

## A Statistical Demand Function for Imports in South Korea

Augustine Arize\*  
and  
John Spalding\*\*

This paper is an empirical study of demand for imports in South Korea, a small open economy. Four conventional log-linear specifications of the import demand function are examined. The preferred log-linear specification is compared to its linear alternative. Recent specification suggestions are taken into account in the estimation. A battery of diagnostic tests is presented. The relevance to South Korea of the Marshall-Lerner condition for successful devaluation and Thirlwall's economic growth rule is examined. The empirical results suggest that income and relative price are important determinants and that Marshall-Lerner and Thirlwall's rule are satisfied.

### I. Introduction

Considerable empirical research has been devoted to the estimation of aggregate import demand elasticities in the recent decades.<sup>1</sup> Besides being useful in trade theory, these elasticities are becoming increasingly important for developing economies because of their role in the development of policies to deal with the existing debt crisis and balance of payments difficulties.

While much of the empirical research on South Korea has centered on export demand behavior, relatively little systematic analysis exists for import behavior in Korea.<sup>2</sup> As noted by Kang and Kwon (1988), "The im-

\* Professor of Business Statistics, College of Business and Technology, East Texas State University, Commerce, Texas 75428.

\*\* Professor of Business, College of Business Administration, University of North Texas, Denton, Texas 76203.

<sup>1</sup> See, for example, Goldstein and Khan (1985) for a review.

<sup>2</sup> As far as is known, only Bahmani-Oskooee (1984, 1986) and Kang and Kwon (1988) have examined the import behavior of South Korea. This paper differs from these studies at least in that (a) the major quest here is to evaluate the many possible import models with

portance of foreign trade in Korea's economy is manifested by its trade-dependency ratio: in 1980 Korea's exports accounted for 40.2% of GNP while imports accounted for 50.4%."

It is the aim of this paper to estimate an appropriate import demand function for South Korea using quarterly data over the period 1973:1 through 1985:4. Several comments about the paper are worth making. First, it starts with four conventional log-linear specifications of the import demand function. In so doing, recent specification suggestions (e.g., Murray and Ginman (1976), Khan and Ross (1975)) are taken into account in the estimation. Second, special attention is given to the dynamic structure of the statistical models, which seems warranted in order to draw meaningful conclusions on the speed of adjustment. This view is supported by recent comments by Hendry and Mizon (1978) and Maddala (1988). Third, particular attention is given to testing for higher order autocorrelation, heteroskedasticity, normality of the residuals, omitted variables, and functional form misspecifications.<sup>3</sup> As Engle (1982) pointed out, "to assess the validity of the specification of an econometric model, it is useful to have a variety of diagnostic statistics which might provide evidence on the existence and possibly the type of misspecification involved ... strong rejection of any of these tests suggests some degree of misspecification as the data and model are apparently incompatible."

Fourth, the log-linear specifications are used in this paper, since a constant elasticity seems more appropriate than a constant propensity specification (i.e., the linear model) in a sample period where the share of imports in output increased over time, we use the procedures suggested by Gujarati (1988: 183) and Maddala (1988: 179) to compare the two specifications.<sup>4</sup> In fact, the linear specification would imply low price elasticity which seems unlikely.

Fifth, we examine whether importers in South Korea are subject to

the aim of determining the feasibility of a single model; (b) the sample period is extended using quarterly (rather than annual) data. Bahmani-Oskooee and Kang and Kwon all use small samples; (c) recent specification suggestions are examined and formally tested; (d) special attention is given to the dynamic structure of the model; (e) particular attention is given to diagnostic tests; and (f) the Marshall-Lerner condition for successful devaluation and Thirlwall's economic growth rule are examined.

<sup>3</sup> A review of the literature on developing economics reveals that the specification issues examined here are completely ignored.

<sup>4</sup> Khan and Ross (1977), Boylan et al. (1980), and Thursby and Thursby (1984) have shown that the logarithmic functional form is preferable empirically to the alternative linear form. Nevertheless, we examine this for South Korea since the cited studies deal largely with industrial countries.

money illusion (see, Leamer and Stern (1970: 10)).<sup>5</sup> Finally, the forecasting ability of the four log-linear specifications are examined.

The rest of the paper is organized as follows. Section II describes the models used in the paper. The estimation is carried out using quarterly data for the period 1973 through 1985. The estimator used is ordinary least squares procedure. The empirical results and diagnostic tests are discussed in Section III. The relevance to South Korea of the Marshall-Lerner condition for successful devaluation and Thirlwall's economic growth rule is examined in Section IV. Finally, some concluding remarks are given in Section V.

All data used in this paper were compiled from various issues of *International Financial Statistics* and its supplements. The base year used is 1980 = 100. Seasonal adjustment dummies ( $D_1, D_2, D_3$ ) were included in all four equations (given below) in our estimation to reflect seasonal shifts in the level of the intercept term of the regressions. These dummies were jointly statistically non-significant at the 15 percent level. The deletion of these dummies results in almost no loss in explanatory power and in very little alternations of the parameter estimates.

## II. Models and Hypotheses

For the purpose of this study, it is assumed that South Korea is a "small country" internationally, that is, South Korea is viewed as a price taker with respect to its imports. This assumption supports the use of single-equation techniques for estimating Korea's aggregate import demand function.

As is customary, real import demand is assumed to be related primarily to some type of price variable and a measure of real domestic income. However, economic theory is of little help in formulating a precise specification of the model. Accordingly, we have drawn on the work of Thursby and Thursby (1984) which tested nine common specifications of aggregate import demand. Four specifications performed fairly well in that study. We have chosen to work with these four log-linear disequilibrium models which are analogous to equations (1) through (4), namely:

<sup>5</sup> As far as is known, previous studies have implicitly assumed that the demand function is homogeneous of degree zero in prices and nominal income. We examine this because it is highly unlikely that the utilized data for every country have this desirable characteristic.

$$(1) \quad \ln M_t = f(\ln Y_t, \ln P_t, \ln M_{t-1})$$

$$(2) \quad \ln M_t = g(\ln Y_t, \ln P_t^m, \ln P_t^d, \ln M_{t-1})$$

$$(3) \quad \ln M_t = h(\ln Y_t, \ln(Y/Y^*)_t, \ln P_t, \ln M_{t-1})$$

$$(4) \quad \ln M_t = K(\ln Y_t, \ln(Y/Y^*)_t, \ln P_t^m, \ln P_t^d, \ln M_{t-1})$$

where  $M$  is the quantity of imports in time period  $t$ ;  $P$  is the ratio of the unit value of imports ( $P^m$ ) to ( $P^d$ ) the domestic price level;  $Y/Y^*$  is the ratio of current real income ( $Y$ ) to its trend value, that is, the "output-gap";  $Y^*$  represents the trend value of real income and is the value predicted by a regression of the logarithm of real income against time and time squared.<sup>6</sup>

Standard demand theory would indicate that the partial derivatives of the demand for imports with respect to the regressors would have the following signs:

$$\partial M / \partial Y > 0; \partial M / \partial Y^* > 0; \partial M / \partial (Y/Y^*) > 0;$$

$$\partial M / \partial P < 0; \partial M / \partial P^m < 0; \text{ and } \partial M / \partial P^d > 0.$$

With the exception of secular income ( $Y^*$ ) and business cycle ( $Y/Y^*$ ), the arguments of equations (1) through (4) are conventional and spelled out extensively in the trade literature.<sup>7</sup> Therefore, to economize on space, it is not necessary to repeat them here. The cyclical income is used as a proxy for the rate of capacity utilization. It has been hypothesized by Dunlevy and Deyak (1989), Yadav (1975), Gregory (1971) and others that high capacity utilization rates are associated with tight domestic supply of importables and therefore are also associated with worsened terms-of-sale. Hence, consumers are encouraged to turn to foreign suppliers for their purchases. As noted by Dunlevy and Deyak, "To the extent that prices do not clear markets, the cyclical income elasticity will exceed the secular income elasticity." This is one way to evaluate the appropriateness of the specifications. However, note that Thirlwall (1986) has suggested that the

<sup>6</sup> A similar procedure is adopted in several previous studies (see, for example, Dunlevy and Deyak (1989)). However, the specification of the secular component of income may appear rigid and the cyclical variable may be capturing some secular effects. In addition, the effects of any factor (such as trade liberalization) which affects the time trend trade flows will be attributed to secular income changes. Spectral analysis has been suggested as a possible solution, however, this technique is not without problems. See, Haynes and Stone (1983: 95).

<sup>7</sup> See, for example, Arize (1987) for details.

income variable ( $Y$ ) captures elements of non-price competition. Before presenting the empirical results, four technical notes regarding our models and the method of estimation are in order.

First, despite the convenience that it affords, the partial adjustment in the models assumes both geometrically declining weights and a response pattern invariant in either income or prices. Testing for the validity of the dynamic specification involves comparing, for example, the predictions of equation (1) against those generated by an "unrestricted" dynamic specification:

$$(5) \quad \ln M_t = \ln \beta_0 + \beta_1 \ln M_{t-1} + \beta_2 \ln Y_t + \beta_3 \ln P_t \\ + \beta_4 \ln Y_{t-1} + \beta_5 \ln P_{t-1} + e_t$$

As it stands, equation (5) is a partial adjustment model in which changes in income and prices produce different dynamic adjustment (see Hendry et al. (1984) and Fair (1987)). The data will support the partial adjustment in equation (1) if  $\beta_4 = \beta_5 = 0$ , a hypothesis tested with a LaGrange multiplier test.

A second issue relates to the implicit assumption that importers are not subject to money illusion. In order to test the validity of this assumption in equation (1), for example, an F-test may be used. For explicitness, let us write equations (1) and (2) as

$$(6) \quad \ln M_t = \lambda \ln a_0 + \lambda a_1 \ln Y_t + \lambda a_2 \ln P_t + (1-\lambda) \ln M_{t-1} + e_2$$

$$(7) \quad \ln M_t = \lambda \ln a_0 + \lambda a_1 \ln Y_t^m + \lambda a_2 \ln P_t^m + \lambda a_3 \ln P_t^d + (1-\lambda) \ln M_{t-1} + e_3$$

where  $\lambda$  = speed of adjustment,  $Y^m$  = nominal income and  $Y = Y^m / P^d$  is current real income. The absence of money illusion or if the demand function is homogenous of degree zero in money prices and money income,  $a_1 + a_2 + a_3 = 0$ .

Third, to assess the reliability of equations (1) through (4) further, Breusch-Godfrey statistic (see, Johnston (1984: 320)) is used to test the hypothesis that all the coefficients of AR(8) for the residual are equal to zero.<sup>8</sup> The hypothesis of homoskedasticity is tested with the following

<sup>8</sup> Consider the usual model  $Y = X\beta + u$  (based on  $N$  observations) where the matrix  $X$  may include lagged values of the dependent variable. Let  $e = (e_1, e_2, \dots, e_N)$  be the vector of residuals and  $E_k$  and  $N \times K$  matrix whose  $m$ th column consists of  $m$  zeros followed by  $e_1, e_2, \dots, e_{N-M}$ . Then  $BG_K = e \cdot E_K (E_K \cdot E_K - E_K \cdot X (X \cdot X)^{-1} X \cdot E_K) E_K e' / (e \cdot e / N)$  follows chi-square  $K$  distribution.

three statistics: Breusch-Pagan (see, Johnston (1984); Engle (1982); and White (1980)). The hypothesis of normality of the residual is tested with Jarque-Bera statistic (Spanos (1986)). The RESET statistic suggested by Thursby and Thursby (1984) is used to test for functional form and omitted variables.<sup>9</sup> The cubes and squares of the predictions of the models are used. Finally, we compare the models in terms of their forecasts of real imports for the post-sample simulations. To perform simulations, we first re-estimated the models using data from 1973 through 1980. To examine the forecast performance, we use the Hendry (1980) forecasting test.<sup>10</sup>

Finally, our preferred log-linear specification is compared to its linear alternative. To do this, three methods were used. First, we use the test procedure suggested by Bera and McAleer (see, Maddala (1988)). As pointed out by Maddala (p. 179), the test may not be useful if it accepts or rejects both models. Second, we compare the long-run elasticities; as noted earlier, the linear model will give low elasticities. Third, Gujarati (1988) suggests how the coefficient of multiple determination in the linear model can be compared to that of the log-linear specification. Specifically, if  $\hat{Z}_t$  is the predicted value of the linear model, it is converted to  $\ln \hat{Z}_t$ , and finally the coefficient of multiple determination between  $\ln \hat{Z}_t$  and  $\ln M$  is calculated (see, Gujarati (1988: 183-185) for more on this).

### III. The Empirical Results and Diagnostic Tests

The empirical results are displayed in Table 1. As can be seen, the statistical fits of the models to the data are excellent as indicated by values of Theil's  $\bar{R}^2$ , standard error of estimate (SEE), and the F value for testing the null hypothesis that all the right-hand side variables, as a group, except the constant term, have a zero coefficient.

<sup>9</sup> Note that domestic real income is assumed to be exogenous. To test the validity of this assumption, the Hausman (1978) test is used. The models tested are equations (1) and (3). The instrument set used are the same as in Arize (1989) except that once lagged values of relative price is included. This orthogonality assumption was not rejected at the 5 percent level. The resulting t-statistic was in each case less than 0.30 in absolute term. The legitimacy of the instrument test was performed as suggested in Sargan (1958). These findings are consistent with RESET statistic reported in Table 2 which is also a test of  $E(\epsilon|X) = 0$ . See, also White (1980: 823).

<sup>10</sup> The Hendry forecast test compares the within-sample standard error SEE, with the outside sample forecast errors,  $f_t$ ;  $HF(n) = \sum_t f_t^2 / (SEE)^2$  where  $n$  = number of forecast periods. HF is asymptotically distributed as chi-square under the null hypothesis of constant parameters and constant variances. Surprisingly, the Chow forecast test did not reject the null hypothesis in each of the four cases.

**Table 1**  
SHORT-RUN IMPORT DEMAND REGRESSION RESULTS,  
1973-1985

Independent Variables	Regression Equations			
	(A)	(B)	(C)	(D)
$\ln(P^m/P^d)_t$	-0.4263 (2.62)*	—	-0.5195 (3.35)*	—
$\ln P^m_t$	—	-0.5069 (3.08)*	—	-0.5017 (3.18)*
$\ln P^d_t$	—	0.6773 (3.25)*	—	0.3931 (1.70)
$\ln Y_t$	0.2202 (3.81)*	0.1600 (2.5)*	—	—
$\ln Y_t^*$	—	—	0.824 (3.56)*	0.9634 (3.22)*
$\ln(Y/Y^*)_t$	—	—	0.4452 (1.63)**	0.4633 (1.68)**
$\ln(M/P^m)_{t-1}$	0.6646 (8.46)*	0.5097 (4.50)*	0.3652 (2.95)*	0.3649 (2.93)*
Constant	0.1828 (1.28)	0.2221 (1.57)**	-0.1514 (0.81)	-0.2288 (1.07)
$\bar{R}^2$	0.9379	0.9409	0.9462	0.9457
SEE	0.1009	0.0984	0.0939	0.0943
F	252.7	200.2	221.04	175.2

\* Significant at the 0.05 level.

\*\* Significant at the 0.10 level.

The numbers in parentheses beneath the estimated coefficients are absolute t-statistics.  $\bar{R}^2$  is the coefficient of determination adjusted for degrees of freedom. SEE is the standard error of estimate and F value is for testing the null hypothesis that all the right-hand side variables, as a group, except the constant term, have a zero coefficient.

The signs of all estimated coefficients are quite consistent with the theory's *a priori* expectations. However, to make sure that the models do not violate the assumptions of classical linear regression and restrictions embodied in them, a battery of diagnostic tests are presented in Table 2. Inspection of the evidence reveals several features of interest. First, there is

**Table 2**  
**DIAGNOSTIC TESTS (1973 through 1985)**

Test Statistics	Tests	Regression Equations			
		A	B	C	D
a) Serial Correlation	Breusch-Godfrey (B-G)	$\chi^2_{(6)}=13.9$	14.39	13.52	15.23*
b) Functional Form & Omitted Variables	Ramsey RESET	$\chi^2_{(2)}=3.52$	2.95	2.15	5.52
	Breusch-Pagan (B-P)	$\chi^2_{(4)}=4.97$	$\chi^2_{(4)}=2.78$	$\chi^2_{(4)}=1.8$	$\chi^2_{(5)}=3.54$
c) Heteroskedasticity	White (1980)	$\chi^2_{(10)}=7.13$	$\chi^2_{(15)}=14.0$	$\chi^2_{(14)}=13.2$	$\chi^2_{(20)}=24.5$
	Engle's ARCH	$\chi^2_{(1)}=0.11$	2.25	1.90	1.92
d) Normality of residuals	Bera and Jarque (JB)	$\chi^2_{(2)}=0.68$	0.01	0.26	0.56
e) Dynamic Specification	Hendry-Pagan-Sargan	$\chi^2_{(2)}=0.29$	$\chi^2_{(1)}=7.78$	$\chi^2_{(3)}=7.83*$	$\chi^2_{(4)}=15.9*$
	Hendry (1980) (HF)	$\chi^2_{(10)}=13.17$	19.96	31.38*	271.97*
g) Homogeneity of degree zero in prices (F)	Yadav (1975)	----	F(1,46=343)	----	F(1,46=0.55)

Notes: \* Significant at the 5 percent level. The values in parenthesis are the degrees of freedom.



evidence of dynamic misspecification and predictive failure in models (C) and (D). Furthermore, model (D) is autocorrelated. Second, as may be seen, models (A) and (B) passed all the tests; however, the homogeneity in prices and money income is not rejected by the F-statistic of  $F(1,46 = 3.43)$  at the 0.05 level.

Given the above misspecification test statistics, it is clear that equation (1) or model (A) in Table 1 is reasonably well defined statistically<sup>11</sup> and, thus, we compare the preferred log-linear model to its linear alternative. Four factors suggest that the linear model is not appropriate for South Korea import demand: (a) the coefficient of multiple determination of the log-linear ( $R^2 = 0.9416$ ) is higher than the  $R^2 = 0.9353$  for the linear model. Note the linear model's  $R^2$  was computed as suggested by Gujarati (1988); (b) the linear model failed the Breusch-Pagan test for homoskedasticity. This test, as noted by Maddala (1988: 165) does not depend on the functional form of the model. The computed value is 9.72, whereas the critical value is 7.82; (c) the Bera and McAleer test resulted in a  $t$  value of 1.29 when the linear model is the null hypothesis, whereas when the log-linear model is the null hypothesis, the calculated  $t$  was 0.44. Both  $t$  values are not significant at the conventional level. However, 1.29 is higher than 0.44; and (d) the long-run elasticities calculated at the mean of data for the linear model are  $-0.844$  for relative prices and  $0.761$  for real income. The relative price elasticity is much smaller in absolute terms than  $-1.27$  derived from the log-linear model. The real income long-run elasticity is  $0.656$  for the preferred log-linear model. The long-run, log-linear elasticity was computed as the coefficient of the estimated relative price or real income divided by one minus the coefficient of the lagged dependent variable in model (A) of Table 1. The speed of adjustment for the linear model is  $0.3519$  per quarter, whereas for the preferred model it is  $0.3354$ .

Turning now to the estimated coefficients of our preferred equation (model (A) in Table 1), the empirical results suggest: (a) that the relative price elasticity is greater than unity and statistically significant at the 5 percent level. The high price elasticity of imports would tend to enhance an expansionary policy, if such a policy is accompanied by a depreciating exchange rate. The large price elasticity would tend also to minimize

<sup>11</sup> In this paper, several misspecification tests have been used. Krämer et al. (1985) have suggested that conventional regression output be supplemented with a battery of tests since this will make it harder for results to appear significant due to a researcher's intentional or unintentional "data mining" process. Furthermore, Thursby (1989) reported that some tests performed well against "what we might loosely refer to as their designed alternatives." The use of a battery of tests appears necessary.

adverse J-curve effects on the balance of payments (BOP) position of the economy. It is clear that the long-run elasticity of  $-1.27$  does lend support to the theory of effectiveness of devaluation in eliminating the huge deficits of South Korea. A fall in the quantity of imports will more than compensate for the increase in price of imported items; (b) that the large price elasticity may reflect that the economy has made progress in developing industries which produce substitutes for imports (Melo and Vogt (1984)); (c) the real income variable is positive and statistically significant at the 5 percent level. However, the long-run, demand-real income elasticity is  $0.656$ .

The inelastic-income elasticity implies that a 1 percent increase in real income induces Korean residents to increase their demand for imports by only  $0.66$  percent, on average. As a result of this, a growth in income may not lead to the expectation of a balance of trade deficit. That is, Korea may still grow without a substantial increase in imports. Given the fact that in 1980, ten Korean companies were listed on *Fortune's* list of 500 largest corporations outside the United States (see, Alam (1989: 248)), this finding should not be surprising. Such a vigorous growth of domestic capital is rare among developing countries; and (d) the estimated speed of adjustment is  $0.3354$ . The median lag is  $1.7$  (calculated as  $\ln(0.5)/\ln(\text{coefficient on the lagged dependent variable})$ ), whereas the mean lag is  $1.98$  (calculated as the coefficient on the lagged dependent variable divided by the speed of adjustment). Thus, Korea's speed of response in the event of a shift from equilibrium in the case of devaluation policy is found to be fairly high. This finding appears to be consistent with large-price, and low-income elasticities discussed above.

Finally, observe that the Hendry forecasting statistic resulted in a chi-squared value of  $13.17$ , which is below the critical value of  $25.0$  at the 5 percent level. As mentioned earlier, the preferred equation was re-estimated for the quarterly period 1973 through 1980.<sup>12</sup> The long-run price elasticity for this period is  $1.49$ , whereas the income elasticity is  $0.514$ . In addition, the speed of adjustment is  $0.3311$ . These estimates are consistent with those reported for the full-sample period 1973 through 1985.

<sup>12</sup> A longer version of this paper with these results is available from the authors. As an anonymous referee has pointed out that Korean government easing of import restrictions on consumer products through lowering of tariffs as well as reduction of the number of goods on the prohibited list in the early 1980s may have resulted in a substantial change in the composition of imported goods. Therefore, it would be useful in future research to decompose aggregate income into consumption expenditure, investment expenditure and export demand to determine whether structural changes actually occurred.

In comparison to previously published estimates, the elasticities presented here are close to those reported for industrial countries by Goldstein and Khan (1985) and Akhtar (1980). Recently, Kang and Kwon (1988) using translog restricted GNP function obtained a price elasticity of  $-1.76$  which is very close to our estimate of  $-1.27$ . Bahmani-Oskooee (1986) obtained long-run price and income elasticities of  $-1.18$  and  $1.12$ , respectively. For the 1984 paper, Bahmani-Oskooee obtained  $-0.37$  for price and  $1.71$  for income. These results contrast with our findings. However, note that the Bahmani-Oskooee studies are based on a small sample size.

While our primary focus thus far has been the preferred model results, two other features of our findings deserve mention. First, Thirlwall's suggestion that the real income variable captures elements of non-price competition is supported by our data. Models with split-income variable were those rejected by diagnostic tests used in this paper. Second, we find no evidence to support the claim by Dunlevy and Deyak that the cyclical income elasticity will be larger than the secular income, since prices may not clear markets.<sup>13</sup> The next section examines the relevancy of the Marshall-Lerner stability condition and Thirlwall's growth rule to the developing economy of South Korea.

#### IV. The Marshall-Lerner and Thirlwall Growth Rule

The restricted form of the Marshall-Lerner condition which is both sufficient and necessary for a successful devaluation is given as follows

$$(8) \quad M/X(P) + (P_x) > 1 + m$$

where  $M$  = imports,  $X$  = exports;  $P$  = long-run relative price elasticity of imports;  $P_x$  = long-run price elasticity of exports (see Arize, 1990);  $m$  = marginal propensity to import.

The long-run import demand function for South Korea is

$$(9) \quad M = 0.1820 - 1.27P + 0.656Y.$$

The marginal propensity to import is obtained by differentiating  $M$  with respect to  $Y$ . Thus,

<sup>13</sup> As a further check, industrial production (1980 = 100) index was used. The results, available from the authors upon request, correspond in spirit to this conclusion.

$$(1/M)(dM/dY) = 0.656(1/Y)$$

$$m = dM/dY = 0.656(M/Y).$$

In 1985, in billions of won,  $M = 27,089$ ,  $Y = 54,674$ , and  $X = 26,347$ , therefore.

$$m = 0.656 (27089/54674) = 0.325$$

The Marshall-Lerner condition necessary and sufficient for successful devaluation is

$$(27,089/26,347)(1.27) + (2.14) = 3.45 > 1.325.$$

Thus, the ML condition is satisfied in Korea.

Thirlwall's law of economic growth is examined next. Thirlwall (1979, 1982, 1986) has argued that the long-run growth of real output is constrained by balance of payments and empirical confirmation is given by the rule

$$(10) \quad \dot{Y} = \dot{Y}^e = (1/\pi)\dot{X}$$

where  $\dot{Y}$  = the BOP constrained growth rate of domestic real income,  $\dot{Y}^e$ ;  $\pi$  is the income elasticity of imports, and  $\dot{X}$  is the rate of growth of export volume. Equation (10) suggests that  $\dot{Y}$  is determined by Harrod's foreign trade multiplier  $(1/\pi)$  and the rate of export growth,  $\dot{X}$ . Using  $\pi$  from equation (9) above,  $\dot{X} = 10.167$ ; and  $\dot{Y} = 14.46$  gives the equilibrium growth of real output  $(1/\pi)\dot{X}$  of 15.14. The results obtained support Thirlwall's approach. South Korea's real output growth from the Harrod formula are very close to the actual growth experience of South Korea. From a policy point of view, Korea has manipulated the Harrod foreign trade multiplier very well. One more point deserves mention. To our knowledge, there has not been any previous study confirming Thirlwall's theory for South Korea. Therefore, this is an important aspect of this study. Note that Thirlwall (1982), Bairam (1988), and other side not include South Korea in their samples.

## V. Conclusion

South Korea represents a small, open economy that has achieved significant economic growth over the last two decades. However, very little empirical work has been done to examine the import behavior of this

economy. In this paper, a modest attempt has been made to investigate empirically the import demand relationship in South Korea over the quarterly period 1973 through 1985. The preferred equation provides an adequate explanation of real import demand in the developing economy of South Korea.

Four main conclusions seem interesting. The first conclusion is that, given the low income elasticity, the country will continue to grow without a substantial increase in imports.<sup>14</sup>

The second conclusion is that the high price elasticity implies that demand for imports may come down if the real exchange rate is allowed to depreciate in order to reverse the real appreciation that took place during the last 1970s.

Third, the preferred import demand equation chosen here for South Korea is found to exhibit the following characteristics: absence of money illusion, serial noncorrelation, homoskedasticity, normality of residuals, zero disturbance mean (i.e., no specification errors), regressor-error term noncorrelation, absence of predictive failure, and absence of dynamic misspecification.

Finally, Thirlwall's economic growth rule and Marshall-Lerner's stability condition were found to be easily satisfied.

<sup>14</sup> As pointed by the anonymous referee, imports into Korea has increased very rapidly after 1985. This may also suggest that the change in the import composition played an important role in increasing the real income elasticity of imports.

**Appendix A**  
**SHORT-RUN IMPORT DEMAND REGRESSION RESULTS,**  
**1973-1980**

Independent Variables	Regression Equations			
	(A)	(B)	(C)	(D)
$\ln(P^m/P^d)$	-0.4945 (2.48)*	—	-0.3875 (3.30)*	—
$\ln P_t^m$	—	-0.6375 (3.37)*	—	-0.3513 (1.67)**
$\ln P_t^d$	—	0.9761 (3.76)*	—	-0.8688 (1.08)
$\ln Y_t$	0.1701 (3.81)*	0.0778 (0.97)	—	—
$\ln Y_t^*$	—	—	0.8215 (2.87)*	2.5881 (2.596)*
$\ln(Y/Y^*)_t$	—	—	0.2127 (0.66)	0.092 (0.292)
$\ln(M/P^m)_{t-1}$	0.6689 (6.51)*	0.3813 (2.62)**	0.2502 (1.53)**	-0.0160 (0.08)
Constant	0.3667 (1.44)**	0.2849 (1.222)	-0.388 (1.19)	-2.118 (2.14)*
$R^2$	0.9531	0.9612	0.9641	0.9672
SEE	0.1132	.1029	0.099	0.0947
Dh	-1.51	-1.17	-0.97	—

\* Significant at the 0.05 level.

\*\* Significant at the 0.10 level.

See notes in Table 1. Dh is the Durbin-h statistic and could not be calculated for Model. D.

**Appendix B**  
**IMPORT DEMAND EQUATION, 1973-1985**

Independent Variables	Regression Equations with Industrial Production as Regressor				
	A	B	C	D	E
$\ln(P^m/P^d)_t$	-0.3149 (1.75)*	—	-0.4969 (2.93)*	—	-0.4889
$\ln P^m$	—	-0.5277	—	-0.6193	—
$\ln P^d_t$	—	-0.8247 (3.84)*	—	0.8274 (3.81)*	—
$\ln X_t$	0.0859 (1.16)	0.1099 (1.65)*	—	—	—
$\ln X_t^*$	—	—	0.9801 (3.92)*	0.6802 (2.49)*	0.2586 (4.63)*
$\ln(X/X^*)_t$	—	—	0.8464 (3.41)*	0.5180 (1.87)*	-0.100 (1.28)
$\ln(M/P^m)_{t-1}$	0.8550 (12.01)*	0.4483 (3.45)*	0.5896 (6.31)*	0.3820 (2.99)*	0.5850 (6.98)*
Constant	0.1081 (0.48)	0.0689 (0.34)	-0.4618 (1.88)*	-0.3228 (1.33)**	-0.0216 (0.12)
$\bar{R}^2$	0.9210	.9369	0.9387	0.9438	.9442
SEE	0.1138	.1017	0.1002	0.0959	.0956
BG $\chi^2(8)$	29.23	28.03	14.90	18.00	13.01
BP $\chi^2(4)$	—	—	7.82	—	4.44
HPS $\chi^2(3)$	—	—	3.90	—	2.82

See notes in Table 1. BG = Breusch-Godfrey Statistic; BP = Breusch-Pagan Statistic and HPS = Hendry-Pagan-Sargan Statistic; X = Industrial Production (1980 = 100).

In Model E,  $X^*$  is derived from real GDP whereas  $X^*/X$  is derived from industrial production.

## References

- Akhtar, M.A., "Income and Price Elasticities of Imports in Industrial Countries," *Business Economics*, September 1980, 69-75.
- Alam, M.S., "The South Korean 'Miracle': Examining the Mix of Government and Markets," *The Journal of Developing Areas*, January 1989, 233-258.
- Arize, A., "An Econometric Investigation of Money Demand Behavior in Four Asian Developing Countries," *International Economic Journal*, Winter 1989.
- , "An Econometric Investigation of Export Behavior in Seven Asian Developing Countries," *Applied Economics*, July 1990, 891-904.
- , "The Supply and Demand for Imports and Exports in a Simultaneous Model," *Applied Economics*, September 1987, 1233-1247.
- Bahmani-Oskooee, M., "Determinants of International Trade Flows: The Case of Developing Countries," *Journal of Development Economics*, January-February 1986, 107-123.
- , "On the Effect of Effective Exchange Rates on Trade Flows," *Indian Journal of Economics*, July 1984, 57-67.
- Bairam, E., "Balance of Payments, the Harrod Foreign Trade Multiplier and Economic Growth: The European and North American Experience, 1970-85," *Applied Economics*, December 1988, 1635-1642.
- Boylan, T.A., M.P. Cuddy, and O'Muircheartaigh, "The Functional Form of the Aggregate Import Demand Equation: A Comparison of Three European Economies," *Journal of International Economics*, November 1980, 561-566.
- Dunlevy, J.A. and T.A. Deyak, "Seasonal, Cyclical and Secular Stability of Canadian Aggregate Demand for Merchandise Imports," *Applied Economics*, April 1989, 449-459.
- Engle, R.F., "A General Approach to LaGrange Multiplier Model Diagnostics," *Journal of Econometrics*, October 1982b, 83-104.
- , "Autoregressive Conditional Heteroscedasticity with Estimates of the Variance of the United Kingdom Inflation," *Econometrica*, June 1982, 982-1007.
- Fair, R.C., "International Evidence on the Demand for Money," *Review of Economics and Statistics*, August 1987, 473-480.
- Goldstein, G.M. and M.S. Khan, "Income and Price Effects in Foreign Trade," in R.W. Janes and P.B. Kenen (eds.), *Handbook of International Economics*, 11, Amsterdam: Elsevier Sciences Publishers B.V., 1985, 1041-1105.



- Gregory, R.G., "United States Imports and Internal Pressure of Demand: 1948-1968," *American Economic Review*, March 1971, 28-47.
- Gujarati, D.N., *Basic Econometrics*, Second Edition, New York: McGraw Hill, 1988.
- Hausman, J.A., "Specification Tests in Econometrics," *Econometrica*, November 1978, 1251-1270.
- Haynes, S. and J.A. Stone, "Secular and Cyclical Responses of U.S. Trade to Income: An Evaluation of Traditional Models," *Review of Economics and Statistics*, February 1983, 87-95.
- Hendry, D.F., "Predictive Failure and Econometric Modelling in Macroeconomics: The Transactions Demand for Money," in P. Ormerod (ed.), *Modelling the Macroeconomy*, London: Heinemann, 1980, 217-242.
- \_\_\_\_\_, and G.E. Mizon, "Serial Correlation as a Convenient Simplification, Not a Nuisance: A Comment on a Study of the Demand for Money by the Bank of England," *The Economic Journal*, September 1978, 549-563.
- Hendry, D.F., Pagan, A.R. and Saragan, "Dynamic Specification," in Z. Griliches and M.D. Intriligator (eds.), *Handbook of Econometrics*, Amsterdam: North Holland Publishing Co., 1984, 1023-1100.
- Johnston, J., *Econometric Methods*, Third Edition, New York: McGraw-Hill, 1984.
- Khan, M.S., "Imports and Export Demand in Developing Countries," *IMF Staff Papers*, November 1974, 678-693.
- \_\_\_\_\_, and K.Z. Ross, "Cyclical and Secular Income Elasticities of the Demand for Imports," *Review of Economics and Statistics*, August 1975, 357-361.
- Krämer, W., H. Sonnberger, J. Maurer and P. Havlik, "Diagnostic Checking in Practice," *Review of Economics and Statistics*, February 1985, 118-123.
- Kung, J.M. and J.E. Wong, "An Estimation of Import Demand, Export Supply and Technical Change for Korea," *Applied Economics*, December 1988, 1661-1674.
- Leamer, E.E. and R.M. Stern, *Quantitative International Economics*, Boston: Allyn and Bacon, 1970.
- Maddala, G.S., *Introduction to Econometrics*, New York: MacMillan Publishing Company, 1988.
- Melo, O. and M.G. Vogt, "Determinants of the Demand for Imports of Venezuela," *Journal of Development Economics*, April 1984, 351-358.
- Murray, T. and P. Ginman, "An Empirical Examination of the Traditional Aggregate Import Demand Model," *Review of Economics and Statistics*, February

- 1976, 75-80.
- Sargan, J.D., "The Estimation of Economic Relationships Using Instrumental Variables," *Econometrica*, July 1983, 1-30.
- Spanos, A., *Statistical Foundations of Econometric Modelling*, Cambridge University Press, Cambridge, 1986.
- Sundararajan, V., "Exchange Rate Versus Credit Policy: Analysis with a Monetary Model of Trade and Inflation in India," *Journal of Development Economics*, January-February 1986, 75-105.
- Thirlwall, A.P., "Balance of Payments Constrained Growth: A Reply to McGregor and Swales," *Applied Economics*, December 1986, 1259-1263.
- , "The Balance of Payments Constraint as an Explanation of International Growth Differences," *Banca Nazionale del Lavoro Quarterly Review*, March 1979, 45-53.
- , "The Harrod Trade Multiplier and the Importance of Export-Led Growth," *Pakistan Journal of Applied Economics*, March 1982.
- Thursby, J.G., "A Comparison of Several Specification Error Tests for a General Alternative," *International Economic Review*, February 1989, 217-229.
- and M. Thursby, "How Reliable are Simple Single Equation Specifications of Import Demand?" *Review of Economics and Statistics*, February 1984, 120-128.
- White, H., "A Heteroskedasticity-Consistent Covariance Matrix Estimator and a Direct Test for Heteroskedasticity," *Econometrica*, May 1980, 817-838.
- Yadav, G., "A Quarterly Model of the Canadian Demand for Imports 1956-72," *Canadian Journal of Economics*, August 1975, 410-422.