

THE DEMAND FOR AGRICULTURAL PRODUCTS IN LIBYA

A QUANTITATIVE APPROACH

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Introduction :

In developing countries, where the economy is predominantly agricultural, economic research has been largely concerned with the analysis of mobilizing this sector for the purpose of capital formation, release of unproductive resources and the provision of the required food for the other developing sectors. The process of this mobilization is often at a pace consistent with the rate of growth achieved in the industrial and manufacturing sectors and the steady growth in per capita income. Where the country's demand for agricultural output is rising at a much faster pace, due to a sudden and drastic change in the country's natural resources, complications start to present themselves due to the inelastic nature of agricultural supply.

In this situation, the rapid increase in the country's demand for agricultural output reflects itself clearly in the behaviour of its imports and exports of agricultural products. The two variables would seem to offer some evidence of the type of adjustment that takes place in these circumstances and it is of concern for economic policy makers to know the extent of such an adjustment and its future economic consequences.

If external trade is free, imports and exports seem to offer two ready degrees of freedom for the expanding home demand given an inflexible domestic supply of agricultural products. At least in the short-run context, a sudden and rapid increase in income of a less developed country is expected to result in a higher demand for food

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and other agricultural material. Some of this increase in demand can be met by movements along the supply curve of the small commercial farm sector where supply may conceivably be thought of as responsive. But soon the increase in home demand is reflected in the country's external trade, with a tendency to increase imports and to contract exports. If this balancing process continues the country will rely heavily on imported food materials, the balance of payments problems present themselves and home producers will face heavy competition from efficient neighbour countries.

It can, therefore, be argued that some understanding of the export and import functions in a country typified by the above situation is important and can present some evidence of the likely demand for agricultural output which is in itself useful for policy measures that aim at a balanced growth within the various sectors of the economy.

The Libyan economy is a typical example of the above situation. It has until recently been a low income and predominantly agricultural economy. The share of the agricultural sector was estimated in 1958 to stand at 26% of gross domestic product at factor cost. And the total farm population, according to the 1960 Agricultural Census results, amounted to about 63% of the total population. About 43% of the total farm population are classified under tribal tenure, which indicates that a large proportion of the farming population lead a self subsistence life, together with a small commercial agricultural sector which provides for urban food requirements and export demand.

Since 1957, the country has started a new phase of economic change affected largely by the activities of oil exploration and the sudden flow of foreign capital which has increased rapidly through the ensuing months due to highly promising prospects of oil production. The amount of money spent locally by the oil companies rose from £L 4.3 millions during 1957 to £L 102.0 millions in 1964.

The injection effect of foreign capital, together with the rising oil

revenue, have been responsible for increasing per capita income which rose from about £L 23 in 1954 to £L 132, in 1963. This, together with an increasing population, rising at a compound rate of 3.65% between the two population census years 1954-1964, may lead us to expect that the demand curve for agricultural products had shifted to the right. The purpose of this study is to investigate this statement and to assess the magnitude and direction of the changes in the total demand for agricultural products. Like other developing countries, the Libyan statistics on expenditure and consumption are incomplete which makes a direct evaluation of the demand changes very difficult. Yet it can be argued that the understanding of the export and import functions offers, in the Libyan case, a useful substitute for assessing changes in the total demand for agricultural products. This approach is particularly facilitated by the availability of statistics in the field of external trade.

Given the assumption of an inflexible agricultural output, changes in demand will be directly reflected in the behaviour of the country's imports and exports of agricultural products. The assumption of a low supply response in Libya can be attributed to various factors to which fragmented statistical data can give some concrete support. According to the I. B. R. D. mission to Libya [2] "The soil of Libya is known to be potentially fertile over large areas including the desert regions but rain fall is low and erratic and droughts are frequent so that water and its absence is the essential factor in Libyan agriculture". The mission states further that "... the most serious physical difficulties that have to be overcome in the development of Libyan agriculture are the shortage of water and the erosion of soil ..., but as a broad judgement, the mission is convinced that the limitation in the expansion of agricultural production derives more from human than from physical factors." The factors leading to inelastic supply are :

1. The system of land ownership and tenure, particularly tribal ownership which still prevails over much of Cyrenaica and parts of Tripolitania.

2. The limitations on supply of adequate credit to small farmers.
3. The very limited agricultural training and extension services.
4. The lack of adequate marketing facilities.
5. The drift of labour out of agriculture to the expanding oil sector and sectors associated with it.

In these circumstances, the response of agricultural supply to a changing pattern of consumption may be limited, and, in the event of a rising demand, the pressure would be felt in home prices. For the last few years, Libya has witnessed some drastic changes in prices of food commodities. [3] United Nations experts working in Libya as part of the technical assistance programme, looked at the problem of rising prices as originating partly from higher expenditure and mainly from irresponsible home supply. [4-10] However serious the problem of inflation appeared to be, the government action was on the lines of finding an immediate solution to it ; that is by opening the import door for agricultural products, and by taking effective steps to reduce the various rates and tariffs on food commodities. By this action the government has allowed the import balancing effect to function smoothly, thus transferring home demand to external markets. Under the assumption of an inflexible supply, the response of home output to the change in demand is also reflected through the behaviour of exports.

THE MODEL

The Export Function

Various explanations have been given of the observed fluctuations in the exports of agricultural commodities and to their sluggish growth from most underdeveloped and primary producing countries. Nurkse [11] for instance, argues that the slower rate of growth in exports of the less developed countries is "mainly a reflection of the relative sluggishness in external demand emanating from the great industrial consumers.", While recent investigations conducted by G. A. T. T. in this context, and based on cross-sectional observations on world trade, explain the slow growth in the demand of industrial countries for imports of agricultural products on the basis of :

- (a) A shift in the pattern of output in the industrial countries in favour of engineering, chemicals and other industries and services which have a low import content.
- (b) Agricultural protection in the industrial countries which has proved in practice more difficult to remove than trade restrictions on manufactures.
- (c) A substantial substitution of synthetics for imported natural material.

On the other side of the argument the slow growth of exports from a primary producing country is regarded as a consequence of structural changes within the domestic economy. The view is put that industrial growth in such a country will involve the consumption of greater quantities of its own agricultural produce, thus restricting supply for export market. Cairncross [12] argues that "The sharper rise in

prices of exports from the non-industrial countries, reflected the acute pressure on supplies of primary commodities in a fully employed economy - a pressure that continued because of the low elasticity of supply of this produce which was aggravated by the concentration of effort in many underdeveloped countries on industrialization rather than agricultural development." [13]

Thus changes in exports of agricultural products from Libya are hypothesized to be determined by changes in the balance of demand and supply for agricultural products within Libya and in the world context. We might expect Libyan demand to grow as income per capita and population expands while Libyan supply will be determined by the expected price of agricultural products relative to the price of inputs, technology change and weather conditions. The interaction of demand and supply within Libya will determine farm gate and retail prices of agricultural products.¹ Variations in world demand relative to world supply of agricultural products are indicated by fluctuations in world price. This may be expressed symbolically as the export function :

$$Y_1 = f (X_1 , X_2 , X_3 , X_4 , X_5 , X_6)$$

where Y_1 is Libyan exports of agricultural products ; X_1 (per capita income) and X_2 (population) are factors determining home demand ; X_3 (farm gate price of agricultural products relative to the price of agricultural inputs), X_4 (rainfall) and X_5 (technology) are factors determining home supply ; and X_6 (deflated export price of agricultural products) is an indicator of world demand. The next section on estimation will indicate how this general model is modified by the limitations of the available data.

(1) This mechanism will of course be influenced by the volume of imports and exports, which will be determined by external conditions as well as by Libyan conditions.

The Import Function

The import demand for agricultural products is also determined by domestic and external factors. The quantity imported is influenced by factors acting on domestic consumption together with others determining the quantity of home supply. Equally important is the price of the imported product which is influenced by forces originating in the exporting country plus changes in freight rates, insurance and import duties. Another variable, particularly relevant to most under-developed countries, is the availability of foreign exchange.

The import function may thus be expressed as follows :

$$Y_2 = f (X_1 , X_2 , X_3 , X_4 , X_5 , X_7 , X_8)$$

where Y_2 is Libyan imports of agricultural products, X_7 is the import price of agricultural products including taxes and X_8 is export earnings in terms of import purchasing power.

The home demand variables X_1 , X_2 are hypothesized to be positively related to imports, the home supply variables (X_3 , X_4 , X_5) negatively related. Import price (X_7) is expected to have a negative coefficient and export earnings (X_8) a positive one. It is sometimes argued that an increase in population can be taken as a proxy for "market size" on the assumption that an increase in the market size lowers cost and thus permits the substitution of domestic production for imports. Consequently, we would expect the population coefficient to be negative. This argument was verified by Chenery [14] in terms of inter-country cross-section analysis. However, the existence of economies of scale with respect to the agricultural sector is still a debatable subject, and evidence from many developing countries, including Libya [15] suggest that the market for food is already large enough. Imperfections arise mainly on the production side and thus an increasing population would, other things being equal, imply an increase in total demand for agricultural products.

ESTIMATION

The aim in this study has been to try and assess the changes in the Libyan demand for food and other agricultural products. Yet the country has not had enough statistics in the field of expenditure and consumption that can conveniently be used for the purpose. Statistics on the movement of trade are, however, available and the fact that they originate from one source makes them even more reliable to use. As we have seen earlier, the behaviour of imports and exports can be taken as good indicators in Libya to show the change in the consumption of food and other agricultural products. They are expected to assume certain adjustments under the influence of a shift in demand and a fairly constant home agricultural output over the period. This adjustment would respond directly to changes in the relevant variables working on the demand side, together with the other assumed variables which are expected under the Libyan circumstances to exert their share of influence on import and export behaviour.

Nevertheless, the use of the external trade statistics is also limited by the shortness of the period over which these statistics have been recorded. In fact the official records have only been published since 1954. This necessarily confines our observations for statistical estimation to a rather small number. Yet this in itself is inevitable, for statistical series related to population, income, prices and other relevant variables have also only started to appear in 1954 (some of them are even back dated to 1954 under certain assumptions made by the official census and statistics department).

The estimates of the export and import functions in this study are based on ten annual observations covering the period 1954-1963. Assuming linear in the logarithms relationships between the dependent

and independent variables, the estimation of the parameters is by single equation ordinary least squares method. The level of estimation attempted is an aggregate one explaining the behaviour of total real exports and total real imports of agricultural products.

Estimation of the Export Function

We have seen that the determinants of exports are assumed to be broadly confined to home demand or consumption, world demand and home supply. Unfortunately, no data are available over the period, on the quantities or value of the total agricultural products supplied at the farm gate, nor on total output as such. The general, single-equation model, for exports, in log-linear form is set out below.

$$Y = a_0 X_1^{a_1} X_2^{a_2} X_3^{a_3} X_6^{a_4}$$

Where Y_1 is the real value of total exports of agricultural products at 1958 export prices. The series of export values at current prices are derived from the Ministry of Agriculture classification [16] and are deflated by a composite export price index calculated for the purpose.

X_1 is per capita income in terms of Libyan pounds. It is computed by dividing gross domestic product at factor cost by an estimate of population X_2 , computed on the basis of a compound rate of 3.65% per annum, an increase which is observed between two population census dates. 1954 and 1964².

X_3 here is the retail price index for the food group, relating to average retail prices of twelve months, January to December, with January 1955 as a base year. It shows the average prices for

(2) The variable X_2 will not be included as a separate variable, largely because of its high correlation with X_1 / X_2 . The implications arising from its omission will be considered in the discussion on the elasticity estimates.

Source : Same as that for table (1)

TABLE (1)
Regression Equations Explaining Total Exports of Agricultural Products

$\log_e Y_1$	$\log_e$ Constant	$\log_e X_1$	$\log_e X_3$	$\log_e X_6$	R^2	R^{-2}	$\frac{\Delta^2}{S^2}$
(1)	12.098 (2.424)	-0.4828 (0.1075)			0.72	0.86	1.22
(2)	21.274 (2.203)		-2.3204 (0.4620)		0.76	0.73	3.01
(3)	4.2591 (11.035)			1.2843 (2.3800)	0.04	0.00	0.49
(4)	22.060 (1.418)		-2.9610 (0.3442)	0.3148 (0.0804)	0.92	0.89	2.01

* The figures in parentheses indicate the standard errors the associated coefficients.

** (Δ^2) is the Von Neuman ratio. Autocorrelation is indicated when the coefficient is 0.84 or 3.69 for sample size (10) at 1% probability level.

selected food commodities sold in Tripoli town. It is assumed to be representative of the whole country. This would seem fairly reasonable as the bulk of retail trade takes place in the more populated western region of the country with Tripoli as a centre, and because the largest share of agricultural output is actually realised in this region. Variations between Tripoli and the surrounding towns are not expected to be large due to the close link between their markets. Yet although the retail price for food commodities in the eastern region with Benghazi as a centre may be higher, due to the fact that large supplies are transported over long distances from the western region, and may thus exhibit monthly fluctuations, it seems reasonable to believe that the annual variation in retail prices should not differ greatly from that realised in Tripoli.

It may be argued that a high retail price for food would mean less consumption at home and leave more to be exported, given that these prices are lower than world average prices. However, a consistently rising level of retail prices and the fact that in most underdeveloped countries the price elasticity of the demand for food is low [1] together with the fact that all evidence points to a low price elasticity for Libyan agricultural output, may indicate that a rising level of retail prices is associated with an increasing demand for home produced agricultural commodities. Consequently, less would be available for exports and the change in X_3 would be negatively related to Y_1 .

X_6 is a composite export price index constructed from data on the most important of the commodities exported from Libya over the period, as a weighted average of the price relatives where the weights represent current year export value. The error possibilities associated with the estimation of changes in the export price should be noted. Trade statistics provide unit values rather than prices, and since unit values are calculated by dividing value of trade by volume, these are affected by changes in quality and commodity composition.

It is assumed here that the export price is determined by exogenous factors working mainly on the external demand front. A shift

in the external demand for Libyan products in either direction may, other things being equal, increase or decrease export prices and thus the incentive to export.

Table (1) shows the least squares estimates of the parameters of the export function. The coefficients estimated are a direct measure of the elasticity of response of Y_1 with respect to each relevant variable. Individual formulations of the independent variables are used to explain Y_1 mainly because of the high degree of multicollinearity between these variables. The zero-order correlation coefficient between X_1 and X_3 , and X_1 and X_2 , is 0.94 in both cases.

The first three equations are therefore simple relations showing the effect of per capita income X_1 , retail price X_3 and export price X_6 on the total real exports of agricultural products. (Y_1)

On the whole the relations attempted provide statistically significant estimates³ of the relevant coefficients. As expected, a priori, per capita income, has a negative coefficient indicating that as income rises home demand for agricultural products shifts to a higher position and the impact is transferred as a reduction in exports.

The shift in home demand is not only seen through the income parameter, but is clear from the behaviour of retail price (X_3), the coefficient of which is shown in equation (4) to be statistically significant. The high elasticity of response with respect to X_3 indicates that exports have been sensitive to an increasing home demand. The negative sign supports our hypothesis in that an increasing home demand, in circumstances where home supply is not responsive enough to match this increase, would eventually translate itself in terms of higher prices of agricultural products sold in the home market.

The export price coefficient is statistically non-significant in equation (3), but, in combination with X_3 , equation (4) gives a significant estimate of the partial effect of X_6 on exports. However small

(3) At the 95% probability level, and with 8 degrees of freedom, $t = + 2.306$.

the elasticity of export supply to export price appears to be, it is interesting to notice that the response is a positive one as expected a priori. In fact, equation (4) is more generally interesting : since X_3 can be taken to reflect changes in X_1 and X_2 and since X_6 which reflects world demand is present, equation (4) actually includes indirectly most of the factors that are assumed to influence the volume of real exports.

Estimation of the Import Function

We have assumed that the determinants of the total Libyan demand for imports of agricultural products are broadly confined to home demand, home supply, the import price plus duties and indirect taxes on imports, and the availability of foreign exchange. To assess the influence of these determinants in the light of available data, the following variables have been included in the general model for imports which is expressed in the log-linear form :

$$Y_2 = b_0 X_1^{b_1} (X_7 / X_3)^{b_2} X_8^{b_3}$$

where Y_2 is the total real import value of agricultural products at 1958 constant prices. (Import value deflated by a composite import price index with 1958 as a base year). Total imports can be looked at from two angles of aggregate definitions : The first is the Ministry of Agriculture's classification which includes under imports only those products which are produced at home. And the second is the external trade definition where we regard as total imports of agricultural products the sum of (S.I.T.C.) classification of the sub-groups 0 : Food and Livestock, 1 : Beverages and Tobacco and 4 : Animal Fats and Vegetable Oils.

X_7 is a composite price index with 1958 = 100.

It is constructed from data on values and quantities of the major

agricultural products imported into the country during the ten years period 1954-1963. On average these commodities amount to about 70 to 75 per cent of the total group of commodities imported each year. Since the trade statistics do not give records about the volume of imports on any of the commodities concerned during 1957, estimates of unit values for this year are based on average unit values of the same commodity for 1956, 1958, and 1959. As regards the remaining group of the total agricultural commodities imported, the discontinuity of data over time will force us to assume that changes in their prices follows the composite price index.

X_7 / X_3 is the ratio of import price index to retail price index for food commodities. In the absence of data on prices of agricultural products at the farm gate, use may be made of the retail price index to serve with X_7 as a proxy for home supply. The danger in this stems from the fact that X_3 could conceal large changes in the retail margin. In fact, the ratio can more reasonably be thought to reflect year to year changes in rainfall and may thus be taken as a proxy for weather conditions in the sense that an increasing ratio is indicative of a good year and consequently higher import prices relative to home prices.

X_8 is real export earning - total value of exports deflated by the import price index. Since data on total import price index are not readily available, use is made of the composite import price index for agricultural products X_7 . The variable X_8 is essentially indicative of the country's foreign exchange earnings from exports. It is used as a proxy for the country's ability to pay for imports.

Table (2) shows the least squares estimates of the import function parameters. In this case also the problem of multicollinearity is a serious one. The inclusion of two or more highly correlated variables in one equation would not only affect the significance of the estimated parameters but may also be responsible for changing the sign

of the parameters in arbitrary direction. Yet the estimation of the import function with respect to individual variables is not truly indicative of the independent effect of such variables on imports. For in the real world, imports as well as exports, are determined by a number of variables which ought to be present in the estimated equation. The estimated parameter of any variable would then indicate its partial influence on the dependent variable while other relevant variables are taken into consideration but are assumed constant.

The income elasticity of import demand is positive and consistent with our a-priori expectations (equation 1). Equation (2) shows the individual effect of import price X_7 on Y_2 . Although the coefficient sign is negative, and thus supports our hypothesis regarding the effect of import price on total agricultural imports, the estimate is associated with a large standard error which makes the coefficient statistically not different from zero.

The individual effect of real export earnings X_8 on Y_2 appears to be a fairly significant one as equation (3) shows. One limitation is that the country's ability to pay for its foreign commitments did not rely totally on the export earnings over most of the period in question, but was initially met by various grants-in-aid, which are not included in variable X_8 .

Equation (4) shows the effect of X_7 / X_3 on Y_2 and produces a statistically significant coefficient. Varying in magnitude, the variable appears to be statistically significant when combined with other explanatory variables in equations (5) and (6). This indicates that import demand is actually responsive to the relative price changes, and lends support to the hypothesis that changes in weather conditions reflect a significant influence on imports via changes in supply and ultimately in home prices, assuming, of course, that the change in X_7 as determined exogenously is not as drastic over the period.

The import variable in the above analysis is measured in terms

TABLE (2)
Regression Equations Explaining Total Imports * of Agricultural Products

$\log_e Y_2$	$\log_e$	$\log_e X_1$	$\log_e X_7$	$\log_e X_8$	$\log_e X_7/X_3$	R^2	$\frac{-2}{R}$	$\frac{\Delta^2}{S^2}$
(1)	8.108 (0.2361)	0.6345 (0.0599)				0.933	0.925	2.154
(2)	22.788 (7.178)		-0.2624 (1.5430)			0.265	0.173	0.490
(3)	9.654 (0.3269)			0.2172 (0.0735)		0.521	0.461	0.799
(4)	17.634 (1.2194)				-2.0822 (0.2713)	0.880	0.865	1.650
(5)	15.565 (1.025)			0.0954 (0.0288)		0.953	0.940	3.246
(6)	10.5414 (1.8087)	0.4100 (0.0966)			-0.8593 (0.3266)	0.966	0.956	2.817

* Total Imports as classified by the Ministry of Agriculture.

TABLE (3)

Regression Equations Explaining Total Imports ** of Agricultural Products

$\log_e Y_2$	$\log_e$ Constant	$\log_e X_1$	$\log_e X_7$	$\log_e X_7/X_3$	$\log_e X_8$	R^2	$\bar{R}^2$	$\frac{\Delta^2}{S^2}$
(1)	6.5973 (0.27787)	0.5522 (0.0752)				0.884	0.870	2.293
(2)	21.5736 (6.0364)		-2.7576 (1.2981)			0.360	0.280	0.512
(3)	17.1487 (1.0563)			-1.8694 (0.2350)		0.887	0.873	2.136
(4)	7.9581 (0.3060)				0.1854 (0.0688)	0.475	0.410	0.866
(5)	12.1421 (2.1393)	0.2894 (0.11432)		-1.0061 (0.3863)		0.941	0.924	3.050

* Total Imports Subject to (S.I.T.C.) Classification : Total Food and Livestock, Beverages and Tobacco and Animal Fats and Vegetable Oils.

of those agricultural products which can be produced domestically. It is therefore not surprising to find that the import demand for such products is greatly influenced by income X_1 , while X_7 the import price appears to be a non-significant variable, for one would expect the rise in the demand to absorb firstly the commodities which are grown domestically irrespective of slight changes in import price. However, if we look at the import variable in terms of all types of agricultural commodities imported into the country, the import function estimates as shown in Table (3) exhibit some notable differences. Although the import response under the new definition - to X_1 does not change much in magnitude (equation (1)), the response of imports to changes in X_7 and X_8 is now different. Equation (2) produces an import price coefficient which is significant and negative, indicating that under the new definition of imports, less is imported in the event of an increase in the import price. The price elasticity of import demand is greater than unity and it appears to be consistently so, even when the import price X_7 is combined with other explanatory variables.

Generating total demand elasticities

The previous analysis has been mainly concerned with estimating export and import functions. From this work we have some estimates of the home income elasticity of demand for imports and potential exports in Libya. It is possible to generate from these elasticities estimates of the income elasticity of demand for total agricultural products. This seems particularly relevant to the Libyan case where the reduction in exports and the rapid increase in imports have been major components of home consumption of agricultural products.

Assuming a non-linear demand function for agricultural products,

$$D = k_0 X_1^{k_1}$$

where the per capita income elasticity of demand is equal to the

regression coefficient k_1 and assuming further that total demand is defined as

$$D = A + Y_2 - Y_1$$

where A is total Libyan agricultural output which is assumed constant.

The import function is defined as

$$Y_2 = k_{01} X_1^{k_{11}}$$

where k_{11} is the elasticity of imports with respect to income, and the export function is defined as

$$Y_1 = k_{02} X_1^{k_{12}}$$

and the elasticity of exports with respect to income is k_{12} .

$$\text{Since } k_1 = \frac{dD}{dX_1} \cdot \frac{X_1}{D} = \frac{d(A+Y_2-Y_1)}{dX_1} \cdot \frac{X_1}{D} \text{ and also}$$

$$\frac{d(A+Y_2-Y_1)}{dX_1} = \frac{dA}{dX_1} + \frac{dY_2}{dX_1} - \frac{dY_1}{dX_1}$$

and

$$\frac{dA}{dX_1} = 0 ; \quad \frac{dY_2}{dX_1} = k_{11} \cdot \frac{Y_2}{X_1} ; \quad \frac{dY_1}{dX_1} = k_{12} \cdot \frac{Y_1}{X_1}$$

$$\begin{aligned} \therefore k_1 &= \frac{k_{11} Y_2 - k_{12} Y_1}{X_1} \cdot \frac{X_1}{D} \\ &= \frac{k_{11} Y_2 - k_{12} Y_1}{A + Y_2 - Y_1} \end{aligned}$$

for although statistics for total agricultural output are only available

for one year (1958), the behaviour of production for commodities on which data are available show very little change over time. Using the estimate of agricultural output for 1958 = £ 13.6 million, demand elasticities have been computed for 1958 and for the beginning and end years, 1954 and 1963 (Table 4).

The estimates are perhaps surprisingly high [17]. We can in fact immediately detect one source of upward bias. A more realistic demand model would be

$$D = k_0 + k_1 X_1 + k_2 X_2$$

where X_2 is population. It is left out because X_2 is highly correlated with X_1 ($r=0.94$) and the two explanatory variables were therefore not included in the same import or export equation. It would be reasonable to assume the population coefficient k_2 to be one (i.e. a 1% increase in population results in a 1% increase in demand for agricultural products), and if this is so, how is the estimate of income elasticity of demand affected? Over the period of the analysis (1954-63) income per capita has increased by the dramatic amount of 278%. The estimate of the demand elasticity in 1958 would suggest that total demand for agricultural products has increased by 488% over the same period. At the same time however the population has expanded by 38%. Assuming a population elasticity of demand of one a 450% rise in demand can be ascribed to the rapid increase in per capita income. This implies an income elasticity of demand of 0.84⁴.

(4) The work of Thiel (*Linear Aggregation*, North Holland Publishing Co., Amsterdam, 1958) would suggest the bias in our first estimate of k_1 is equal to r_1 , from the relation

$$X_2 = r_0 + r_1 X_1$$

This coefficient is estimated to be 0.183.

TABLE (4)

Income elasticities of demand for agricultural products

Year	k_{11}	k_{12}	k_1
1954	0.6345	-0.4828	1.011
1958	0.6345	-0.4828	1.021
1963	0.6345	-0.4828	0.934

The formula used for calculating k_1 , the income elasticity of demand for agricultural products is :

$$k_1 = \frac{k_{11} \log_e Y_2 - k_{12} \log_e Y_1}{\log_e A (1958) + \log_e Y_2 - \log_e Y_1}$$

Total imports Y_2 include only commodities produced domestically.

This revised coefficient still appears substantial and we may ask how this might occur. An obvious error can occur in the estimates and assumptions regarding A (Libyan agricultural output). The income elasticity would be biased upward if A was underestimated or if

$\frac{dA}{dX_1} < 0$. Both these situations are possibilities and could result

in "wrong" estimates. It is also possible that the estimate is substantially right and may be explained by (1) the very low income level at the beginning of the period - and the subsequent low level of food consumption ; (2) a rapid increase in wealth is associated with an important change in income distribution (on which there is no data), or (3) a slow change in consumption patterns, accentuated by the very rapid change in income. Consumption patterns may have been relatively stable because of a slow adjustment by consumers or due to supply restrictions on non-traditional consumer goods.

Conclusions and Policy Implications

Demand for agricultural products in Libya has been increasing and, in this study, it has been observed in the behaviour of imports and exports. The per capita income elasticity of demand was estimated to be 0.84 in 1958.

The country is facing an even bigger increase in income and population, more capital is invested in the economy and oil exports are rising at a faster pace every year. The investigation provides evidence that at least for the next few years home demand for food and agricultural products will increase substantially. Consequently, and as long as the local farmer remains inefficient, home supply will fail to meet the expanding demand and the country will become increasingly dependent on external sources of supply. The problem as it stands is not entirely one of balance of payments, for nowadays development inevitably implies a certain drain on the developing

country's foreign exchange reserves, one may even further argue that Libya will easily be able to pay for its imports for some time to come. The question is rather whether government policy should allow this sort of adjustment to go on indefinitely until home producers may one day manage to get through the various bottlenecks facing them, or else take effective steps so as to meet the expected increase in home demand for agricultural products at least partly from home output, in which case the drain for the country's foreign exchange may be less drastic and the agricultural sector is mobilized to contribute effectively in the development of the whole economy. The second view can only be carried through intelligent planning. But it is essential to emphasize that action on this line should involve effective measures aimed at increasing the responsiveness of the agricultural output to the changes in the pattern of consumption. This also implies solving the problem of land tenure, eliminating factors responsible for yield uncertainty, disseminating information of modern farming practices, extending credit for small farmers and helping to build a marketing system based on cooperation and efficiency. Yet more important is the design of an import policy which is consistent with the above aims, one which recognises the fact that some degree of inflation has in most developing countries been regarded as a phenomenon associated with development, if not a pre-requisite to it.

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