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A REEXAMINATION OF SOUTH KOREA'S AGGREGATE IMPORT DEMAND FUNCTION: THE BOUNDS TEST ANALYSIS

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This paper uses a robust estimation method referred to as the unrestricted error correction model - the bounds test analysis to re-analyze the long-term relationships between the demand for imports and it's determinants for South Korea over the period 1980-2000. Our results show that the volume of imports, income, and relative prices are all cointegrated. The estimated long-run (short-run) elasticities of import demand with respect to income and relative price are 1.86 (0.86) and -0.2 (-0.05), respectively. The major implication of our study is that neither monetary nor fiscal policies may be used as instruments to maintain the trade balance in South Korea's favor during this sample period.

Keywords: Aggregate Import Demand Function, UECM, Bounds Test Analysis
JEL classification: C22, C32, F14

1. INTRODUCTION

Over the past few decades, a vast amount of research has been devoted to studying the aggregate demand for imports in both developed and developing countries, with the income and price elasticities of the demand for imports being the most important empirical estimates used in international economics. Deriving such estimates is more than just an intellectual exercise, as it also has implications regarding the problem with unfavorable trade balances. For example, many multi-country studies have been performed, including Gafar (1988) for Trinidad and Tobago, Gafer (1994) for three Caribbean countries, Bahmani-Oskooee (1998) for six less developed countries, and Sinha (2001) for five Asian countries. Besides, there have also been many country-specific studies, such as Salas (1982) for the Mexico, Ariaze and Walker (1992) and Mah (1994) for Japan, Mah (1993, 1997) and Bahmani-Oskooee and Rhee (1997)

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for South Korea, Doroodian *et al*. (1994) for Saudi Arabia, Carone (1996) for the United States, Abbott and Seddighi (1996) for the UK, Sinha (1997) and Arize *et al*. (2000) for Thailand, Milas (1998) for Greece, Dutta and Ahmed (1999) for Bangladesh, Raijal *et al*. (2000) for Nepal, and Mohammad and Tang (2000) for Malaysia.

Nevertheless, there have been some drawbacks with the previous studies. Some studies used standard ordinary least squares (OLS) regression models and partial adjustment approaches to estimate the import demand function. These studies assume that there exists an underlying equilibrium relationship between the volume of imports and the explanatory variables in the model. As shown by Granger and Newbold (1974), an unsatisfied stationary assumption as a result of using the OLS method may lead to spurious regressions and unreliable statistical inferences. Other studies estimate the long-term elasticities of import demand using the Johansen (1988) multivariate cointegration method. Kermers *et al*. (1992) have shown that, for small-scale data, no cointegration relation can be found among variables that are integrated of order one, or I(1). Mah (2000) also states that the error correction model (ECM) and the Johansen (1988) method are not reliable in studies that have small sample sizes; such as in the previous studies. Finally, the conventional ADF test (like many other unit root tests) suffers from its poor size and power properties (Harris (1995)).

The major objective of this study is to re-estimate the aggregate import demand function for South Korea over the period from 1980 to 2000 by using a more robust and recently-developed estimation method - the bounds test - proposed by Pesaran *et al*. (2001), and based on the unrestricted error correction model (UECM). According to Mah (2000), the Pesaran, *et al*. approach has two main advantages over the common practices of coinetgration analysis as exemplified by Engle-Granger (1987) and Johansen-Juselius (1990). First, the bounds test procedure can be applied irrespective of whether the explanatory variables are I(0) or I(1). Second, the methodology can be applied to studies with samples that are small in scale, as is the case in the present study.

South Korea provides an interesting venue for research for several reasons. First of all, South Korea has made remarkable economic progress over the last several decades with an annual average economic growth rate of 5.7% over the past decade (1990-2000) and a per capita GDP of US$9,821 in 2000.[1] Secondly, South Korea has become the world's twelfth largest trading country with foreign exchange reserves estimated to be $US95.9 billion at the end of the year 2000. Lastly, South Korea liberalized its economic institutions in the early 1980s, thus providing researchers with sufficient data to evaluate the phenomenal effect of economic liberalization on the economy.

[1] More than five years have passed since the Asian financial turmoil erupted on July 2, 1997 and ended in the third Quarter of 1999. South Korea has since gained a good momentum in its economic recovery and its economic growth rate has strongly recovered to in excess of 10% in 1999 and 9% in 2000.

The remainder of this paper is organized as follows. Section two presents the data used. Section three describes the study's methodology and discusses the empirical findings, and finally Section four concludes.

2. DATA

Our empirical uses annual data on real GDP (1995=100), the GDP deflator, import prices, and import volumes for South Korea over the period from 1980 to 2000.[2] All of the data used in this study are taken from IMF's International Financial Statistics, and all the data series are transformed into their logarithmic form in order to achieve stationary in variance.

3. METHODOLOGY AND EMPIRICAL RESULTS

The import demand function can be estimated by using the relative and absolute price versions that follow most of the studies and estimations.[3] The import demand function can be expressed by the following equation:

$$Md = F(Y, Pm/Pd) \qquad f_1 > 0,\ f_2 < 0\,. \tag{1}$$

The variables are as follows; the desired quantity of imports demanded (Md), the domestic income (Y is usually expressed as real GDP), the price of imports (Pm is usually an import unit value index), and domestic prices (Pd is the domestic wholesale price index, the retail price index, or the GDP deflator). In order to fit Equation (1) econometrically, a particular functional form must be used. Two of the most common ones used in the literature are the linear and log-log formulations. Recent studies by Doroodian *et al*. (1994), Sinha (1997), and Raijal *et al*. (2000) have used the Box and Cox (1964) procedure and have shown that log-log specifications are more preferable compared to the linear specification. Accordingly, it is postulated that the aggregate demand for imports takes the following form:[4]

[2] Since major import liberalization measures started to be implemented in the early 1980s, therefore, our sample period is chosen to cover the period from 1980 to 2000.

[3] One of the properties of the theory for demand is that standard demand functions are homogeneous of degree zero in prices and income, by which is implied the absence of money illusion. Accordingly, this suggests that the demand for imports can be expressed in terms of real income and relative prices, which is the formulation used in most empirical studies. Based on the Wald test result, we find the null of no money illusion cannot be rejected in our study therefore we use the relative price version.

[4] Based on the results of the Box and Cox (1964) procedure, we also find that the log-log specification is

$$\ln Md_t = a + b\ln Y_t + c\ln(Pm_t / Pd_t) + u_t, \tag{2}$$

where ln is a natural logarithm, and u is an error term that is assumed to be randomly and normally distributed. The estimated coefficients b and c are the estimated income and price elasticities of the demand for imports, respectively. Finally, the usual procedure is to assume that $b > 0$ and $c < 0$.

Since our study has a very small sample size (21 observations), the cointegration relationship for the import demand function is estimated using the recently-developed econometric techniques of the bounds test that was proposed by Pesaran *et al*. (2001), and which is based on the following unrestricted error correction model (UECM):

$$\begin{aligned} d\ln Md_t = {} & a_0 + \sum_{i=0}^{n} a_{1i} d\ln Y_{t-i} + \sum_{i=0}^{n} a_{2i} d\ln P_{t-i} \\ & + \sum_{i=1}^{n} a_{3i} d\ln Md_{t-i} + a_4 \ln Y_{t-1} + a_5 \ln P_{t-1} + a_6 \ln Md_{t-1} + e_t, \end{aligned} \tag{3}$$

where $d\ln Md_t$, $d\ln Y_t$, and $d\ln P_t$ $(P_t = Pm_t / Pd_t)$ are the first differences of the logarithms of the quantity of imports demanded ($\ln Md_t$), real GDP ($\ln Y_t$), and relative prices (Pm_t / Pd_t), respectively. Following Pesaran el al. (2001), the test is conducted in the following way. The null hypothesis is tested by considering the UECM for the import demand function in Equation (3). By excluding the lagged variables lnMd, lnY and lnP, the hypothesis is also based on the Wald or F-statistic. The asymptotic distribution of the F-statistic is non-standard under the null hypothesis, which means that there is no cointegration relationship between the examined variables, irrespective of whether the underlying explanatory variables are purely I(0) or I(1). More formally, we perform a joint significance test, where the null and alternative hypotheses are:

$$H_0 : a_4 = a_5 = a_6 = 0$$
$$H_a : a_4 \neq 0, a_5 \neq 0, a_6 \neq 0.$$

For a given significance level of α, if the F-statistic falls outside the critical bound, a conclusive inference can be made without considering the order of integration of the underlying regressors. For instance, if the F-statistic is higher (lower) than the upper (lower) critical bound, then the null hypothesis of no cointegration is rejected (accepted). In cases where the F-statistic falls inside the upper and lower bounds, a conclusive inference cannot be made. Here, the order of integration for the underlying

the most preferred in our study.

explanatory variables must be known before any conclusion can be drawn. Through the estimated UECM, the long-run elasticities are the coefficients of the explanatory variables lagged one period (multiplied by a negative sign) divided by the coefficient of the dependent variable also lagged one period (see Bardsen (1989)). Thus, the long-run income elasticity and relative price elasticity are $-(a_4/a_6)$ and $-(a_5/a_6)$, respectively, and the short-run effects are captured by the coefficients of the first differenced variables in Equation (3).

The bounds test results are reported in Table 1.[5] The computed F-statistic - 8.5275 is found to exceed the upper bounds critical value of 5.73 for a significance level of 5%. This result indicates that the volume of imports and its determinants, namely, domestic income and relative prices, are cointegrated. Table 2 gives the estimates of the import demand functions. It is found that the price elasticity of import demand is inelastic and has an absolute value of about 0.2 in the long run (0.05 in the short run).

Table 1. Bounds Testing for Cointegration Analysis

Computed F-statistic：8.527513 (lag structure, k=1)
Critical bound's value at 5% -Lower：4.94 and Upper：5.73
(Two regressors and no trends in the model)
Pesaran, *et al*. (2001), p.300, Table C1.iii: Case III.

Heien (1968) argues in relation to the effectiveness of devaluation, "for any country a value of the price elasticity between -0.5 and -1.0 is necessary to ensure success of exchange depreciation." Apparently, our results regarding the estimated price elasticity are not in the range suggested by Heien (1968), who suggested that exchange rate policies could not be used to correct the balance of payments disequilibrium in South Korea during this sample period. Based on this estimate, the import volume appears to be insensitive to increases in relative price levels. This shows that any increase in the domestic inflation rate will not trigger a higher volume of imports. Here, fiscal or monetary policies may not be used as policy instruments to keep inflation at a reasonable rate so as to rectify any trade imbalances. The estimated long-run income elasticity of import demand is positive and significant - about 1.82 (0.86 in the short run), meaning that a 1 percent increase in income will lead to a 1.82 (0.86) percent increase in imports. This implies that economic growth will have a negative impact on the trade balance of South Korea.

[5] The lag length, k=1 was selected based on the Schwartz criterion (SC).

To overcome this, South Korea's government policies should be set to encourage the development of more local industries with low import content, especially resource-based industries (see Tang and Nair (2002)).

It is interesting to see how the estimates obtained in this study compare with other published elasticity estimates for South Korea. Our results are remarkably close to those of Bahmani-Oskooee and Rhee (1997), insofar as income effects are concerned. Our income elasticity, however, is higher when compared to the income estimates reported by Mah (1993, 1997) and Bahmani-Oskooee and Rhee (1997). In terms of price elasticity, our price elasticity is only consistent with the price elasticities reported by Bahmani-OsKooee and Rhee (1997), but is not consistent with the price elasticity of Mah (1993). We believe our empirical results are more reliable due to the use of more advanced econometric techniques.

Table 2. The Estimated UECM for the Korean Import Demand Function

Variable	Coefficients	t-statistics
$\ln M_{t-1}$	-0.34131	-1.71107
$\ln Y_{t-1}$	0.635768	2.932983**
$\ln P_{t-1}$	-0.06957	-0.24627
$\Delta \ln M_{t-1}$	0.277154	0.972418
$\Delta \ln Y_t$	0.779035	5.914154**
$\Delta \ln Y_{t-1}$	0.080524	0.060218
$\Delta \ln P_t$	-0.15844	-0.50579
$\Delta \ln P_{t-1}$	0.105227	0.362367
Constant	0.887145	0.588535

Notes：Significant at the *** 1% ** 5% * 10% levels

Dependent variable: $\Delta \ln M_t$

Sample: 1980-2000, Included Observations：21, R-squared: 0.945594

Jarque-Bera:0.7433, RESET: 1.666

ARCH Test(1): 0.048901, (2): 0.054459

L-BQ(1): 0.2459, (2)：0.5084

F-statistic：21.72544 (Prob.: 0.000023)

Table 2 also presents diagnostic tests of our model and suggests an absence of major diagnostic problems such as serial correlation, ARCH effects, non-normality and specification errors. These results indicate that our estimated import demand model is well specified.

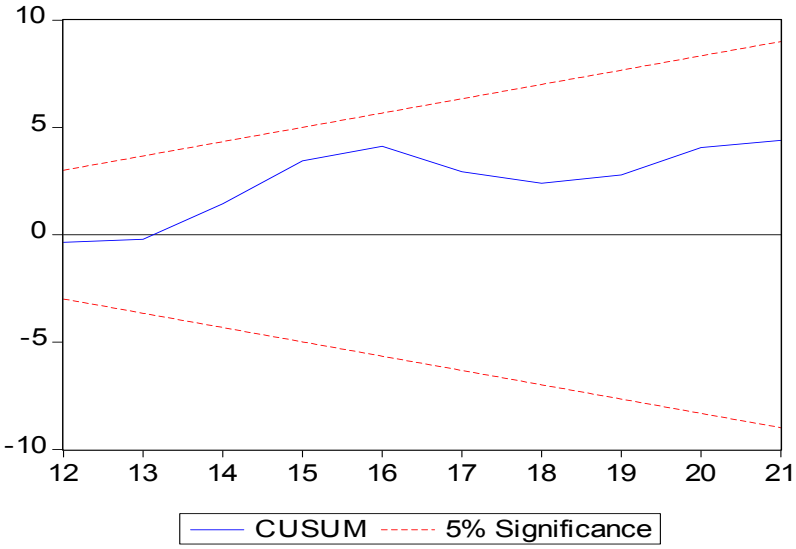

Figure 1. Plots of CUSUM for UECM

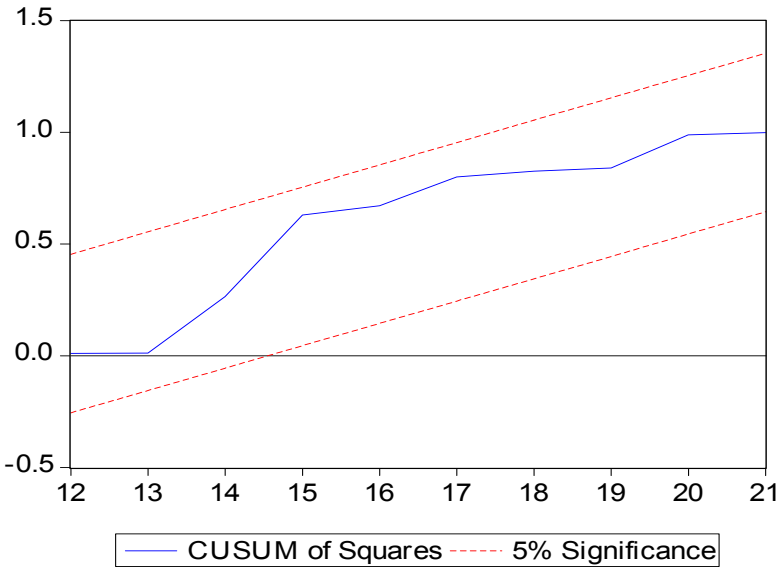

Figure 2. Plots of CUSUM of Squares for UECM

Since the stability of the import demand function is vital for an effective trade policy, testing whether the estimated import demand equation has shifted over time is an important part of our empirical studies. As we can see from Figures 1 and 2, the CUSUM and CUSUM Square tests[6] of parameter stability indicate that the parameters are stable during the sample period. This finding is also confirmed by the use of the Farely-Hinich test (for the details see Farely *et al*. (1975)).[7]

4. CONCLUSIONS

In this study we empirically re-analyze the aggregate import demand function for South Korea, using the recently - developed UECM - Bounds test proposed by Pesaran *et al*. (2001), over the period from 1980 to 2000. Our empirical results show that import volume, domestic income and relative price are cointegrated. The estimated long-run (short-run) elasticities of import demand with respect to income and relative prices are 1.86 (0.86) and -0.2 (-0.05), respectively. The major implication of all this for our study is that monetary or fiscal policies may not be used as instruments to maintain a favorable trade balance for South Korea during this sample period. In our opinion, the South Korean government should encourage the development of more local industries with low import content, especially resource-based industries.

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[6] The CUSUM test detects systematic changes in the regression coefficients, while the CUSUM Square test is particularly useful in capturing sudden departures from the constancy of regression coefficients.

[7] Since our sample size is small and the suspected shift in our import demand function does not occur near the middle of the sample, using the Farely-Hinich test may be more appropriate than the Chow test. Therefore, the Farely-Hinich test is also performed in our study.

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