

Modeling the Pattern of Structural Change in Saudi Arabian Import Demand (Gradual Switching Regression)

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Abstract. The question of stability in import demand in the area of international trade is of eminent practical importance. In this paper, the hypothesis of structural change in Saudi Arabian import demand is tested in five regions using LA/AIDS (Linear Approximation of Almost Ideal Demand System) system with parameters following a gradual switching regression model. The results derived provide evidence of structural change in Saudi Arabian import demand. The structural change was biased against Arab countries and Japan, neutral for imports from United States, in favor of Europe and rest of the world, and it does affect estimated elasticities. The time path of structural change began in 1980 and completed in 1988.

The estimated coefficients of the second-stage LA/AIDS and first-stage import demand were combined to obtain the total effects of price and income changes on imports by source before 1980 and after 1988. However, after 1988, Japan is the only source that has own-price elasticities greater than one. Income elasticities are greater than one in nine of the ten cases. Finally, the finding of structural shift in expenditures on Saudi Arabian import demand during the 1980s suggests the use by researchers of post 1988 data or the use of other measures that take into accounts this shift for policy analysis and forecasting.

Introduction

Econometric studies of import demand occupy an important place in government policy formulation especially in developing countries with estimates of expenditure and price elasticity providing useful in several planning models. Although the empirical literature on this subject is large in developed countries, relatively few studies discussed this subject in developing countries. Some studies such as [1] and [2] have already looked into this issue in developing countries following [3]. However, previous studies dealing

with the developing economics have ignored examining the structural stability of import demand. Moreover, the new market order and trade system in world market which influenced by new trade rules through World Trade Organization (WTO) would change most of government or private business policies regarding import, export, or marketing strategies. In other words, policy makers could not modify their policy without enough knowledge regarding demand structure in given field.

Given the current economic climate characterized by volatile import markets and prices, the structure of the Saudi Arabian import market is essential. The Saudi Arabian import demand is considered one of the fields that would carry many speculations in the future under the new market structure of all commodities and services. On the other hand, the structure of import demand for countries that experienced rapid economic growth such as Saudi Arabia would be an important tool for decision making in both government and private sectors.

With the marked expansion of external trade and the resulting alterations in relative prices of all commodities in Saudi Arabia in the past 20 years, the import demand structure seems to have been showing a considerable change. Moreover, income and economic growth supported primarily by oil revenues during the 1970s and 1980s have linked Saudi consumers with other affluent nations in the global market place. However, much of the Saudi needs which come from other markets has experienced remarkable changes over all these years that could affect the behavior of import demand. Hence, the Saudi Arabian import demand behavior is a candidate for investigating its structural stability⁽¹⁾. In this paper, we have focused our attention on one rapidly expanding single market, Saudi Arabia, and examined the structure of import demand, emphasizing imports from five foreign regional categories.

Import Demand Structure

The sizable change in Saudi Arabian import volumes that has taken place since the 1980s has led to some speculation in both nature and structure of the import demand.

Over the past 20 years, Saudi Arabia has experienced remarkable economic growth following the formation of the Organization of Petroleum Exporting Countries (OPEC). The government invested most of these revenues in building and improving living standards as expenditure on infrastructure, industry, education, services, imported goods

⁽¹⁾ In demand analysis, we assume that the parameters are stable over the time period. However, a shift in a parameter will cause predictions based on such biased estimates to diverge systematically from observed values, particularly strongly if the shifts occur near the end of the series used in parameter estimation. Also, if the parameter undergoes a discrete shift in value during the period of observation, the estimate parameter is in general biased estimator of both the pre-shift and the post-shift slope.

and services, increased several fold. However, much of the Kingdom needs are imported and will continue in the foreseeable future.

Table 1 shows some indicators and growth rate of Saudi Arabian import by five classified markets (Arab countries, United States, Eastern and Western Europe, Japan, and rest of the world) for the period of 1974 to 1994. The average annual growth rate of import value measured in Saudi Riyals was higher than 10% for four of the five trade flows regions during this period. But the growth rates were not uniform. While the average growth rate of import value is 13.1%, the average annual growth rate of imports from Arab countries, United States, Europe, Japan, and rest of the world (mostly Asia, South America, Canada, Islamic - non-Arabic countries, African - non Arabic countries, Australia and Ocean countries) are 1.73%, 15.72%, 19.14%, 10.86% and 46.7%, respectively. However, the high growth rate of the rest of the world may not be an indication of the true structure of import demand in Saudi Arabia. Foreign suppliers may be more interested in the value growth rates measured in U.S. dollars.

Table 1. Saudi Arabian import structure indicators and variables (1974-1994)

Variables	Definition	Mean	StD. Dev	Min.	Max.
General					
GNP	Gross National Product (Billion)	345.62	131.73	29.51	574.28
CPI	Consumer Price Index (%)	98.89	14.11	51.30	109.8
Import volumes (Thousands Tons)					
STI	Total Import	21091	10763.21	3067	44263.4
SIFA	Import from Arab countries	1285.3	327.16	707.9	2028.9
SIFUS	Import from United States	1881.1	762.7	323.9	3080.2
SIFUR	Import from E & W. Europe	8463.6	5697.01	712	21774.5
SIFJ	Import from Japan	2715.8	2547.2	309.97	9163.8
Import values (Billion Riyals)					
STI	Total import	84.87	35.88	10.15	139.34
SIFA	Import from Arab countries	2.62	0.67	1.49	3.80
SIFUS	Import from United States	16.39	7.81	1.74	29.19
SIFUR	Import from E & W. Europe	35.11	15.43	2.57	57.28
SIFJ	Import from Japan	13.69	7.12	1.62	26.66

The growth in import value is due to a combination of import quantity growth and import price changes. Table 1 summarizes these changes as import value peaked at 139.34 billion Saudi Riyal, (SR) in 1982 and declined to SR 70.8 billion in 1986, but most of the decline reflected falling world prices rather than reduced volume. Moreover, the mean values of shares of total expenditure on import over the present data set were , Arab countries 8%; United States 19%; Europe 40%; Japan 16%; and rest of the world 17%. These suppliers region reached its peak in mean value share in different periods.

For example, Arab countries were in 1974 (28%); United States in 1992 (23%); Europe in 1978 (46%); Japan in 1984 (20%); and rest of the world in 1987 (23%).

Model Specification

A rapid change in the import market renders the effort more difficult and interesting to characterize the import demand in Saudi Arabia. Issues raised here include the stability and proper specification of the demand function. However, the stability or specification of import demand in Saudi Arabia has never been investigated or discussed by others which would create difficulties to our analysis. Prior information of such research could ease and justify our suggestion and model specification. Moreover, the empirical demand analysis requires hypotheses auxiliary to those required by economic theory. Fundamental among these is the hypothesis of stable preferences. Another auxiliary hypothesis must specify the stochastic structure of prices and quantities to justify the use of particular estimator [4]. The stochastic structure of prices and quantities, in turn, is determined by market structure.

Due to unobservability or insufficient knowledge of import demand structure in Saudi Arabia, economic environment and observable indicators shed some light on import demand in Saudi Arabia. For example, one such change occurring in the early 1980s in the economic environment surrounding imports is an evidence of structural change. Moreover, the nature of import regime in Saudi Arabia would help us to assume that the import demand has experienced a structural change around this period. On the other hand, assuming that these changes were abrupt and excluding the possibility of a gradual change seems inappropriate.

When the structural change is defined as a change in one or more of the parameters of the model in question, the econometric problem becomes one of identifying the point in time (join points separating the regression into different regimes) at which the parametric change occurred, characterizing the seed of transition from the old to the new regime (whether the transition is abrupt or gradual), and drawing inferences about the parameters of the model before and after the structural change.

In this study, a time-varying version of the almost ideal demand system (AIDS) model, which assumes unknown join points (points in time associated with the beginning and ending of transition periods between regimes) and accommodates a gradual transition to a new regime, is employed to test the hypothesis of no structural change in the Saudi Arabian import demand. Following [5], the points of gradual switching and the impact of structural change on the estimated parameters of the model and on the structure of import demand is examined.

Gradual Switching AIDS Model

The almost ideal demand system of Deaton and Muellbauer [6] is chosen for the demand analysis. The AIDS used in the present analysis is an extension of the work of [7] and [8] on Engle curves through the addition of price variables. The system can be described as follows, beginning with an Engle curve formulation in terms of expenditure shares,

$$W_i = \alpha_0 + \beta_i \log X \quad (1)$$

where W_i presents expenditure share good i and x is total expenditure. This work was extended by [6] to include prices by making use of duality concepts. It is assumed that marked demands result from a preference ordering, as derived from a minimum expenditure or cost function, that is, the required expenditure necessary to achieve a given utility level at a given set of prices.

The stochastic version of the system of share equations generated by the AIDS model (the budget share of imports of a commodity from source i) can be written as ,

$$W_{it} = \alpha_i + \sum_j \gamma_{ij} \log P_{jt} + \beta_i \log \left(\frac{X}{P^*} \right) + E_{it} \quad (2)$$

where t represents time, i and j index countries (sources of imports), w_i is the expenditure share of imports from source i in total imports, P is the price of imports from source j , X is total expenditure on imports from all sources, P^* is a price index and E is a time-wise independent error term. P^* is approximated by Stone's share weighted price index,

$$\log P^* = \sum_i W_i \log P_i$$

The resulting model is called the "linear approximate almost ideal demand system" [9]. Equation 2, consists of five equations which should be estimated simultaneously after we delete one equation to avoid singularity. Moreover, in every equation we regress the budget share for Arabic countries, for example, on the prices of imports from this source and other sources and expenditure as follow,

$$W_{it} = \alpha_1 + \gamma_{11} P_1 + \gamma_{12} P_2 + \gamma_{13} P_3 + \gamma_{14} P_4 + \gamma_{15} P_5 + X_1 \quad (3)$$

Where W_{it} is the budget share of Arab countries, P_1, \dots, P_5 are import prices for

Arab countries, United States, Eastern and Western Europe, Japan, and rest of the world, and X_1 is expenditure on imports from Arab countries.

The LA/AIDS system should be estimated simultaneously with demand restrictions imposed. However, this system was chosen because it, (i) gives an arbitrary first-order approximation to any demand system; (ii) satisfies the axioms of choice exactly; (iii) aggregates perfectly over consumers; (iv) has a functional form consistent with previous household budget data [10]; (vi) may be used to test for homogeneity and symmetry; (vii) the AIDS model is an attractive feature for the econometric analysis of structural change. In addition, it should be noted that the AIDS model is indirectly non-additive. Thus it does not impose the severe substitution limitations as in other additive models such as Linear Expenditure System [11].

A time transition path (it, is introduced into each equation of the LA/AIDS model and represents gradual structural change in the system. Following Ohtani and Katayama [12] the transition path from one regime to the other is approximated by a linear function of time t ,

$$\begin{aligned} \lambda_{it} &= 0 \text{ for } t = 1, 2, \dots, t_1^*, & (4) \\ \lambda_{it} &= (t - t_1^*) / (t_2^* - t_1^*) \quad \text{for } t = t_1^* + 1, \dots, t_2^* - 1, \\ \lambda_{it} &= 1 \text{ for } t = t_2^*, t_2^* + 1, \dots, T \\ t_1^* &\leq T - m / (n-1), \quad t_2^* \geq m / (n-1), \quad t_1 < t_2. \end{aligned}$$

where t_1^* = the end point of the first regime,

t_2^* = the start point of the second regime,

n = the number of equations in the demand system, and

m = total number of free parameters to be estimated.

Incorporating the time transition paths into the LA/AIDS model yields,

$$\begin{aligned} W_{it} &= \alpha_i + \gamma_i \lambda_{it} + \sum_j (\gamma_{ij} + \delta_{ij} \lambda_{jt}) \log P_{jt} \\ &+ (\beta_i + \phi_i \lambda_{it}) \log \frac{X_t}{P^*} + E_{it} \end{aligned} \quad (5)$$

According to Eq. 3, at time $t = t_1$, the parameters $\theta_1 = (\alpha_i, \gamma_{ij}, \beta_i)$ of Eq.4 begin to gradually switch along a linear time path to $\theta_2 = (\gamma_i, \gamma_{ij} + \delta_{ij}, \beta_i + \phi_i)$. At $t = t_2$, the

switch is complete; hence t_2 signifies the beginning of the second regime. However, if $t_2 = t_1 + 1$, the shift in regime is abrupt. Note that with $\gamma_i = \delta_{ij} = \phi_i / \theta$, Eq. 4 reduces to the basic AIDS model (Eq. 1). After the joint estimation of θ , t_1 and t_2 , a test of structural change can be constructed as a test of the hypothesis that $\theta_2 - \theta_1 = 0$. [13].

By construction, the demand system represented by Eq. 5 should satisfy the following restrictions,

$$\sum_i \alpha_i = 1, \sum_i \gamma_i = 0, \sum_i \gamma_{ij} = 0, \sum_i \delta_{ij} = 0, \sum_i \beta_i = 0, \sum_i \phi_i = 0; \quad (6)$$

$$\sum_j \gamma_{ij} = 0, \sum_j \delta_{ij} = 0; \quad (7)$$

$$\gamma_{ij} = \gamma_{ji}, \delta_{ij} = \delta_{ji} \quad (8)$$

These restrictions impose adding-up, homogeneity, and symmetry, respectively.

A change in the price and expenditure parameters of the model suggest the way in which the import demand responds to changes in price and income has changed. The nature of this behavioral change can be realized by the comparison of price and expenditure elasticities before and after the structural change. However, the value of t_1^* and t_2^* can be obtained by searching over all possible pairs of t_1^* and t_2^* for the pair that maximizes the log likelihood function.

Marshallian elasticities under the assumption of structural change and conditional on weak separability⁽²⁾ of import expenditures are expressed as⁽³⁾.

Expenditure elasticities

$$\epsilon_{ix} = \frac{(B_i + \phi)}{W_{ia}} + 1; \quad (9)$$

⁽²⁾ Preferences, in general, are weakly separable if the marginal rate of substitution (MRS) between any two commodities, i and j , belonging to the same group is independent of the quantity consumed in any other group.

⁽³⁾ Budget shares are believed to shift gradually with the shift in preferences. The time transition path in each equation should catch the gradual switching trend. Thus, any potential bias in elasticity estimates caused by structural changes should be small.

Own-price elasticities

$$\epsilon_{ij} = \frac{(\gamma_{ij} + \delta_{ij})}{W_{ia}} - (\beta_j + \phi_i) - 1; \quad (10)$$

Cross-price elasticities

$$\epsilon_{ij} = \frac{(\gamma_{ij})}{W_{ia}} - (\beta_i + \phi_i) (W_{ja} / W_{ia}) \quad (11)$$

where i and j are sources of imports, W_{ia} the mean of i th country share in total import after structural change and the rest of the parameters are defined in Eq.5. To obtain elasticities prior to the structural change, the ϕ parameters in (9), (10), and (11) are set to zero and substituting W_{ib} (the mean of i th country share in total import) for W_{ia} . To compare elasticities evaluated at the same level of the exogenous variables, the mean of the estimated share over the whole period is used to represent W_{ia} , and W_{ib} is obtained by subtracting from W_{ia} the average bias measure.

Data and Estimation Procedures

Trade-flow data on imports were collected from International Monetary Fund; Direction of Trade Statistics [14] and Ministry of Finance and National Economy-Central Statistic Department; Foreign Trade Statistics [15].

The LA/AIDS equations were estimated for the Saudi Arabian imports from five regions; Arabian countries, Europe (Eastern, and Western Europe), United States, Japan, and rest of the world using annual data for the period of 1974 to 1994. Indexes and national income were collected from Saudi Arabian Monetary Agency, Annual Report [16].

The prices used in this analysis were calculated as the total value of imports divided by the total quantity imported from each exporting region. However, it should be emphasized that the data related to international trade in every commodity are frequently unreliable in the sense that these data are highly aggregated and subject to political and economic changes.

This kind of data problems means that caution should be exercised in the interpretation of statistical results derived from quantitative models of international trade. However, data in this study should be good enough so that the statistical results are sufficiently robust to support the conclusions drawn. Finally, an estimation was

carried out with 6.2 of the SHAZAM program [17].

Empirical Results and Discussion

The gradual switching LA/AIDS model in (5) was estimated using the iterative seemingly unrelated regressions procedure available in SHAZAM 6.2 which converges to the maximum likelihood estimator. The model has four equation⁽⁴⁾, and with the restrictions in (6-8) imposed, has 52 free parameters. Since (5) has discontinuous derivatives with respect to t_1^* and t_2^* , the estimation strategy followed entails searching over all possible pairs of t_1^* and t_2^* (such that $t_1^* \leq 1992$, $t_2^* \geq 1977$, and $t_1^* < t_2^*$) for the pair that maximizes the log likelihood function. This set of combinations ensure that all parameters of the system are estimable and requires estimating the system of equations a total of 1,287 times. The search yields an optimum value of $t_1^* = 1980$ and $t_2^* = 1988$ with maximum of log likelihood function of 261.527.

The estimated coefficients for the gradual switching LA/AIDS conditional on the optimal t_1^* and t_2^* , reported in Table 2, along with some single-equation statistics. The R^2 values indicate that the fit of the model is good, while the D-W test statistics indicate that tests for autocorrelation are inconclusive.

The first equation in the system (5) which belong to Arab countries can be written as,

$$\begin{aligned}
 W_{AAC} = & 0.026 + 0.022 \lambda_1 + 0.096 \log P_1 - 0.062 \lambda_1 \log P_1 \\
 (2.4) & \quad (0.43) \quad (2.43) \quad \quad (-0.61) \\
 & + 0.033 \log P_2 - 0.061 \lambda_2 \log P_2 - 0.019 \log P_3 \\
 & \quad (2.16) \quad \quad (-1.8) \quad \quad (0.64) \\
 & + 0.031 \lambda_3 \log P_3 + 0.031 \log P_4 - 0.014 \lambda_4 \log P_4 \\
 & \quad (0.42) \quad \quad (1.7) \quad \quad (-0.33) \\
 & - 0.033 \log P_5 + 0.106 \lambda_5 \log P_5 - 0.124 \log \frac{X_1}{P} \\
 & \quad (-1.1) \quad \quad (0.95) \quad \quad (-7.2) \\
 & + 0.197 \lambda_1 \log \frac{X_1}{P} \quad \quad \quad (3.9) \quad \quad (12)
 \end{aligned}$$

where the numbers in parentheses are t-ratio, and R-square for the Arab countries equation is 0.91. However, defining the parameters of such equation has no economic meaning unless we define the whole system which been estimated with cross-equation restrictions [4].

⁽⁴⁾ To avoid the singularity problem in the ITSUR, an equation for rest of the world is deleted.

The two regimes that classified the structure of import demand in Saudi Arabia suggest that the structural change is gradual starting in 1980 and ending in 1988⁽⁵⁾. Over 65% of the non-varying parameters in Table 2 are more than twice the size of standard errors. All expenditure parameters are significant at the 95% level. While own-price effect is significant in all equations, Europe equation has insignificant own-price effect and has strong cross-price effect with Japan and rest of the world. In contrast to the non-varying parameters, only eleven of the 28 time-varying parameters are significant at the 95% and 90% levels. Five of these significant parameters were associated with expenditure variables.

Table 2. Maximum likelihood parameter estimates for the time-varying LA/AIDS model

Eq	α_1	β_1	Price parameters					R ²	DW	F
			AAC	USA	EWE	JAP	ROW			
AAC	0.026	-0.124	0.096	0.033	-0.019	0.031	-0.033	0.91	1.51	8.24
	(2.4)	(- 7.2)	(2.43)	(2.16)	(0.64)	(1.7)	(-1.1)			
USA	0.022	0.197	-0.0619	-0.061	0.031	-0.014	0.106	0.85	1.54	4.79
	(0.43)	(3.9)	(-0.61)	(-1.8)	(0.43)	(0.33)	(0.95)			
EWE	0.197	0.035	0.033	-0.056	0.004	-0.038	0.058	0.75	1.14	4.1
	(43.7)	(3.5)	(2.2)	(-3.3)	(0.28)	(- 3.6)	(4.6)			
JAP	-0.034	-0.052	0.061	0.172	-0.027	0.079	-0.164	0.77	1.9	3.62
	(- 1.4)	(- 2.2)	(-1.8)	(5.1)	(-0.89)	(3.9)	(- 4.1)			
ROW	0.438	0.061	-0.019	0.004	0.008	-0.054	0.061	0.77	1.9	3.62
	(42.2)	(3.9)	(-0.64)	(0.28)	(0.24)	(-3.1)	(3.2)			
JAP	-0.665	-0.083	0.031	-0.027	0.023	0.056	-0.083	0.77	1.9	3.62
	(- 1.4)	(- 1.7)	(0.43)	(-0.88)	(0.29)	(1.3)	(- 1.1)			
ROW	0.173	0.044	0.031	-0.038	-0.054	0.059	0.002	0.77	1.9	3.62
	(24)	(3.9)	(1.7)	(- 3.6)	(- 3.1)	(3.3)	(0.11)			
ROW	0.032	-0.077	-0.014	0.079	0.056	-0.120	-0.002	0.77	1.9	3.62
	(0.72)	(-2.4)	(-0.33)	(3.9)	(1.3)	(-3.4)	(-0.46)			
ROW	0.166	-0.016	-0.33	0.058	0.061	0.002	-0.088	0.77	1.9	3.62
	0.645	0.015	0.106	-0.164	-0.083	-0.002	0.143			

Note: For each equation, the first row of coefficients refers to the fixed component of the parameters, and the second row is the time - varying component of the parameters; t-values are reported in paranetheses;

⁽⁵⁾ Total import start to increase rapidly in 1980 to reach its peak in 1983 and then start to decrease in volume until 1988.

maximum likelihood = 261.527; AAC, USA, EWE, JAP, Row denote Arab countries, United States, Eastern and Western Europe, Japan, and rest of the world, respectively.

The hypothesis of no structural change using likelihood ratio test statistic which distributed as chi-square are computed and reported in Table-3. The hypothesis of no structural change (constancy of the parameter vector over time) in the full set of parameters is rejected at the 0.01 and 0.05 significance levels. The results suggest that there is a difference in some or all structural parameters of the model before 1980 and after 1988, and a constant set of parameters cannot be postulated to rationalize import structure within the assumed model. To gain some insight into the nature of this change, the assumption of common slopes and common intercepts of the LA/AIDS model are tested separately. From table 3, it is apparent that constant price parameters, constant expenditure parameters, or constant price and expenditure parameters hypothesis are rejected and are subject to change, whereas the hypothesis of constant intercept parameters cannot be rejected at 0.05 significance level. However, the hypothesis of no structural change in intercept parameters is rejected at 0.10 significance level.

Table 3. Likelihood Ratios for Structural change tests

Hypothesis	Likelihood ratio test	Degree of freedom	2 X0.01	2 X0.05
No structural change in,				
All parameters	176.70	24	43	36.4
Intercept parameters	7.81	4	13.3	9.49
Price parameters	84.28	16	32.0	26.3
Price and expenditure parameters	39.85	4	13.3	9.49
Parameters	132.73	20	37.6	31.4

The results in Table 3 postulate that the Saudi Arabian import demand has experienced a structural change over the period of 1980 to 1988 with transition period of almost 9 years implying a very gradual structural change adjustment. The period between 1980 and 1988 was the period when per capita GNP increased rapidly and therefore the import demand has increased and diversified as the consumer income increased. Therefore, it would not be surprising to expect such a structural change.

Bias of Structural Change and Elasticities

Structural change effects elasticities as well as quantity demanded with prices and expenditure level held constant [5]. The results concerning bias of structural change are presented in Table 4. The bias estimated as $\beta_i = W_{ia} - W_{ib}$, and a, b denotes the *i*th country share after and before structural change, respectively. Table 4 indicates that (according to the sign) the structural change in import demand appears to be biased away from Arab countries and slightly away from Japan and toward the import from rest

of the world and Europe, while import demand from United States appears to be neutral. Therefore, the estimated bias of structural change indicates that a decline of 59% and 2.4% in the Arab countries and Japan share respectively can be accounted for by the estimated changing structure at constant prices and expenditure.

Table 4. Bias of structural change

Import sources	Bias	Mean share	
		1974 - 1980	1988 - 1994
AAC	-0.1124	0.1649	0.0525
USA	0.0129	0.1863	0.1992
EWE	0.0436	0.3712	0.4148
JAP	-0.0038	0.1400	0.1362
ROW	0.0599	0.1375	0.1974

Marshallian elasticities evaluated at mean of budget shares before and after structural change shown in Table 5. However, to evaluate elasticities at the same level of the exogenous variable, Moshini and Meilke allow the mean of the budget shares over the entire sample to represent W_{ia} while W_{ib} is obtained by subtracting the average bias measure shown in Table 4 from W_{ia} ⁽⁶⁾.

Table 5. Estimated Marshallian elasticities of the sample mean

Elasticity of	Price of imports from					Expenditure
	AAC	USA	EWE	JAP	ROW	
Before structural change						
AAC	-0.294	0.340	0.114	0.293	-0.097	0.25
USA	-0.111	-1.34	-0.049	-0.230	0.285	1.19
EWE	-0.078	-0.020	-1.04	-0.169	0.141	1.16
JAP	0.169	-0.330	-0.503	-1.470	-0.032	1.31
ROW	-0.221	0.444	0.487	0.031	-1.62	0.88
After structural change						
AAC	-0.424	0.402	-0.348	0.134	0.726	2.4
USA	0.477	-0.435	0.033	0.217	0.029	0.920
EWE	0.032	-0.045	-0.903	0.012	-0.011	0.947
JAP	0.138	0.349	0.116	-1.48	0.048	0.758
ROW	0.370	0.537	-0.110	0.001	-0.720	0.995

The demand for import from all sources (except the Arab countries) is elastic and highly elastic for Japan and rest of the world. All the own-price elasticities are of the expected sign before and after structural change. However, after 1988 the import

⁽⁶⁾ Elasticities that reflect demand response before structural change are obtained from (9), (10), and (11) by setting δ and θ parameters to zero and substituting W_{ib} for W_{ia} .

demand from AAC and JAP became more elastic. All expenditure elasticities (before and after structural change) are positive and greater than one for three sources (USA, EWE, and JAP) before 1988 and one source (AAC) after 1988. However, 50% from calculated price and expenditure elasticities has increased after the structural change took place.

The elasticities reported above computed conditional on total group expenditures and based on the conditional second-stage import demand system to analyze the structure of import demand in Saudi Arabia. Therefore, any inference on the total effects of price and income changes on imports from different sources based on these results, could be unsatisfactory. To see the total effect of price and income, the parameters in the first-stage demand equation should be obtained.

The parameters estimated for the first stage demand equations can be used to derive the total price and income elasticities of demand for imports by source [18]⁽⁷⁾ combining with the second stage gradual switching LA/AIDS estimates. The total price elasticity, TP, and the income elasticity, TE, are respectively expressed as,

$$TP_{ij} = -K_{ij} + (1 + e_1) + W_j + [(\gamma_{ij} + \delta_{ij}) + e_1(\beta_i + \phi_i)W_j] \div W_i \quad (13)$$

$$TE_i = e_3 [1 + (\beta_i + \phi_i) \div W_i] \quad (14)$$

where K_{ij} is the kronecker delta ($K_{ij} = -1$ if $i=j$ and zero otherwise); e_1 and e_3 are the price elasticity and the income elasticity from the first-stage equation [18] and the other variables are defined before (in the second-stage estimation).

Using the estimated parameters⁽⁸⁾ (Table 2) and mean values of the shares (Table 4), the total elasticities of import demand by source with respect to own and cross price and income were calculated. The results are shown in Table 6. All the own-price elasticities have the expected sign. However, the magnitude of the own-price elasticities varies with the source of import and the time. Because consumers consider products different if the sources are different, it is natural to expect different own-price elasticities by source of imports even though the products have a common commodity name.

(7) In this study, we concentrate on second-stage import demand to examine the structural change. Therefore, results from previous study have been used in this part [18].

(8) All parameters from the second-stage except e_1 and e_3 in equations (13) and (14). However, the values of these elasticities are (1.21) and (1.41) for e_1 and e_3 , respectively.

Table 6. Estimated total price and income elasticities of Saudis import demand⁽¹⁾

Source of import	AAC	USA	EWE	JAP	ROW	Income
Before structural change						
AAC	-0.23	-0.92	-0.59	-0.61	-1.02	0.50
USA		-0.88	-0.10	-0.80	-0.41	1.69
EWE			-0.12	-0.80	-0.57	1.65
JAP				-0.23	-0.78	1.79
ROW					-1.58	1.21
After structural change						
AAC	-0.31	-0.72	0.47	-0.26	0.48	2.7
USA		-0.54	-0.28	-0.45	-1.2	1.28
EWE			-0.57	-0.66	-0.79	1.33
JAP				-1.02	-0.66	1.21
ROW					-0.30	1.40

(1) Elasticities evaluated at the mean over the entire sample for W_{ia} , W_{ib} obtained by subtracting the mean bias in 4 from W_{ia} .

The total effect of price and income have changed the magnitude of elasticities. For example, 99% of own-price elasticities in Table 6 are decreased in absolute value. Moreover, income elasticities are greater than expenditure elasticities as shown in Tables 6 and 5. Income elasticities are greater than one in nine of the 10 cases. Except AAC and ROW, all income elasticities have decreased after structural change. However, income elasticity for AAC is large (2.7) even though import shifts from this source to the other sources. The small share of AAC after structural change, however, caused these commodities to be luxury good.

Conclusions

In this study, we evaluate empirically a gradual switching LA/AIDS model of the Saudi Arabian import demand. The nature and structure of the import demand have been analyzed and evaluated based on very small knowledge that is available in the literature⁽⁹⁾. However, the evidence presented in this paper should be one of the most urgent subjects for Saudi Arabia trade research agenda given that the accumulation of knowledge is so small, despite its increasing importance for decision making.

The structure of Saudi import demand has experienced a rapid change over the past 20 years. The evidence supports the idea that the observed import demand patterns cannot be fully explained by the dynamics of prices and income over this period. The hypothesis of constancy of the parameters was strongly rejected against a more general

⁽⁹⁾ To my knowledge, this is the first study that investigate import demand by sources for Saudi Arabia.

time-varying parameter model. Instead, the econometric evidence of structural break in the import demand reflects the oil boom prices in the early 1980s. Moreover, the results suggest that the gradual change, starting in 1980 and completed in 1988, took place in the structure of the Saudi Arabian demand. The time-varying component of the model found to have had a significant impact on estimated parameters of a reasonable specified LA/AIDS model for five regions that present all sources of Saudi import. However, estimates of bias of structural change indicate that the structural change was biased in favor of Europe (EWE) and rest of the world (ROW) and against Arab countries (AAC) with little disadvantage of Japan (JAP). Furthermore, the United States (USA) appears natural in this process. The root of this bias is unknown. Economic growth, increasing demand, shift in the source of supply or other factors could contribute to this new structure of import demand.

Accordingly, the structural change in the Saudi Arabian import demand has its natural implications. The implication is relevant to these regions which structural change was biased against them, calling possibly for quality of products adjustment and increased efforts in promotion and marketing. Trade policies and cost of imports could increase the bias against these regions.

Lastly, the above evidence provided important picture of the structure of Saudi Arabian import demand for policymakers and researchers. A policy maker's understanding of the nature and characteristics of import demand is vital to competent policy formulation. We have identified several characteristics of each export region and provided evidence of a drastic change during the past 21 years. Redefining the future of the import demand in Saudi Arabia should use this base of analysis and knowledge that this paper provided. The future of this sector will be surrounded by new trade policies and new market order and, therefore, any future policy should be drawn to reflect this structure. The other implication regarding the finding of this study is related to econometric policy analysis and forecasting. For example, knowing the time path of structural change would correct any kind of policy making and forecasting for the future of trade. Finally, we certainly need a formal model that expresses consistently the import behavior of traders combined with consumer preference and the structure of industrial organization in trade business. Such analysis will render difficulties and problems that associated with researches in this area. However, the research in trade is still in infant stage and the study here is just a milestone for further research.

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التغير الهيكلي التدريجي في الطلب على الواردات في المملكة العربية السعودية

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ملخص البحث: يستهدف هذا البحث دراسة الطلب على الواردات في المملكة العربية السعودية لمعرفة طبيعة وتركيب هذا القطاع والذي من المتوقع أن يشهد بعض المتغيرات في ظل أنظمة التجارة الدولية الجديدة حيث شهد هذا القطاع تغيرات تركيبية خلال السنوات العشر الماضية. وحيث إن الدراسات الاقتصادية في هذا الجانب معدومة، فإن القراءات الأولية لواردات المملكة العربية السعودية توحي بأن هذا القطاع شهد تغيرات تركيبية خلال الثمانينات المحررية.

وباستخدام نموذج التغير التدريجي في المعادلة الخطية من نظام (الإيدز) تم تحديد طبيعة وتركيب هذا القطاع خلال الفترة من ١٩٧٤م حتى ١٩٩٤م حيث وجد أن هناك تغير هيكلي لواردات المملكة العربية السعودية ابتداء من عام ١٩٨٠م حتى عام ١٩٨٨م.

فرض التغير الهيكلي في الطلب على الواردات في المملكة العربية السعودية دراسة هذا القطاع خلال فترتين زمنييتين، قبل التغير الهيكلي (١٩٧٤-١٩٨٠م) وبعده التغير الهيكلي (١٩٨٨-١٩٩٤م)، حيث وجد أن هذا التغير كان منحازاً ضد الدول العربية واليابان وطبيعي لصادرات الولايات المتحدة الأمريكية للمملكة وفي مصلحة أوروبا الشرقية والغربية وبقية دول العالم. من ناحية أخرى، تم تقدير تأثير الأسعار والدخل الكلي من خلال استخدام المعاملات المقدرة في هذا البحث (معاملات المرحلة الثانية في الطلب على الواردات) وبعض المرونات المشتقة من

المرحلة الأولى للطلب من دراسة سابقه، على جميع مصادر التصدير في العالم قبل وبعد التغير الهيكلي. وفي ظل المعاملات المقدره والمرونة الناتجة وُجد أن اليابان هو المصدر الوحيد الذي يواجه طلب مرن على صادراته بعد حدوث التغير الهيكلي مما يجعل تغير الأسعار في ظل الظروف التجارية الجديدة ذو مردود سلبى على صادراته. هذا وقد تبين أن جميع المصادر تتمتع بمرونة دخل مرتفعة مما يجعلها في وضع اقتصادي جيد تستطيع من خلاله زيادة صادراتها إلى الأسواق السعودية في حالة زيادة الطلب. أخيراً، وجود التغير الهيكلي في الطلب على الواردات في المملكة يفرض على الباحثين خصوصاً المهتمين بالتنبؤات السوقية أن تتم دراساتهم عن طريق معاملة الفترة الزمنية التي مرت بها الواردات على ثلاث مراحل: قبل التغير الهيكلي (١٩٧٤-١٩٨٠)، أثناء التغير الهيكلي (١٩٨٠-١٩٨٠) - (١٩٨٨) وبعد التغير الهيكلي (بعد عام ١٩٨٨م) حيث تتمتع كل فترة زمنية بخصائص اقتصادية مختلفة عن الأخرى.