac{T_o}{\sqrt{\hat{V}_o(T)}} \sim N(0,1) \text{ under } H_o$$

While if H_1 is taken as the maintained hypothesis, the rest statistic is given by,

$$N_1 = \frac{T_1}{\sqrt{\hat{V}_1(T)}} \sim N(0,1) \text{ under } H_1$$

6. Empirical Results:

In this section we report the empirical results for estimation and testing of alternative functional forms of the consumption function.

6.1 The Parameter Estimates:

In Table 2, we present the ILS and 2SLS estimates of all specifications together with their standard errors and the associated t statistic. The values of DW, h statistics, and the coefficients of determination, R^2, for each model are also given. ILS and 2SLS estimates of the short-term and long-term mpc are presented in Table 3.

Table 2

ILS and 2SLS Estimates of Alternative Specifications of The Consumption Function

Model	I L S	2 S L S
1- Simple Keyensian	$\hat{C}_t = 0.278\, y_t$ (0.045) 6.178 DW = 1.186*	$\hat{C}_t = 0.304\, y_t$ (0.047) 6.468 DW = 1.325*, R^2=0.50 F = 10.112
2- Simple lag income	$\hat{C}_t = 0.234\, y_t$ (0.040) 5.850 $+ 0.202\, y_{t-1}$ (0.041) 4.927 DW = 1.364*	$\hat{C}_t = 0.250\, y_t$ (0.041) 6.25 $+ 0.188\, y_{t-1}$ (0.040) 4.70 DW = 1.432*, R^2 = 0.69 F = 8.98
3- Previous high Income	$\hat{C}_t = 0.216\, y_t$ (0.037) 5.838 $+ 0.238\, y_t^o$ (0.039) 6.103 DW = 2.099*	$\hat{C}_t = 0.222\, y_t$ (0.039) 5.692 $+ 0.234\, y_t^o$ (0.041) 5.707 DW = 2.113*, R^2=0.75 F = 12.24

Continued........

4- Previous high Consumption	$\hat{C}_t = 0.220\ y_t$ (0.042) 5.236 $+ 0.425\ c_t^o$ (0.187) 4.545 DW = 2.505*, h = 1.15*	$\hat{C}_t = 0.242\ y_t$ (0.043) 5.628 $+ 0.408\ c_t^o$ (0.192) 4.250 DW= 2.523*, h = 1.16* $R^2 = 0.70$, F = 9.10
5- Simple lag consumption - Distributed lag Income 5'- Permanent or Expected Income	$\hat{C}_t = 0.268\ y_t$ (0.039) 6.872 $+ 0.409\ c_{t-1}$ (0.181) 4.519 DW=2.445*,h=0.975*	$\hat{C}_t = 0.284\ y_t$ (0.042) 6.762 $+0.406\ c_{t-1}$ (0.189) 4.296 DW = 2.547*, h=1.183* $R^2 = 0.69$, F =8.73

* denotes acceptance of zero autocorrelation coefficients.
The Durbin h statistic is given by

$$h = \hat{\rho} \sqrt{\frac{N}{1 - N\ \mathrm{Var}(\alpha)}},$$

where $\hat{\rho}$ = the estimate of the first order serial correlation calculated as

$$\simeq 1 - \frac{DW}{2},$$

N = the sample size, and var (α) is the variance of the coefficient of the lagged c_{t-1}

- Standard errors of the estimates are in brackets, and the values of t statistic are beneath the standard errors of the estimates.

Table 3

ILS and 2SLS Estimates of Propensities to Consume

Model	ILS		2SLS	
	Short-term	Long - term	Short-term	Long-term
1- Simple Keyensian	0.278 (0.045) 6.178		0.304 (0.047) 6.468	
2- Simple lag Income	0.234 (0.040) 5.850	0.436 (0.051) 8.549	0.250 (0.041) 6.250	0.438 (0.052) 8.423
3- Previous High Income	0.216 (0.037) 5.838	0.454 (0.044) 10.318	0.222 (0.039) 5.692	0.456 (0.046) 9.913
4- Previous High Consumption	0.220 (0.042) 5.236	0.383 (0.178) 2.149	0.242 (0.043) 5.628	0.409 (0.183) 2.234
5- Simple lag Consumption Distributed lag Income 5'- Permanent or Expected Income.	0.234 (0.039) 6.872	0.396 (0.186) 2.129	0.284 (0.042) 6.762	0.478 (0.191) 2.503

Now, considering the above results of table 2 and 3, the following are our findings:

i) The estimates of the parameters B_1, B_2, λ, k, γ are all non-negative and not larger than one, thus, confirm to the economic theory. In addition, the short-term and the long-term effects lie within this range as expected since they are themselves propensities to consume.

ii) The estimates of the short-run mpc are always less than the long-run mpc for all models considered and for the methods of estimation employed.

iii) The numerical values of the estimates of the short-term and the long-term marginal propensities to consume are-to some extent -low. This may be largely due to the nature of the data, and not so much to the methods of estimation employed. Furthermore, all models estimated above have only private consumption as the dependent variable, if government consumption which constitutes a considerable component of consumption expenditure in Saudi Arabia, is included, the picture may be quite different.

iv- There are slight variations between the estimates of mpc derived from ILS method and those obtained from 2SLS method; the estimates from the latter method are somewhat larger than those derived from the former one.

v- The standard errors of the estimates of the parameters of all models are such that almost all the values of t-statistic are significant at the 5% level of significance.

vi- Recasting all equations in terms of first differences, eliminates the serial correlation problem of the disturbances as indicated by the values of the DW or h statistics being constructed.

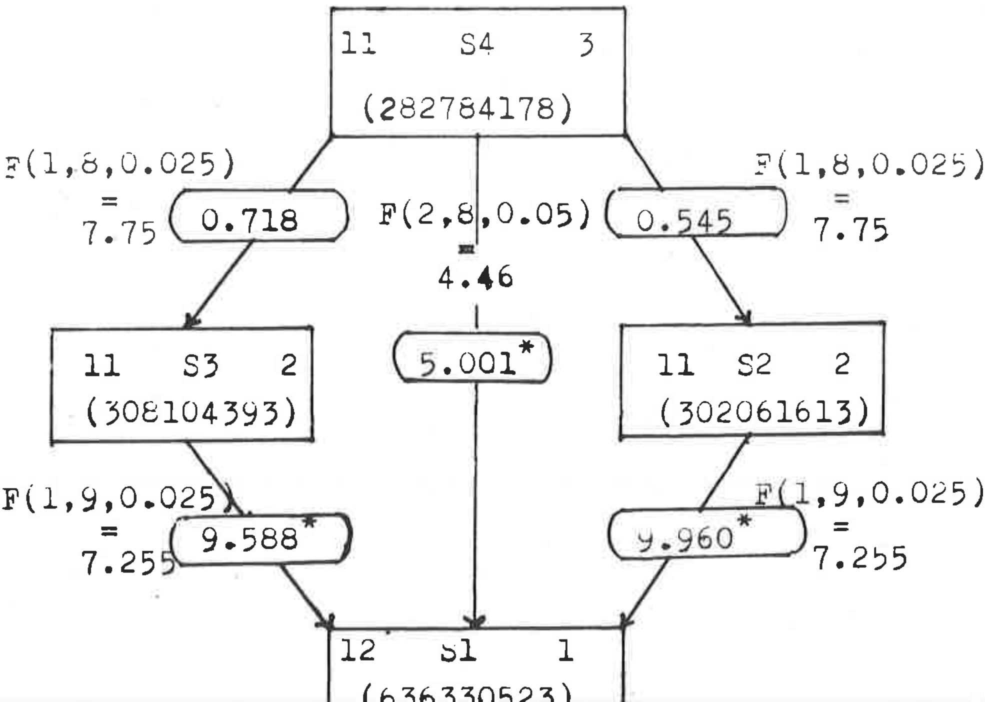
On the basis of the above results, almost all models of consumption reviewed have the same performance, hence one is not able to discriminate between the forms of take a decisive decision as to which of these specifications is the best. However, considering the variations between the estimates of th short-term and the long-term

mpc-though slight- as a base for empirical comparison of alternative models, we see that model 5; the model with lagged consumption, has the largest long-run mpc, 0.478. This gives the model slight preference in practical work. In this case, the proportions of the long-run reaction that are felt in each period after income-change stimulus are 0.594, 0.241, 0.098, 0.040, ... , so that after only three periods, 97.3% of the total effect has been felt. Hence, we can disregard incomes further back than three years ago when making consumption decisions.

6.2 The Nested Testing Results:

In figure (1), we present the test statistics for the nested models reviewed in section 3. The residual sum of squares for each model, obtained from the second stage regression is given between brackets, the number of observations, the number of free parameters and the number of degrees of freedom for each test are also shown. Finally, the values of the test statistics are given between elements of the nested sequences.

Figure 1



From the test statistics in figure (1), we see that the simple lag income model (S2) is accepted in the first nested sequence; S4, S2, S1. Similarly, the simple lag consumption model (S3) is accepted in the second nested sequence; S4, S3, S1. However, the simple Keyensian model (S1) is rejected in both sequences when tests against the simple lag income, and the simple lag consumption models(S2), (S3) respectively. This justifies our rejection of the simple Keyensian model when tested directly against the general composite model (S$) in the third sequence; S4, S1. Again, we are left with the two models S2 and S3 for which no discrimination decision can be taken on the basis of the nested test statistics. We, therefore, conclude that both models can be used in empirical work. It should be noted, however, that both S2 and S3 are accepted when tested against a general maintained hypothesis (S4). If we consider, in addition, the possibility that the true model may not be included even in the composite model; in this case, the above tests of restrictions involved in each model will be of no help since the whole experiment is being conducted within a false maintained hypothesis and therefore meaningless. If we accept this argument, we see how it is necessary to move to a non-nested testing procedure which makes pairwise tests of the competing hypotheses without the intermediation of a general composite one.

6.3 The Non-Nested Testing Results:

Let the two models under consideration, the simple lag income and the simple lag consumption models be denoted by H_0 and H_1 respectively. We start our non-nested test procedure by first taking H_0 as our maintained hypothesis. This gives a test statistic N_0 of --73.34 which is a symptotically distributed as N(0,1) under H_0. Hence, H_0 must be rejected. Reversing the process and taking H_1 as our maintained hypothesis, this by a similar sequence of calculations, leads to a test statistic N_1 of −115.014. We therefore conclude that H_1 too must be rejected.

We can sum up the above results for our tests in Table 4. Each row relates to a particular maintained hypothesis while each column relates to the alternative.

Table 4
The N – Statistics For H_o and H_1

Maintained hypothesis \ Alternative hypothesis	H_o	H_1
H_o	-	-73.34
H_1	-115.01	-

Now, the above results show that the two forms of the consumption function reject each other on the basis of a non-nested testing procedure. This indicates that we are not able - even using non-nested tests to discriminate between the two models. We, therefore, canclude that the correct model is not included in the comparison, that is, far away from the models considered in and suggest that one has to consider other specifications if one has to make a choice from a set of competing models.

Another point is worth mentioning; the results of the non-nested testing reported above may seem to contradict our earlier findings using the nested testing procedure. Bearing in mind - as previously mentioned - that the whole process of nested testing ma y be conducted within a false maintained hypothesis and therefore meaningless, and that the non-nested testing procedure makes pair-wise tests of the competing models in which case there is no maintained hypothesis, therefore, we can assert that our non-nested testing results are not peculiar. These results show in addition that too many hypotheses are accepted too readily in econometric work, and thus one has to pay a great deal of attention in establishing and testing economic models.

7- Summary and Conclusion:

In this paper we attempt to compare and discriminate, on economic and statistical grounds, between alternative specifications of the consumption function with the purpose of choosing the best form to be adopted and employed in econometric work in the Kingdom of Saudi Arabia. Such choice is necessary since it has important implications for subsequent statistical tests, for forecasts, and for policy analysis.

Our empirical results, based on Saudi Arabian data, have shown that the mpc is about 0.48, which seems to be low. This is probably due to the following reasons:

a) Using differenced rather than the original data.

b) Considering only private consumption expenditure as the dependent variable in all consumption functions. If the government consumption, which constitutes a considerable component of consumption expenditure in Saudi Arabia is included, we may have different values.

c) Treating the residual expenditure variable, R, as if it were predetermined. See Cramer (1975). By its definition R is a composite of many macro-economic aggregates; by the construction of its "observed" values which were obtained by subtracting C from Y, it may however be expected to vary inversely with the disturbance U rather than to be independent of the unaccountable elements of consumption which this term represents. The negative covariance of R and U will explain the low values of the estimates and therefore of the short-term and long-term effects, that we have obtained.

d) Finally and more importantly, there has been a considerable increase and a rapid growth in individuals income and hence in the GNP in the Kingdom of Saudi Arabia due to the

expansion in the production of oil and the rise in its prices since late 1973. This may give us an indictor to expect that the mpc be somewhat low; the Saudi people have satisfied almost all their basic needs. A very big margin, therefore, is left for saving. To say it differently, the more increases in incomes they get, the more saving margin they tend to have.

We have also found that all models considered in this study confirm to the economic theory with respect to the sign and magnitude of the parameter estimates. The similarity between the estimates for the various alternative consumption functions makes it difficult to choose between the models, since their performance in this respect differ hardly. The nested testing results have shown that the two forms; simple lag income and simple lag consumption models, can not be rejected when tested against a composite model which contains the two forms as specialisations. We, therefore, have derived the conclusion that either model can be used for future work in applied consumption analysis in Saudi Arabia. Moving next to the non-nested testing procedure to discriminate between the two forms, we have found that each model rejects the other, indicating once again the difficulty with the present set of data to choose between the alternative forms.

Considering the above results of estimation and testing, one is still entitled to ask, which of the various models considered in this study, one has to choose to analyse the consumption expenditure in the Kingdom of Saudi Arabia. A closer look at the numerical values of the parameter estimates obtained from 2SLS method, shows that the simple lag consumption model has the largest long-run mpc and thus has some preference in this respect compared with other models of consumption. We, therefore, may choose this form as the one which represents the consumption hehaviour in Saudi Arabia, and upon which consumption decisions

can be taken.

The choice of the above model assumes that some consumption is habitual and that habits persist from one year to another. This means that the consumption expenditure in the Kingdom of Saudi Arabia is greatly influenced by imitation and emulation and that the consumers change their consumption habits very slowly. This is exactly the same consumption behaviour as described by Brawn (1952). Consequently, one has to disregard income further back than three years when making consumption decisions.

A word of caution, however, has to be mentioned. Although it is a fact that the results obtained in this study could vary with other bodies of data, we hope that our application of the statistical techniques employed here could lead to more w ork using these procedures in different areas in economic research.

APPENDIX A;

" Steps Required to Calculate the N_o Statistic"

Consider the following set of hypotheses:

$$H_o : y = xb_o + u_o \quad \text{where } u_o \sim N(0, \sigma_o^2 I)$$

$$H_1 : y = zb_1 + u_1 \quad \text{where } u_1 \sim N(0, \sigma_1^2 I),$$

The regressions to be run to compute the N_o statistics, which tests H_o against H_1 are,

1- Regress y on the columns of x to obtain $x\hat{b}_o$ (=the predicted values of y);, e_o (= the vector of residuals) and $\hat{\sigma}_o^2$ $= \left(\frac{e_o' e_o}{T-k_o} \right)$.

2- Regress y on the columns of z to obtain $\hat{\sigma}_1^2 \left(= \frac{e_1' e_1}{T-k_1} \right)$

3- Regress $x\hat{b}_o$ on the columns of z to obtain $M_z x\hat{b}_o$ (=the vector of residuals) and $\hat{b}_o' x' M \; x \hat{b}_o$ (=the sum of squares residuals).

4- Regress $M_z x\hat{b}_o$ on the columns of x to obtain $\hat{b}_o' x' M_z M_x M_z x \hat{b}_o$ (= the sum of squared residuals).

Information from regressions 1), 2) and 3) is used to calculate

$$\frac{\hat{\sigma}_1^2}{\hat{\sigma}_{1o}^2} = \frac{\hat{\sigma}_1^2}{\hat{\sigma}_o^2 + \hat{b}_o' x' M_z x\hat{b}_o}$$

$$T_o = \frac{T}{2} \log \left(\frac{\hat{\sigma}_1^2}{\sigma_{1o}} \right) \qquad \text{(A.1)}$$

Where $\hat{b}_o = (x'x)^{-1}x'y$, $\hat{b}_1 = (z'z)^{-1}z'y$, $M_x = 1 - x(x'x)^{-1}x'$,

and $M_z = I - z(z'z)^{-1}z'$.

Information from regressions (1), (3), and (4) is used to calculate

$$\hat{V}_o(T_0) = \frac{\hat{\sigma}_o^2}{\hat{\sigma}_{1o}^4}\hat{b}_o' x' M_z M_x M_z x\hat{b}_o \qquad \text{(A.2)}$$

Fro (A.1) and (A.2) , the N_o statistic can be constructed as given in Section (5.3).*

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* Similar steps can be followed to construct N_1 statistics.

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