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A DEMAND EQUATION FOR WEST MALAYSIAN IMPORTS

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SINOPSIS

Makalah ini melaporkan suatu penyelidikan tentang satu fungsi import yang dinamik bagi Malaysia Barat dengan menggunakan data sirimasa untuk jangkamasa 1960–1974. Asas teori penyelidikan ini ialah suatu hubungan kelakuan yang dipostulatkan antara kuantiti import dengan beberapa angkubah penerang, iaitu harga relatif, import tertangguh dan keluaran negara kasar.

Keputusan yang diperolehi dari persamaan regresi yang terpilih menunjukkan bahawa koefisen-koefisen bagi angkubah-angkubah harga relatif dan pendapatan (diwakili oleh keluaran negara kasar) adalah 'significant' pada paras satu peratus. Walau bagaimanapun koefisen import tertangguh tidaklah 'significant'. Koefisen ini tidak 'significant' disebabkan oleh masalah kelinearan berbilang.

Akhir sekali, didapati bahawa keanjalan pendapatan untuk permintaan terhadap import lebih kurang 0.7 keanjalan harga untuk permintaan terhadap import didapati lebih kurang 0.8.

SYNOPSIS

This paper reports an econometric study of a dynamic import function for West Malaysia using time-series data for the period 1960–1974. The theoretical basis of the investigation is a postulated behavioural relationship between the quantity of imports of goods and services and several explanatory variables namely relative prices, lagged imports and gross national product.

The results from the most preferred regression equation show that the coefficients for the relative price variable and income variable (represented by gross national product) are significant at the one percent level. However the coefficient for lagged imports is insignificant. Its insignificance is due to the problem of multicollinearity.

Finally, the income elasticity of demand for imports is found to be approximately 0.7 implying that import demand is income inelastic. The price elasticity of demand for imports is found to be approximately 0.8.

Introduction

This paper is an econometric study of import demand in West Malaysia for the period 1960–1974. The basic purpose is to estimate demand elasticities for imports with respect to income and price. To achieve this objective, a dynamic import demand equation is developed. A dynamic demand equation is preferred to the short run one because import demand is characterised by response lags and rigidities in the transmission mechanism.

In demand analysis, we are faced with three classes of problems. The first problem is the specification of the theoretical model. In particular, a choice is to be made between a short run or a long run approach. Second, the type of analysis to be used, either a cross-section or time-series. Finally, the general problem of identification ie. obtaining consistent estimates of the parameters.

The paper is structured as follows. Section 2 deals with the general problem of identification in relation to demand analysis. The theoretical import demand function is developed in section 3. The theoretical relation is then generalised to formalise the presence of response lags in demand behaviour. The empirical results are presented in section 4. Some conclusions will be given in the final section.

Demand Analysis and the Identification Problem

Let us first consider the problem of identification. Identification plays a significant role in an econometric study. It is logically prior to estimation[1]. The theoretical problem of identifying a demand equation has been couched in the following terms by Schultz H: "Is it possible to deduce statistically the theoretical demand (or supply) curve when we know only the coordinates of the points of intersection of the theoretical (unknown) demand curve with the theoretical (unknown) supply curve at different points of time?"[2]. A complete theoretical answer to this question was first provided by Haavelmo[3]. He showed that under certain circumstances ordinary least squares estimation of an equation belonging to an interdependent system of equations would lead to inconsistent estimates of the parameters. This means that if the parameter of a function is not identifiable, it cannot be estimated without introducing bias of some sense however large the numbers of observations available[4]. To overcome the simultaneity bias, a simultaneous equation method should be

1 Goldberger. A.S. *Econometric Theory*. John Wiley & Sons: 1964. p. 307.

2 Schultz. H., *The Theory and Measurement of Demand*. Chicago: University Chicago Press, 1938, pp. 72–73. Also quoted in Balestra, P., *The Demand for Natural Gas in the United States: A Dynamic Approach for the Residential and Commercial Market*, N.H: Amsterdam, 1967. p. 6.

3 Haavelmo. T., "The Statistical Implication of a System of Simultaneous Equations", *Econometrica*, vol. 11, 1943, pp. 1–12.

4 Koopmans T.C., "Identification Problems in Economic Model Construction", *Studies in Econometric Method*, Couwles Commission for Research in Economics, monograph No. 14, ed. by W.C. Hood and T.C. Koopmans.

used. This implies that for a particular commodity, to estimate its demand function, its supply function should also be simultaneously estimated.

To estimate a demand curve using time-series data, a precondition is that supply curves have shifted over time, assuming an unchanged demand curve. There is no a priori reason why this precondition should be met in practice. In reality both supply and demand curves shift over time, due to simultaneous changes in both demand and supply forces. Consequently we are estimating a hybrid demand curve. This feature of supply and demand forces has led some writers to denounce the use of conventional estimation techniques (simple and multiple regression analysis) to estimate the demand function. For instance Harberger feels that the traditional techniques would not bear fruitful results[5]. A more substantial and influential criticism came from Orcutt G.H.[6]. He was the first to systematically set out the objections to the use of traditional techniques in estimating demand functions.

Orcutt's contention is that the use of such techniques is likely to lead to bias in the estimation of elasticities, particularly those of price[7]. The simultaneous shifts in supply and demand curves mean that the estimated elasticity will be a weighted average of a negative demand elasticity and a positive supply elasticity.

Writers' views on the use of conventional estimation techniques vary however. For instance, Prais S.J. has argued that Orcutt's objections were generally overstated[8]. The use of conventional techniques still obtains valid results if the researcher is cognizant of the conditions under which they are valid and with the proper application of statistical tests. It is admitted that disentangling price effects would be hard because of the tendency for relative prices to show slower trends and the problem of multicollinearity ie. lack of sufficient independent variation in the independent variables. Another factor which weighs in favour of the use of conventional techniques is the lack of success of alternative model specifications, particularly the simultaneous equations method[9].

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5 Harberger, A.C., "Some Evidence on the International Price Mechanism", *Journal of Political Economy*, 65, 1957.

6 Orcutt. G.H., "Measurement of Price Elasticities in International Trade", *Review of Economics and Statistics*, May 1950.

7 Econometric estimation of import demand price elasticities has generally met with limited success. See for instance H.S. Houthakker and S.P. Magee, "Income and Price Elasticities in World Trade", *Review of Economics and Statistics*, May 1966. For this reason, the relative price variable has been omitted from Malaysian import functions. See for example C.K. Cheong, "Preliminary Estimates of a Statistical Model for West Malaysia 1957–68", *Kajian Ekonomi Malaysia*, vol. IX, No. 1, June 72.

8 Prais. S.J., "Econometric Research in International Trade: A Review", *Kyklos*, vol. XV, 1962, pp. 560–57.

9 For instance see Bergstrom, A.R., "An Econometric Study of supply and Demand for New Zealand's exports", *Econometrica*, 23, 258, 1955. The author obtained plausible estimates but they are not statistically significant.

The Import Demand Function

The foundation of the statistical enquiry to be discussed in this paper is a hypothesized behavioural relationship between the quantity of imports of goods and services and several explanatory variables. The basic explanatory variables which enter an import demand function are derived from the postulates of demand theory. According to this theory, the consumer allocates his given income among consummable commodities in an effort to achieve maximum utility. Hence within an utility maximization framework, the individual's demand function for imports may be obtained as a function of relative prices and the individual's income. Calling M^*_{it} as the i th individual's desired quantity of imports at time t, P_m/P_c as the relative price of imports and Y_{it} as the i th individual's current income, leads to the equation.

$$M^*_{it} = f_i\,(P_m/P_c,\ Y_{it}), \qquad (3.1)$$

$$\partial M^*_{it}/\partial \frac{P_m}{P_c} < 0; \ \frac{\partial M^*_{it}}{\partial Y_{it}} > 0$$

where

P_m = price level of imports,
P_c = price level of other goods

This study is not to justify the theoretical derivation of equation (3.1) but to estimate the parameters of an aggregate import demand function. Given n individuals ($i=1, 2, .., n$), relation (3.1) is aggregated across all individuals and across all goods to obtain a total import function[10]. Economic theory suggests that a total import function may actually be written as:

$$M^* = f\,(P_m/P_c,\ Y/P_c) \qquad (3.2)$$

$$\partial M^*/\partial \left(\frac{P_m}{P_c}\right) < 0; \ \frac{\partial M^*}{\partial \left(\frac{Y}{P_c}\right)} > 0$$

where

M^* = quantity of 'desired' imports,
Y/P_c = real domestic income (say the Gross National Product deflated by P_c).

10 Individual demand relations may be aggregated over individuals and goods to yield an aggregate demand equation. This procedure is supported by theorems on aggregation. See Leamer. E.E. and Stern. R.M., *Quantitative International Economics* (Boston: Allyn & Bacon, 1970), Appendix ch. 2.

Relation (3.2) is an 'equilibrium' or static import demand function. It states that 'desired' quantity of imports is a function of relative prices and real income. The theory of import demand underlying this relation is as follows. Imports and other goods (domestically produced) are assumed to be imperfect substitutes or equivalently, price elasticities are relatively low. Assuming that foreign supply of imports is very elastic, expansion in domestic supply of other goods (eg. through capacity expansion in the import competing industries) would cause domestic price to fall. Relative Price of imports will therefore increase. Theory predicts that domestically produced goods (now relatively cheaper) are substituted for imported goods. Thus the impact of a magrinal change in relative price on desired imports, measured by $\partial M^* / \partial \left(\frac{P_m}{P_c}\right)$, holding real income constant would be an inverse one.

The real income variable has the following role. It acts as a portmanteau variable to capture the influence of variations in aggregate economic activity on desired demand for imports. The relationship between economic activity and demand for import is as follows. Higher income, generated by a more buoyant economic activity results in a higher consumption expenditure. Part of this increment in consumption would be met through imports. Similarly, a recession in economic activity would result in lower incomes. Consumption expenditure is reduced and consequently import demand (at the margin) too.

The functional relationship embodied in equation (3.2) ignores the presence of lags in demand behaviour. We hypothesise that the response of actual imports to changes in the determinants of equilibrium or 'desired' imports is not instantaneous but extends over a period. To characterise this behaviour, we specify an autoregressive model. A general form of this model specification is as follows.

$$M_t = \alpha + \beta_0 Y_t + \beta_1 Y_{t-1} + \ldots\ldots + \beta_k Y_{t-k} + U_t \qquad (3.3)$$

where

M_t = actual quantity of imports at time t.
Y_t = real gross national product.
U_t = a stochastic disturbance term.

Equation (3.3) states that current level of imports is influenced by current as well as past values of real income (represented by gross national product). The effect of real income on current imports is a weighted sum of past and current values of real income. For simplicity, we assume that the weights (coefficients) decline in a fixed proportions such that the effects of distant values of real income become negligible as $k \rightarrow \infty$. This means that the distribution of the coefficients follow the geometric lag ie.,

$$\beta_i = \beta_o \lambda^i, i = 1, 2, \ldots k \qquad (3.4)$$
$$0 < \lambda < 1$$

λ's are fixed weights. The condition that λ is a positive number less than unity is to ensure the convergence of the β_i's to zero.

The preferred estimating equation may be derived by employing Koyck's transformation[11]. First we substitute (3.4) into (3.3). Hence:

$$M_t = \alpha + \beta_o Y_t + \beta_o \lambda Y_{t-1} + \ldots\ldots$$
$$\ldots + \beta_o \lambda^k Y_{t-k} + U_t \qquad (3.5)$$

or equivalently,

$$M_t = \alpha + \beta_o \sum_{i=o}^{k} \lambda^i Y_{t-i} + U_t \qquad (3.6)$$

Equation (3.5) cannot be estimated given the availability of time series data. Even if extensive time-series data on real income are available, the high collinearity between the lagged independent variables in equation (3.5) may render the regression estimates to be statistically insignificant. By employing Koyck's transformation, we overcome this problem. Lagging (3.5) one period and multiplying the result by λ, we obtain

$$\lambda M_{t-1} = \lambda\alpha + \beta_o \sum_{i=o}^{k} \lambda^{i+1} Y_{t-i-1} + \lambda U_{t-1} \qquad (3.7)$$

Subtracting equation (3.7) from (3.5) yields the preferred estimating equation:

$$M_t = \alpha(1-\lambda) + \beta_o Y_t + \lambda M_{t-1} + U_t - \lambda U_{t-1} \qquad (3.8)$$

This may be rewritten as:

$$M_t = \alpha^* + \beta_o Y_t + \lambda M_{t-1} + v_t \qquad (3.9)$$

where

$$\alpha^* = \alpha(1-\lambda) \text{ and } v_t = U_t - \lambda U_{t-1}$$

Equation (3.9) postulates a linear relationship between volume of imports and real income and lagged imports. The past influences of real income on current volume of imports are captured by a single coefficient, λ, the coefficient for M_{t-1}. Alternative specification with the relative price variable included will also be tested.

11 Koyck, L.M., *Distributed Lags and Investment Analysis*. Amsterdam: North Holland Publishing Co. 1954.

The advantage of employing the Koyck transformation to derive equation (3.8) is apparent. The number of coefficients to be estimated has been reduced considerably. However this advantage is not obtained without cost. The error term U_t in equation (3.5) may be classically well-behaved. However the error term v_t in equation (3.8) may be serially correlated. Consequently, the ordinary least squares estimators may not be consistent or efficient.

4. Empirical Results

The data sources for this study are described in the Appendix. The period of study covers the period 1960–1974, thus generating fifteen data points. Empirical results are presented in Table I[12]. In this table are presented least squares estimates of the regression coefficients, standard errors of the coefficients in parantheses below, coefficients of multiple determination, Durbin-Watson test statistics, h—statistics and standard errors of the estimated equations. Table I suggests the following observations.

First, the degree of fit as measured by the coefficients of multiple determination, R^2, is generally good. The estimated R^2 ranges from a low of 0.648959 as in equation (1) to a high of 0.900506 as in equation (6). The R^2 measures the percentage variation in the variance of the dependent variable that can be attributed to the variations in the independent variables. For instance, equation (6) shows that 90.0506% of the variance in M_t is explained by variations in its explanatory variables.

The performance of each estimated equation based on the statistical significance of its coefficients differ from equation to equation. The problem of multicollinearity between regressors is evident in some equations causing the standard errors of their coefficients to be large relative to their coefficients.

The preferred estimating equation reported as equation (1) in the table does not perform well. Both its coefficients are insignificant at the 5% level. Their standard errors are of similar magnitude to their coefficients. However a lack of statistical significance is not a sufficient case to dismiss the theoretical relevance of its regressors (M_{t-1} and Y_t). Economic theory suggests that lagged imports and gross national product are important variables in explaining imports. As such we need to seek for other explanation. It is observed that the simple correlation coefficient between M_{t-1} and Y_t is quite high[13]. This suggests the existence of high multicollinearity

12 We present regression estimates of linear models only. We have also estimated the log-linear versions for the import functions and found the elasticity estimates to be similar in magnitudes.

13 The regression equation between M_{t-1} and Y_t is:

$$M_{t-1} = 448.87310 + 0.35968\, Y_t$$
$$(0.03970) \qquad R = 0.92909.$$

Table 1

Ordinary Least Squares Estimates of
Import Demand Functions.(1)

Equation No.	1	2	3	4	5	6	7
Constant	1240.66284	3865.35108	3486.64063	3931.07178	888.46447	3926.09131	4044.45068
M_{t-1}	0.27793 (0.38461)	0.07881 (0.21726)	0.71498** (0.10597)		0.38002 (0.32818)	0.07140 (0.24169)	
GNP	0.15633 (0.14889)	0.26962** (0.08557)		0.29847** (0.03044)	0.63638* (0.23633)	0.25385 (0.19407)	0.26007 (0.18475)
P_m/P_c		−27.22271** (5.16517)	−23.13464** (6.60239)	−27.58853** (4.89897)		−27.7170122 (7.64290)	−28.51208** (6.85020)
Y_{t-1}					−0.49559* (0.20643)	0.0184 (0.20084)	0.03824 (0.18125)
R^2	0.648959	0.900411	0.810540	0.899216	0.769655	0.900506	0.899633
S_e	301.70507	167.83557	221.64263	161.64804	255.26474	175.9542	168.49441
d	1.30819	1.96625	2.20329	1.87090	2.58982	1.919141	1.79411
h	n.a	0.120954	0.431704		n.a	0.443563	
$\bar{R}^2$	0.5900452	0.87325	0.778963	0.882418	0.706833	0.8607084	0.872260

(1) Numbers in parantheses are standard errors.
** statistically significant at the 1% level.

between the two variables. The lack of independent variations between these regressors means that the OLS technique cannot disentangle the separate influence of M_{t-1} and Y_t on M_t. This phenomenon is reflected in the high values of the standard errors relative to their coefficients. In addition, the low value for the Durbin-Watson statistic suggests that other significant explanatory variables have been ommitted from the preferred estimating equation. One such explanatory variable is the relative price variable.

Equation (2) of Table I is one variant of the preferred estimating equation. The relative price variable is included to quantify the role of relative prices in explaining West Malaysian imports. We observe that the R^2 for this equation is very statisfactory (0.900411). It is in fact the second highest, only marginally lower than equation (6)'s. The standard error of the estimated regression equation is also satisfactory. The Durbin-Watson statistic is relatively close to 2, suggesting the absence of first-order serial correlation in the residuals and perhaps correct model specification[14]. The computed h—statistic of 0.120954, for equation (2) supports the null-hypothesis of the absence of positive serial correlation.

Next we look at the significance of each explanatory variable. The coefficients of real income and relative prices are both significant at the one per cent level. The coefficient for real income implies that a one unit increase in real GNP results in a 0.26962 unit increase in the volume of imports. The direction of change is consistent with the prediction of theory[15]. The coefficient for the relative price variable has the correct sign ie. negative. The absence of unit value indices and the national income deflator preclude tests and comparison for alternative specification of the relative price variable. The performance of the relative price variable is remarkable. Its coefficient is significant at the one per cent level of significance and are

14 The use of the d-statistic is not appropriate when a lagged-dependent variable appears as a regressor. DURBIN, J., "Testing for Serial Correlation in Least-Squares when Some of the Regressions are Lagged Dependent Variables", *Econometrica*, 38, No. 3, (May 1970) pp. 410–21 has developed an alternative statistic called the h-statistic. h is defined as:

$$h = (1-\tfrac{1}{2}d)\sqrt{\frac{n}{1-n\,v(\hat{\beta}_1)}} \qquad \text{where}$$

d is the Durbin-Watson statistic, n is the number of observations and $v(\hat{\beta}_1)$ is the variance of the coefficient of the lagged dependent variable. The h-statistic is distributed as a standard normal variable with zero mean and variance of unity. The standard normal distribution table is used to test the absence of serial correlation. To test the null hypotheses of zero first order serial correlation against the alternative hypothesis of positive autocorrelation, at the 95% level, the critical value of h is $\pm$ 1.645. If the absolute value of $h < 1.645$, the null hypothesis is accepted.

15 The estimated coefficient for GNP (0.26962) differs from that obtained by C.K. Cheong, op. cit. In his most preferred equation (equation (2.g)), the coefficient for NNP (net national product) is 0.8304.

of similar order of magnitudes in all equations which contain it. The inclusion of the relative price variable improves the performance of all estimated equations.

In order to infer the marginal influence of M_{t-1} on M_t, we compare equation (2) with equation (4). We observe that the coefficients for Y_t and P_m/P_c are significant and of similar order of magnitudes in both equations. The adjusted coefficients of multiple determination, $\bar{R}^2$, are similar in both equations. The inclusion of the lagged dependent variable in (2) does not improve the explanatory power of the equation. In fact the $\bar{R}^2$ is slightly reduced from 88.24% to 87.33%. Further, the standard errors of the coefficients for Y_t and P_m/P_c have increased slightly. Furthermore the coefficient for lagged imports is not significant at the 5% level. The lack of significance of this variable may be attributed to multicollinearity. If two regressors are highly collinear, one may be ommitted without reducing the explanatory power of the regression equation.

The exclusion of the income variable as in equation (3) results in the M_{t-1} coefficient to be significant at the one per cent level. This is a statistical evidence of the importance of M_{t-1} in explaining M_t. However the relative price coefficient is reduced and its standard error increased. The $\bar{R}^2$ for equation (3) is lower than that of either equation (2) or (4).

The remaining equations do not perform well as far as the significance of their coefficients go, even though their $\bar{R}^2$ are high. In equation (5) we have included lagged GNP as an explanatory variable. Its coefficient is negative and significant at the 5% level. The coefficient for GNP is significant at the 5% level while that of M_{t-1}'s is not significant. The latter's standard error is too large that the h—statistic does not exist. In equation (6) all the explanatory variables are included. Only the relative price coefficient is significant at the one per cent level; the coefficient for Y_{t-1} changes in sign and not significantly different from zero.

In comparing the seven regression results, we are led to the conclusion that the most preferred regression equation is equation (2). Though the $\bar{R}^2$ and standard error of regression for equation (4) is slightly superior to those of equation (2), we are guided by theory to accept a functional relationship which contains M_{t-1}. The data seems to negate the hypothesis that imports response with a lag to economic activity. However, given the problem of multicollinearity that we adduced to earlier, this conclusion must be made with certain reservations.

Table 2 reports the price and income elasticities of import demand computed at the sample means using equations (2) and (4). The short run income elasticity is approximately 0.7 ie. less than unity. The absolute size of the price elasticity is around 0.82. The income elasticity estimate is at variance (somewhat) with our expectation that income elasticity of demand for imports for a developing economy to be elastic. The price elasti-

Table 2

Estimates of Price and Income
Elasticities Computed at The Sample Means

Eqn. No.	Elasticity Income	Price
(2)	0.641405	−0.823787
(4)	0.710038	−0.833647

city estimate seem to suggest that demand for imports is price inelastic, corroborating our earlier assumption that imports and domestic goods are imperfect substitutes.

Let us compare our results with those obtained by HOUTHAKKER and MAGEE[16]. The authors have fitted a log-linear import and export functions for a across-section of developed and less developed countries using annual data covering the period 1951–1966. The estimated income elasticities of demand for imports obtained by the authors range in most cases from unity to two with the exception of two countries, Mexico and Australia. The income elasticities of import demand for Mexico and Australia are respectively 0.52 and 0.90. We may conclude that our income elasticity estimate is quite reasonable. In contrast our price elasticity estimates, which are all significant, the price elasticities reported in Houthakker and Magee's are mostly insignificant. Some estimates even have the wrong sign.

Conclusion

The aim of this paper has been to estimate a dynamic import demand function for West Malaysia, with a view of obtaining price and income elasticities of demand. The basic results may be summarised as follows. First, the estimated elasticity of demand for imports has the expected negative sign and is significant at the 1 % level. The absolute value of this elasticity is around 0.8. Second the estimated income elasticity of demand for imports of approximately 0.7 shows that demand for imports is income inelastic. This figure is generally lower than the corresponding estimates obtained by Houthakker and Magee.

Appendix

Imports: Millions of ringgits. Measured c.i.f., obtained from Department of Statistics, *Monthly Statistical Bulletin for West Malaysia* (various issues).

16 *Ibid.*

Price of Imports: Import Price Index, 1970 = 100. The series for 1962 to 1974 are obtained from Malaysia, *Treasury Economic Report* (various issues). The import price figures for 1960 and 1961 with a base of 1959 = 100 are obtained from Ariff K.A.M., *Export Trade and the West Malaysian Economy* (Kuala Lumpur: University of Malaya, 1972) Appendices C–45, 46, 47. The latter figures are linked with the earlier figures to obtain observations for 1960 and 1961 with 1970 = 100.

Domestic Price Level: Consumer Price Index with 1970 = 100. This series is obtained as follows. First, Retail Price Index with 1959 = 100 for the period 1959 to 1967 is obtained from Department of Statistics, *Monthly Statistical Bulletin of West Malaysia.* Next, the Consumer Price Index with 1967 = 100 for the period 1960 to 1967 is obtained from Bank Negara Malaysia, Quarterly Economic Bulletin, March/June 1967, vol. 9, no. 12. The two series are linked to obtain the price series with 1967 = 100 for the period 1960 to 1974. The base year for this series is then converted to 1970 = 100.

Domestic Income: Gross National Product in million ringgits at current prices. The GNP data are obtained from Malaysia, *Treasury Economic Report*, 1973/74 and 1975/76. The GNP figures are then deflated using the CPI figures.

The use of the Consumer price index to deflate the GNP figures is far from ideal. Ideally, price indices for each of the components of the GNP are required. However, due to a lack of data, the CPI series is used.