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Food Import Demand: Meat, Dairy Products, Eggs and Live Animals in Oman

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الطلب على استيراد المواد الغذائية: اللحوم ومنتجات الألبان والبيض والحيوانات الحية

الملخص: من الضروري فهم تجاوب المستهلكين للعوامل التي تؤثر على طلب السلع المستوردة وذلك لتطوير سياسات فعالة تجاه استيراد السلع الغذائية. هذه العوامل تتضمن تجاوب المستهلك للتغيرات في أسعار المواد المستوردة والدخل. يقوم المؤلف في هذه الدراسة بتطوير معادلات اقتصادية للطلب على المواد المستوردة لثلاث مجموعات من المنتجات بالسلطنة وهي اللحوم ومنتجات الألبان والبيض والحيوانات الحية. هذه المجموعات معروفة عنها أنها مصدر هام للبروتين لسكان السلطنة. بالإضافة إلى تاريخها في الإنتاج المحلي ومساهمتها في تقليل الاعتماد على استيراد المواد الغذائية. تظهر النتائج أن الأسعار المقدرة على طلب منتجات اللحوم مرنة مما يدل على أن الزيادة في السعر قد يؤدى إلى النقص في العائد من استيراد منتجات اللحوم. أما بالنسبة للأسعار المقدرة لمنتجات البيض والألبان فتظهر أنها غير مرنة، مما يشير أن الزيادة في السعر المستورد سينتج عنه زيادة في العائد من استيراد هذه المنتجات. وجد أن مرونة العائد المقدر للحوم ومنتجات الألبان والبيض أقل من واحد مما يشير إلى أن هذه المنتجات هي منتجات عادية. إن زيادة مقدارها ١% في دخل الفرد سينتج عنها زيادة مقدارها أقل من ١% للطلب على منتجات اللحوم و اللبان والبيض المستوردة. هذه النتائج لديها تأثيرات على نمو وتنمية التجارة في هذه المنتجات المهمة لقطاع المواد الغذائية المستوردة.

ABSTRACT: To develop effective food import policies, it is necessary to understand the responsiveness of consumers to factors affecting import demand. These factors include consumer response to changes in import prices and income. In this study the authors develop economic models of import demand for three main product groups in Oman: meats, dairy and eggs, and live animals. These product groups have been identified as major sources of protein for the Omani population. In addition, these products have a history of domestic production and potential for reducing dependence on food imports. The results indicate that the estimated price elasticity of demand for meat products is elastic, which implies that an increase in price will result in a decrease in revenues for meat import businesses. However, the estimated price elasticity for imported dairy and egg products is inelastic. This implies that an increase in import price will result in an increase in revenues for dairy and egg import businesses. The estimated income elasticities for meat products and dairy and egg products were found to be less than one, suggesting that they are normal goods. A one percent increase in per capita incomes will result in a less than one percent increase in demand for imported meat, dairy, and egg products. These results have economic implications for growth and development of businesses in these important food import sectors.

Food security as defined by Penson *et al.* (1996) is "physical and economic access to minimum food requirements". Dependence on food imports raises concerns in most nations of the world. The potential to reduce dependence on imports and increase self-sufficiency is determined by the reason for the flow of food products into the country. For example, products may be imported that cannot be produced domestically given the climate and natural resource endowments. The population may have developed a cultural taste for imported products, which no local product can substitute. Food products may enter a country because they are produced at lower cost in another country, due to comparative advantage or subsidized agriculture. Consumers will choose a lower priced import over higher priced domestically produced substitutes, unless there is a noticeable quality difference or cultural preference for local products. At the national level, importing lower cost food products releases scarce domestic resources to be used in more efficient industries. At the household level, lower cost imports reduce household expenditures on food, allowing the

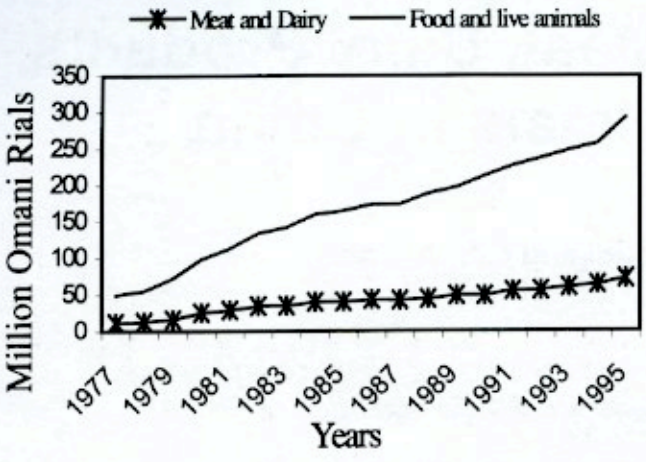

Figure 1. Value of Food Imports.

household to purchase more food and all other products.

For developing nations with traditional agricultural sectors, food imports are likely to increase as the nation's per capita income grows. This will occur as purchasing power increases the volume of food consumed, and higher incomes allow for improved diversity in the diet. Population growth places additional pressure on import demand if population growth exceeds productivity growth in the domestic agricultural sector. As illustrated in Figure 1, the value of food and live animal imports has increased substantially from approximately 50 to 300 million Omani rials since the influx of oil revenues in the 1970s (Ministry of Development). The value of food imports increased from 38.1 million Omani rials in 1977 to 220.2 million in 1995. Imports of some protein products (meat and meat preparations, dairy products and eggs) increased from 11.7 million Omani rials in 1977 to 72.2 million in 1995. In addition to national income growth, an inflow of migrant labor and high native population growth rate have contributed to the substantial increases in import food demand over the last 20 years.

Nutrition levels in Oman have improved over the last 20 years, as a result of higher per capita income levels and better availability of food products both in quantity and diversity made possible by food imports. The increase in food demand associated with rising national income and population growth has outstripped the domestic production of these products, as illustrated by the substantial growth in food and live animal imports in Figure 1. However, many of these products can be produced domestically given the natural resources and human capital in the agricultural sector. To develop effective food import policies, however, it is necessary to understand the responsiveness of consumers to factors affecting import demand. These factors include consumer response to changes in import prices and income. In this study economic models of import demand for three main product groups in Oman are developed: meats, dairy and eggs, and live animals. These product groups have been identified as major sources of protein for the Omani population (Ministry of Health, 1997). In addition, these products have a history of domestic production and potential for reducing dependence on food imports.

Model Description

CONSUMER FOOD PREFERENCES: A consumer's total utility is a combination of all the subutilities from the separable groups (Deaton and Muellbauer, 1980). A utility tree for meat consumption starts with a broad aggregate of all products. Consumers allocate expenditures among these broad classes of food products. For example, a consumer allocates income to food, housing, transportation, and other goods dependent on prices and other variables that influence consumer preferences. The second-stage decision of a consumer is to allocate expenditures within each subgroup. For example, total expenditure on food products will be allocated among different food groups, such as meat, dairy, grains, and vegetables. Then, the consumer will maximize the subutility function for food, subject to prices, expenditure allocated to food, and other variables influencing food demand.

This model of consumer decision making requires the assumption of separability of the consumer utility function (Blackorby *et al.*, 1978). Weak separability of the utility function is a necessary and sufficient condition for the second stage of two-stage budgeting (Deaton and Muellbauer, 1980). Multiple-stage budgeting allows aggregation of broad commodity groups and separable decision making between these groups. Imposing the assumption of separability on the utility function simplifies data requirements for econometric estimation of demand equation parameters and reduces multicollinearity problems.

Quantities in each product group ($x_1, \ldots x_n$) are chosen to maximize the subgroup utility function (u), subject to the consumer's expenditures allocated to the subgroup (m) and the prices of products in the subgroup ($p_i \ldots p_n$):

$$\max u(x_1, x_2, \ldots, x_n)$$
$$\text{s.t. } m = p_1x_1 + p_2x_2 + \ldots + p_nx_n \qquad (1)$$

Solving the first order conditions of utility maximization for the subutility function, the Marshallian demand equations are obtained. For a complete derivation of demand equations from utility maximization see Varian (1996), Deaton and

Muellbauer (1980), or Waugh (1990). The resulting Marshallian demand equations take the following form:

$$x_i = f(p_i, p_j, m) \quad (2)$$

The Marshallian demand equation is a function of the own price (p_i), prices of related products (p_j), consumer expenditure (m), and consumer preferences for the product which may be influenced by socio-economic factors (Waugh, 1990; Varian, 1996).

FOOD IMPORT DEMAND: Modeling import demand for food subgroups requires identification of relevant import demand variables. The change in the relative price of the subgroup or related subgroups will cause quantity demanded to rise or fall. However, the prices of the subgroups may rise or fall for changes in the general price level of the economy. Changes in the general price level can be removed from the price of the product to insure the price parameter measures the effect of a relative change in the product price, rather than a general change in all prices in the economy. This is valid for linear demand equations only if the homogeneity assumption holds (Tomek and Robinson, 1990). Dividing the price variable by the consumer price index will remove the effects of general price movements from the import price parameters and reduces problems of multicollinearity among price and income variables for statistical estimation (Goldstein and Khan, 1985; Waugh, 1990).

Import demand is an aggregate demand derived from individual consumer demands. Consumer expenditure is proxied by a national income variable, which must be deflated by the consumer price index (Sarris, 1981; Thompson and Abbott, 1986). Changes in population have a direct effect on the food demand curve, thus the import quantity and national income variables should be transformed into per capita form before estimating the model parameters (Tomek and Robinson, 1990). Exchange rates between countries influence relative prices of imported goods (Dutton and Grennes, 1988). As the value of the domestic currency falls, relative to the import supply country, the import becomes relatively more expensive. The real exchange rate variable reflects changes in relative price levels of the trading countries (Dutton and Grennes, 1988). The Sultanate of Oman has a fixed exchange rate relative to the U.S. dollar. The fixed exchange rate was devalued once in 1986. This study includes a dummy variable of the fixed exchange rate to capture any import demand effects from the devaluation of the Omani rial relative to the U.S. dollar.

The per capita import demand equation (pcx_i) is a function of deflated import price (dp_i), deflated prices of related goods (dp_j) deflated per capita national income (dpcm), and an exchange rate variable (re). These take the following general form:

$$pcx_i = f(dp_i, dp_j, dpcm, re) \quad (3)$$

Specification of a specific functional form is required for econometric estimation of the parameters of the import demand equation. Estimation of unbiased parameter estimates requires accurate specification of functional form. For small changes in prices, a linear demand function gives good approximations of consumer demand responsiveness and has been used in many import demand studies (Tomek and Robinson, 1990; Tanyeri-Abur and Rosson, 1996). For empirical examples of international trade modeling see Gardiner and Carter (1988), Sarris (1981), and Thompson and Abbot (1986). The specific functional form used in this study is:

$$pcx_i = \alpha\, dp_i^{\beta}\, dp_j^{\delta}\, dpcm^{\phi}\, er^{\Upsilon} \quad (4)$$

This functional form is a Cobb-Douglas type which is linear in logarithmic form, simplifying estimation of the parameters. It is not recommended that these parameter estimates be used for analysis of large changes in prices. Transforming the Cobb-Douglas function into logarithmic form provides for easy interpretation of the estimated demand parameters ($\alpha, \beta, \delta, \phi, \Upsilon$). The estimated parameters on price and income variables represent the price (E_p) and income (E_I) elasticities of import demand. Logarithmic transformation of equation (4) results in:

$$\ln(pcx_i) = \ln\alpha + \beta\ln(dp_i) + \delta\ln(dp_j) + \phi\ln(dpcm) + \Upsilon\ln(er) \quad (5)$$

With no prior assumptions regarding the appropriate functional form for food import demand equations in the Sultanate of Oman, the double logarithmic functional form is used to obtain estimates of the import demand elasticities (Gardiner and Carter, 1988; Tanyeri-Abur and Rosson, 1996). Signs on the estimated parameters are expected to comply with standard consumer demand theory expectations (Varian, 1996). The sign on the price parameter dp_i should be negative. The sign on the related price parameters will depend on the relationship between the subgroups. If the subgroups represent substitute goods, the expected sign on the substitute price parameter is positive. The income elasticity is expected to be positive, assuming that meat and dairy products are normal goods in the Omani diet.

Empirical Results

Time series data were collected on the model variables and standard statistical methods were used to estimate the model parameters (Kennedy, 1986). Price and income elasticities of import demand were obtained from estimated model parameters.

DATA DESCRIPTION: Time series data were collected for imported products by SITC (Standard International Trade) divisions. The divisions of interest in this study are "live animals - SITC 00", "meat and meat preparations - SITC 01", and "dairy products and eggs - SITC 02". The two-digit SITC aggregations were chosen due to the availability of the data from the Ministry of Development, annual Statistical Yearbooks, which are published using the standard international trade classification of goods. Sixteen years of annual observations were obtained (1981-1996) on quantities of imports and values of imports (Omani rials) for the three categories (Ministry of Development).

Oman population estimates and the Consumer Price Index were obtained from the Central Bank of Oman. Quantities of imports were divided by population to obtain per capita consumption. Average import prices for each SITC division were obtained by dividing the value of imports by the quantity. Gross National Product is used to proxy national income. The income variable was divided by population and deflated by the Consumer Price Index to obtain real per capita income.

The exchange rate variable is a fixed exchange rate between the Omani rial and the U.S. dollar. It is used in the import demand equations to measure any impact of devaluation on food import demand. The value of the Omani rial was deflated in 1986 from 0.34505 to 0.384. Changes in the U.S. dollar relative to other world currencies include both appreciations and depreciations. The net change in the U.S. dollar is therefore difficult to measure relative to Oman's food supplying countries. Any relative changes in the U.S. dollar exchange rate, and thus the Omani rial exchange rate, are captured in the intercept term of the import demand equations.

PARAMETER ESTIMATES: The parameters of the import demand equations are estimated using Ordinary Least Squares regression analysis (SAS, 1990). The Durbin-Watson statistic was used to test for autocorrelation of the error term and tests for first degree autocorrelation were conducted. The estimated model parameters for live animals, meat products and dairy & eggs are listed in Table 1.

The import demand equation for live animals (SITC 00) was found to have statistically significant parameter estimates for price, income and exchange rate. The R-square of this equation was 0.85 and an adjusted R-square of 0.82. The high adjusted R-square value suggests that the variables included explain a large share of variation in consumer purchases of imported live animals. However, the intercept term was found to be highly significant, suggesting that other relevant live animal import demand parameters influence consumer choices, which were not included in the model.

TABLE 1

Estimated Import Demand Parameters.

quantity	intercept	price	income	exchange rate
Live Animals	31.19*	-1.01	2.46	7.91
SITC 00	(4.82)**	(-2.39)	(4.02)	(3.72)
Meat Products	7.57	-1.09	0.83	0.56
SITC 01	(3.40)	(-2.70)	(4.54)	(1.17)
Dairy & Eggs	6.03	-0.64	0.66	1.49
SITC 02	(2.46)	(-3.10)	(3.82)	(3.32)

* OLS parameter estimate. ** Students' t-statistic.

Given the use of the linearized form of the Cobb-Douglas functional form, the estimated parameters for price and income variables correspond to the price and income elasticities, respectively. The price coefficient for live animal imports of -1.01 implies that the live animal price elasticity is approximately unitary. A one percent increase in import price will reduce quantity demanded by approximately one percent. The income coefficient for live animal imports of 2.46 implies that live animal imports are a normal luxury good. As consumer incomes increase by one percent, live animal imports will increase by approximately two and one-half percent. However, it is important to point out that live animals includes imported goats, sheep, cattle, and specialized animals for breeding stock and racing camels since this category is an aggregate of all live animals. Therefore, it is difficult to interpret the results of the income elasticity for such a diverse aggregated category. Future work on live animal imports should focus on live animals intended for consumption, such as sheep and goats, while excluding live cattle and camels which may represent breeding stock.

The import demand equation for meat products (SITC 01) had an R-square value of 0.68 and an adjusted R-square of 0.61. All the estimated parameters were found to be statistically significant, including the intercept term. The estimated price coefficient of -1.09 implies that a greater than one percent decrease in quantity demanded would result from a one percent increase in the price of imported meat products. The income elasticity of demand for imported meat products is 0.83, implying that these are normal necessity goods. A one percent increase in income will result in a less than one percent increase in

quantity demanded of imported meat products, approximately eight-tenths percent. Traditionally, meat is an important component of the Omani diet, especially goat and sheep meat. With higher per capita incomes in Oman during the 1980s and 1990s, it is not surprising to find estimated meat import demand being a necessity good.

The dairy and egg products (SITC 02) estimated import demand equation had an R-square value of 0.59 and an adjusted R-square of 0.50. All the parameter estimates were found to be statistically significant. The estimated price coefficient of -0.64 implies an inelastic demand response to changes in price. A one percent increase in the price of imported dairy and egg products will result in a less than one percent decrease in quantity demanded. An estimated income coefficient of 0.66 implies that imported dairy and egg products are normal necessity goods. A one percent increase in income should result in an increase in import quantity demanded of slightly more than half a percent. However, this is a highly aggregated category and implications about price and income effects will not accurately reflect individual responses in dairy products and egg products. These parameter estimates are only useful for considering aggregate dairy and egg import responses to average price changes and income growth.

Conclusions

Estimated price and income elasticities of import demand are valuable to policymakers and businesses for predicting likely changes in quantity demanded of food imports for anticipated changes in import prices and consumer income. Estimated elasticities can be used to simulate the effect of market changes on import volumes and expenditures. This information can be useful when examining the effects of trade policies on the domestic consumers. For example, forming a regional customs union in the Arabian Penninsula will require member countries to adjust import tariffs with special preference to other members. This is likely to affect the price of imported products within the region, relative to imports from outside the customs union. This will indirectly affect food importing businesses and food processors relying on imported live animals or raw materials. Changes in oil prices or economic growth would affect consumer incomes in Oman. These shocks will ultimately have an impact on consumer demand for imports, including live animals, meat, dairy and egg products. Thus, it is useful for businesses to be able to predict changes in consumer import demand in order to make necessary adjustments in their businesses.

The level of own price elasticity of demand has implications for business' revenues. For example, the estimated price elasticity of demand for meat products was found to be elastic, which in turn implies that an increase in price will result in a decrease in revenues for meat import businesses. However, the estimated price elasticity of demand for imported dairy and egg products is inelastic. This implies that an increase in import price may result in an increase in revenues for dairy and egg import businesses, net of any price effects from higher tariffs or duties. However, in light of the progress towards a regional customs union and Oman's application for membership in the World Trade Organisation, it is unlikely that import price increases will originate from rising trade barriers. The estimated price elasticity of demand for live animals is unitary, implying from standard consumer demand theory that an increase in price will have no affect on import revenues in this sector.

The estimated income elasticities for meat products and dairy and egg products were found to be less than one. Thus, a one percent increase in per capita income will result in a less than one percent increase in demand for imported meat, dairy, and egg products. However, the income elasticity of demand for live animals was found to be greater than one, implying that a one percent increase in per capita income will increase demand for live animal imports by more than one percent. This has important economic implications for development of live animal transport businesses and the domestic slaughterhouse sector.

Areas for further research in this area of study include the development of a detailed system of domestic and import demand equations for meat, dairy, and live animals. This will require the collection of domestic data on meat consumption. However, due to the informal structure of domestic meat production and auction markets, data on domestic prices and quantities for the country will require extensive market surveys.

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