AN ECONOMETRIC ESTIMATION OF TRADITIONAL IMPORT DEMAND FUNCTION FOR PAKISTAN

HAFEEZ UR REHMAN*

Abstract. Many studies have estimated the aggregate import demand function for Pakistan by using non-stationary data.[1] Their findings suffer from the so-called 'spurious regression' problem. This study attempts to estimate the aggregate import demand function for Pakistan by employing Johansen and Juselius cointegration technique on the annual data for the period 1975-2005. Our results show that there is long-run equilibrium relationship among variables and the stability tests indicate that import demand function remains stable over the sample period and hence the estimated results are appropriate for policy implications.

I. INTRODUCTION

In recent years, because of the popularity of globalization, the interdependence among countries at world level has increased. Every country wants to achieve rapid pace of economic development through getting the maximum benefits from international trade and use of modern techniques in the production process. The implementation of WTO rules and substantial reduction in trade restrictions, the imports of most of developing countries are rising rapidly. The economy of Pakistan is not an exception as it depends on the rest of the world and this degree of interdependence has increased in the past few years. The value of imports as a percentage of GDP has shown upward trend which has increased from 13.3 percent in 1999-2000 to 19.4 percent in 2005-06. This increase in imports is mainly due to strong growth momentum that Pakistan economy has experienced during the last half decade. The domestic demand has increased substantially during this period which is the major cause of increased investment demand in the economy. The

*The author is Associate Professor and Chairman of Department of Economics, University of the Punjab, Lahore-54590 (Pakistan).

[1]For example, Sarmad (1989), Afzal (2001), etc.

imports demand has increased due to high demand of machinery and raw material. Therefore, the share of machinery in total imports has increased from 13.9 percent in 1999-2000 to 18 percent in 2005-06. The increase in imports demand has further worsened the position of Pakistan's trade balance. The deficit in trade balance has almost doubled from Rs. 4,352 million in 2004-05 to Rs. 8,259 million in 2005-06. As percentage of GDP, trade deficit has increased from 2.1 percent in 1999-2000 to 6.6 percent in 2005-06. The effectiveness of Pakistan's trade policy has slowed down the pace of import growth and has declined to 2.1 percent in 2006-07 (US $ 28.6 billion to US $ 28 billion). This reduction in import growth is mainly due to tight monetary policy to shave off the excess demand, decline in import of fertilizer etc. The effectiveness of any country's international trade policy in relation to its balance of payments and development mostly depends on the magnitude of income and price elasticities of its export and imports. Thus, the empirical work on this issue has great importance for policy makers who formulate trade policies. This study is an attempt to estimate the income and price elasticities for Pakistan by using annual data for the period 1975-2005.

In section II, a brief background of the Pakistan's imports is presented. Section III gives important features of traditional import demand function and model speci-fication for this study. The empirical results of the study are presented in section IV and in section V, conclusion and policy implication are drawn from the study.

II. BACKGROUND

The importance of foreign sector has increased with the globalization of the world in recent years. The countries having higher degree of involvement in the global economy through trade and investment improved their economies significantly and reduced the level of poverty. The Pakistan's trade has also played a very crucial role in the development of its economy. Pakistan's trade as percentage of GDP has an upward trend since 1999-2000 except 2001-02[2] as shown in the Figure 1.

Like other developing countries, Pakistan has tried to achieve the benefits from growth of world economy. Pakistan has experienced an average growth of almost 16 percent in exports and 29 percent in import over the last four years. This rise in exports was mainly due to the rapid improvement in the trading environment at international level. This healthier trade environment was the product of most striving and victorious round of multilateral trade negotiation in Uruguay under the umbrella of General Agreement on Tariffs and Trade (GATT). The rise in domestic demand due to strong economic growth increased the level of investment which ultimately increased the country's import demand. Pakistan's total imports distribution shows that the shares of Petroleum group and raw materials are almost same (22.3% and 22.7% respectively). The major categories of Pakistan's imports are shown in Table 1.

---

[2]Government of Pakistan, *Economic Survey*.

FIGURE 1

Trade as Percentage of GDP

TABLE 1

Pakistan's Major Imports

(*Percentage Share*)

Commodities	1999-2000	2000-2001	2001-2002	2002-2003	2003-2004	2004-2005	2005-2006	2006-2007□
Machinery*	13.9	19.3	17.1	18.5	17.8	22.5	18.0	22.5
Petroleum Group	27.2	31.3	27.1	25.11	20.3	19.4	22.3	22.5
Chemicals**	17.5	20.0	15.9	15.1	16.1	15.5	13.4	12.7
Transport Equipments	5.5	4.0	4.8	5.6	5.6	6.2	7.7	8.0
Foodstuff	6.0	5.0	5.3	6.2	5.4	4.8	3.6	3.6
Iron & Steel	3.0	2.6	3.3	3.3	3.3	4.3	5.1	5.0
Fertilizers	1.9	1.6	1.7	2.1	1.8	2.0	2.4	1.2
Others	25.0	16.2	24.8	24.1	29.7	25.3	27.5	24.5
Total	100	100	100	100	100	100	100	100

Source: Government of Pakistan, *Economic Survey*, 2006-07.

*Excluding Transport Equipments, **Excluding Fertilizers, □July-March (Provisional).

These seven categories accounted for 75 percent of total imports during the year of 1999-2000 which reduced to 72.5 percent in 2005-06 but again increased to 75.5 percent for the first nine month of current fiscal year. The share of machinery, transport equipments, iron and steel and fertilizer has increased by 29 percent, 40 percent, 70 percent and 26 percent respectively in total imports during the period of 1999-2000 to 2005-06. The share of remaining three categories: petroleum group, chemicals and foodstuff has reduced by 18 percent, 23 percent and 40 percent respectively during the same period. The level of imports has increased by the rise in share of four categories to 41.25 percent and decrease in imports due to reduction in share of three categories to 27 percent. Therefore, the net increase in total imports was only 14.25 percent.

III. LITERATURE REVIEW

It is essential for policy makers to understand that how imports react to changing economic conditions for the effective implementation of trade policies. It is generally believed that imports react more rapidly than exports to trade liberalization. Therefore, it is necessary to predict imports demand more accurately to achieve the maximum benefits from the growing world economy. Various researchers tried to estimate the import demand function for different countries for policy purposes. Islam and Hassan (2004) estimated the aggregate import demand function for Bangladesh using quarterly time series data. They applied the Johansen and Juselius multivariate cointegration technique. Their results indicate that import demand function is mainly determined by income and relative prices. The income elasticity was positive and greater than unity showing that imports are 'luxury' goods. The coefficient of relative prices is negative but less than unity; means Bangladesh imports are not much sensitive to prices.

Bahamani and Kara (2003) estimated the import and export demand function for nine industrial countries like Australia, Canada, Denmark, US and etc. by using quarterly data for the period 1973-98. They used ARDL approach for estimation. Their results show that long-run income elasticities are greater in import demand function than in the export demand function. The price elasticities were smaller than unity, indicating that import and export demand functions are relatively inelastic. They fail to provide any specific answer to the policy question that which policy has the quickest impact on trade. According to them, trade flows of different countries do react differently.[3]

Sarmad (1989) estimated the import demand function for Pakistan for the period 1959-60 to 1985-86 at both aggregate and disaggregate level. His results show that there is strong evidence to support the use of log linear form as the appropriate functional form of import equation, both at the aggregate and disaggregate levels. The estimated price and income elasticities appear to be

---

[3]For detail, see Bahamani and Kara (2003).

different from similar estimates of developed countries and for middle-income countries.

Afzal (2001) estimated the import demand function for Pakistan using annual data for the period 1960-99. He used OLS and TSLS techniques for estimation. His results show that the signs of the price coefficient and income coefficient were as expected but price coefficient was insignificant. He concluded that the liberalization policy does have positive impact on the import demand. Shabbir and Mahmood (1991) analyzed the stability of the import demand function for Pakistan. They applied the maximum likelihood-based switching regression technique to examine the timing and nature of the structural change. Their conclusion was that both income and price elasticities were altered during end 1971-beginnig 1972.

The study by Afzal (2001) and Sarmad (1989) suffer from methodological problem in that they used non-stationary data in estimating import demand function for Pakistan. This means their findings suffer from the so-called spurious regression problem. The present study is an attempt to estimate the aggregate import demand function for Pakistan, using annual data for the period 1975-2005, employing error correction model and conintegration techniques that provide more accurate and reliable estimates.[4]

IV. MODEL SPECIFICATION AND EMPIRICAL RESULTS

Following Doroodian *et al.* (1994) the following import demand model for Pakistan is estimated.

$$\ln M_t = \phi_0 + \phi_1 \ln Y_t + \phi_2 \ln P_{mt} + \phi_3 \ln P_{dt} + \phi_4 \ln M_{t-1} + u_t \qquad \text{(A)}$$

$\ln M$ = log of volume of imports

$\ln Y$ = log of real income

$\ln P_m$ = log of import prices

$\ln P_d$ = log of domestic prices

The log-linear form is considered most appropriate by various empirical studies.[5] This functional form gives elasticity coefficients directly. Moreover, log-linear form reduces the problem of heteroscedasticity in an empirical analysis. Therefore, empirical results estimated by this model are appropriate for policy implication.

This study uses Johansen and Juselius (1990) multivariate cointegration technique to examine the long-run equilibrium relationship. For cointegration tests, it is necessary that all data series must have same integrating order. We applied the

---

[4]All data series are collected from International Financial Statistics (IFS) CD ROM.

[5]For more detail, see Khan and Ross (1977) and Boylan *et al.* (1980).

Augmented-Dickey Fuller (ADF) and Phillips-Parren (PP) tests to determine the order of integration.[6] The results are presented in Table 2.

TABLE 2

Unit Root Tests Results

Variables	ADF		PP	
	Level	1st Diff.	Level	1st Diff.
Imports	−2.563792	−5.058116*	−2.532054	−5.091492*
Real Income	−3.278836	−5.301758*	−3.324544	−6.479923*
Domestic Prices	−1.434978	−3.553260**	−1.051940	−4.114939*
Import Prices	1.707775	−4.941590	2.253155	−6.821448*

* and ** shows the level of significance at 1% and 5% respectively.

In Augmented-Dickey Fuller test, we use the Schwarz Information Criterion, Akaike Information Criterion and Hannan-Quinn Criterion for the selection of optimal lag length. But in Phillips-Parren we use the Bartlett Kernel, Parzer Kernel and Quadratic Spectral Kernel in special estimation method and for optimum bandwidth; we use the Newey-West Bandwidth and Andrews Bandwidth. All results indicate that almost all data series are having unit root at level form but not at first difference. This means all series are non-stationary at level but stationary at first difference.

The Johansen and Juselius multivariate trace and maximal eigen value cointegration test (1990) is applied to the variables of equation (A) and results are presented in Table 3.

Both trace and eigenvalue tests give the same results; means the null hypothesis of no cointegration is rejected for $r = 0$ for both trace and eigenvalue tests at 5% level of significance. This implies that there is one cointegrating vector. Therefore, we conclude that although the individual data series are non-stationary but their linear combination is stationary, so the level estimates are appropriate for policy implications.[7] We apply the Error Correction Model to estimate the short-run

---

[6]Visual analysis of the series shows that all data series are non-stationary at level form. It also shows that all data series have intercept and trend.

[7]For detail, see Engle and Granger (1987).

as well as long-run elasticities. The adjustment coefficient is negative and significant (–0.50); suggests that 50% adjustment in total import demand towards equilibrium path occur in each period for the sample used in this study.

TABLE 3

Multivariate Cointegration Results

Test	Null Hypothesis	Cointegration Test Statistics	Critical Value
Trace Test	H_0: $r = 0$	95.74819*	47.85613
	H_0: $r \leq 1$	24.45916	29.79707
	H_0: $r \leq 2$	5.573078	15.49471
	H_0: $r \leq 3$	0.291587	3.841466
Maximal-eigenvalue Test	H_0: $r = 0$	71.28903*	27.58434
	H_0: $r \leq 1$	18.88608	21.13162
	H_0: $r \leq 2$	5.281491	14.26460
	H_0: $r \leq 3$	0.291587	3.841466

*denotes rejection of the hypothesis at the 0.05 level of significance.

The estimated coefficients show that elasticities of import demand with respect to that variable. The elasticities estimated by ECM are presented in Table 4.

TABLE 4

Short-run and Long-run Elasticities

| Variables	Short-run elasticity	Long-run elasticity
Real Income	0.2631 (0.6324)	0.0.6947 (2.6645)*
Domestic Price Level	–0.2905 (–0.6281)	–0.3602 (–1.3271)
Import Prices	–0.1661 (–0.6832)	–0.5043 (–2.0507)*

*denotes rejection of the hypothesis at the 0.01 level of significance.

The results shown in Table 4 indicate that only income and import price elasticities in the long run are significant. The sign of real income elasticity coefficient is positive that indicates an increase in income leads to increase in imports in long run and *vice versa*. The inelastic long-run income elasticity implies that imports are regarded as necessary good in Pakistan. Similarly the sign of import prices show a negative relationship between import prices and level of imports in the long run. But in short run the level of imports is not affected by the level of real income, domestic price level and import prices. The coefficients also indicate that the imports are less elastic with respect to income and import prices in the long run. In regression analysis, the stability of coefficients is considered to be essential for policy purposes. Therefore, the stability tests are performed.

V. STABILITY TESTS

The stability of import demand function is very important for the effectiveness of trade policy. In stability test, we see whether the estimated import demand function has shifted or not over the time period included in the sample of the study. We have applied CUSUM and CUSUM of Squares (Brown, Durbin and Evans, 1975) Tests and Recursive coefficients to check the stability of the import demand function. The CUSUM test (Brown, Durbin and Evans, 1975) is based on the cumulative sum of the recursive residuals.
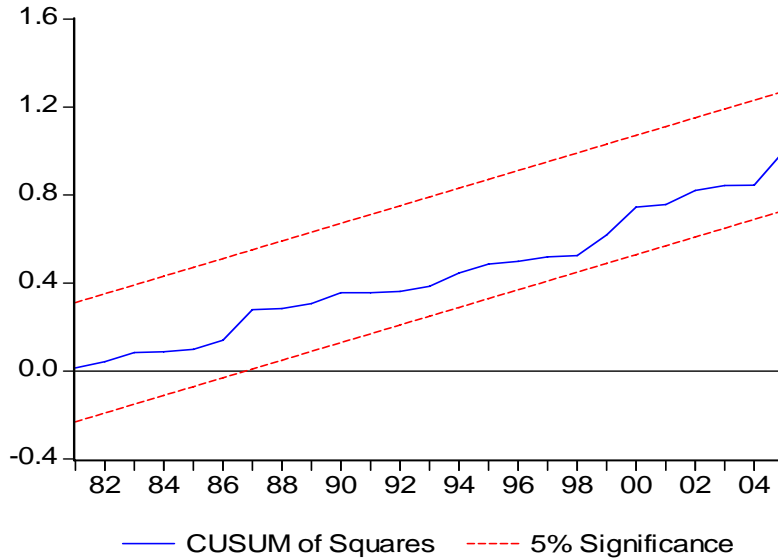
FIGURE 3
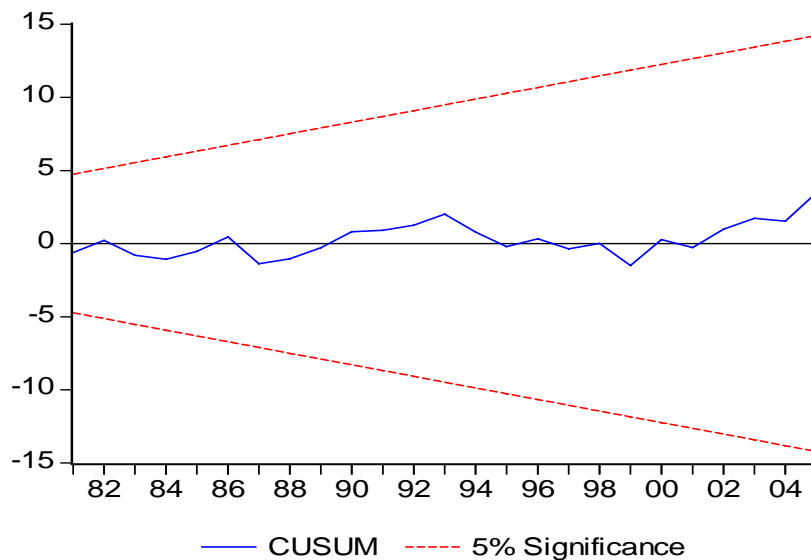
Figure 3 shows that import demand function is stable during the sample period because the cumulative sum does not go outside the area between two critical lines. The CUSUM of Squares Test (Brown, Durbin and Evans, 1975) is based on the test statistic.[8] Like CUSUM test, the diagram indicates that residual variance is stable over the sample period because cumulative sum of squares line does not go outside the 5% critical lines. The Recursive Coefficient test enables us to trace the evolution of estimates for any coefficient as more and more of the sample data are used in the estimation. In this test two standard error bands are plotted around the estimated coefficients. If the coefficient displays significant variation as more data is added to the estimating equation, it is a strong indication of instability. The following diagrams (Figure 3) show that all estimated coefficients are lying within the bands, so all coefficients estimated in the imports demand function are stable.

VI. CONCLUSION AND POLICY IMPLICATIONS

Following Doroodian *et al.* (1994), the import demand function for Pakistan is estimated. By employing Johansen and Juselius cointegration test, the long-run equilibrium relationship among variables is observed using annual data for the period 1975-2005. For estimating the short-run and long-run elasticities, the Error Correction Model is estimated. Furthermore, various stability tests are employed to observe the impact of various changes on the stability of import demand function of Pakistan.

---

[8]For a table of significance lines for the CUSUM of squares test, see Brown, Durbin and Evans (1975) or Johnston and DiNardo (1997).

FIGURE 4
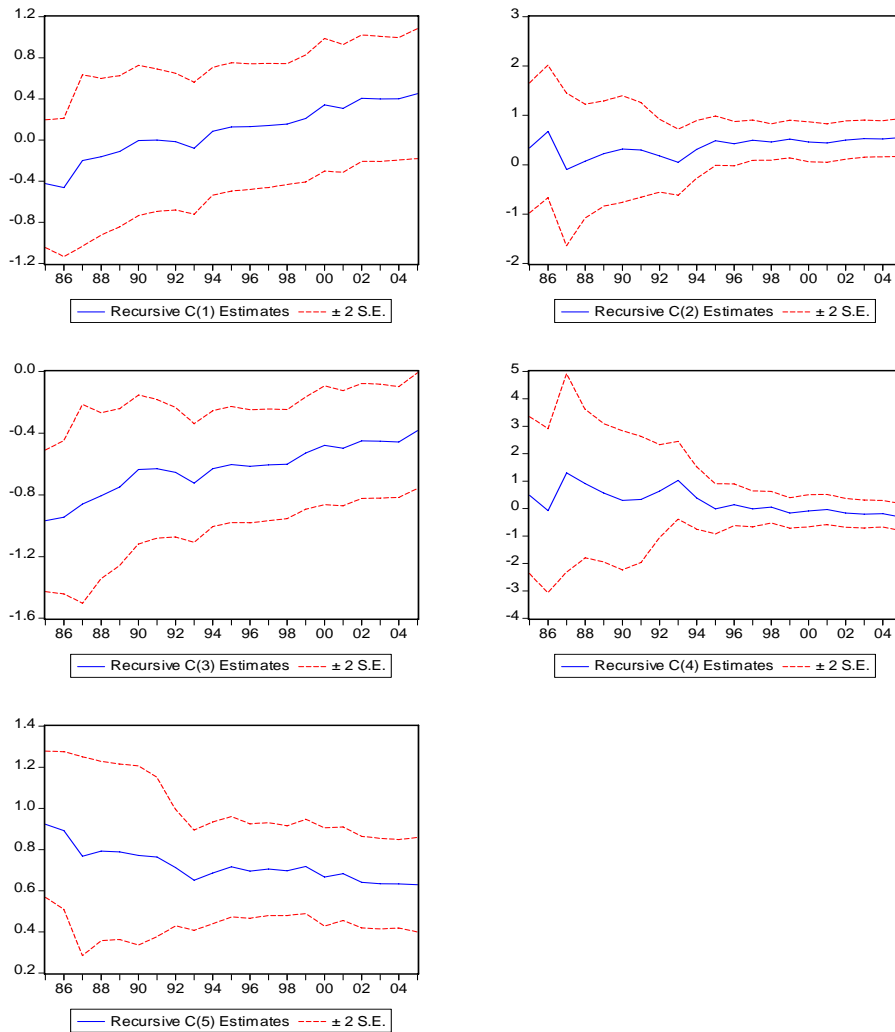
The estimated results show that there is long-run equilibrium relationship among variables. The results of stability tests predict that the import demand functions remain stable during the sample period so the results are appropriate for policy implications. The estimated elasticities indicate that changes in real income and import prices significantly affect the import demand in the long run. But variations in domestic price level and import price level do not affect significantly the imports demand in the short run. The inelastic long-run income elasticity implies that imports are regarded as necessary goods in Pakistan.

REFERENCES

Afzal, M. (2001), Import function for Pakistan: A simultaneous equation approach. *The Lahore Journal of Economics*, Volume 6(2), pp. 109-116.

Arize, A. and R. Afifi (1987), An econometric examination of import demand function in thirty developing countries. *Journal of Post Keynesian Economics*, Volume 9, pp. 604-616.

Bahmani-Oskooee, M. (1986), Determinants of international trade flows: Case of developing countries. *Journal of Development Economics*, Volume 20(1), pp. 107-123.

Bahmani-Oskooee, M. (1998), Cointegration approach to estimate the long-run trade elasticities in LDCs. *International Economic Journal*, Volume 12(3), pp. 89-96.

Bahmani-Oskooee, M. and F. Niroomand (1998), Long-run price elasticities and the Marshall-Lerner condition revisited. *Economics Letters*, Volume 61, pp. 101-109.

Bahmani-Oskooee, M. and O. Kara (2003), Relative responsiveness of trade flows to a change in price and exchange rate. *International Review of Applied Economics*, Volume 17, No. 3, pp. 293-308.

Boylan, T. A., M. P. Cuddy and I. O. Muircheartaigh (1980), The functional form of the aggregate import demand equation. *Journal of International Economics*, Volume 56, pp. 1-66.

Brown, R. L., J. Durbin and J. M. Evans (1975), Techniques for testing the constancy of regression relationships over time. *Journal of the Royal Statistical Society*, Volume 37, pp. 149-163.

Dickey, D. A. and W. A. Fuller (1979), Distribution of the estimators for autoregressive time series with a unit root. *Journal of the American Statistical Association*, Volume 74, pp. 427-431.

Doroodian, Khosrow, Rajindar K. Koshal and Saleh Al-Muhanna (1994), An examination of the traditional aggregate import demand function for Saudi Arabia. *Applied Economics*, pp. 909-915.

Durbin, James (1970), Testing for serial correlation in least squares regression when some of the regressors are lagged dependent variable. *Econometrica*, pp. 410-421.

Dutta, D. and N. Ahmed (1999), An aggregate import demand function of Bangladesh: A cointegration approach. *Applied Economics*, Volume 31, pp. 465-472.

Gafar, J. S. (1988), The determinants of import demand in Trinidad and Tobago: 1967-1984. *Applied Economics*, Volume 20, pp. 303-313.

Government of Pakistan, *Economic Survey* (Various issues). Islamabad: Ministry of Finance.

International Monetary Fund, *International Financial Statistics*, CD-ROM, Washington DC: IMF.

Islam, M. Anisul and Kabir Hassan (2004), An econometric estimation of the aggregate import demand function for Bangladesh: Some further results. *Applied Economic letters*, Volume 11, pp. 575-580.

Johansen, S. and K. Juselius (1990), Maximum likelihood estimation and inference on cointegration with applications to the demand for money. *Oxford Bulletin of Economics and Statistics*, Volume 52(2), pp. 169-210.

Koshal, Rajindar K., Khosrow Doroodian and Ashok Chaluvadi (1993), The behaviour of demand and supply of Thai imports. *Journal of Asian Economics*, pp. 363-375.

Mohammad, H. A., T. C. Tang and J. Othman (2001), Aggregate import demand and expenditure components in five ASEAN countries: An empirical study. *Journal Ekonomi Malaysia*, Volume 35, pp. 37-60.

Sarmad, Khwaja (1989), The determinants of import demand in Pakistan. *World Development*, Volume 17(10), pp. 1619-1625.

Shabbir, T. and R. Mahmood (1991), Structural change in the import demand function for Pakistan. *The Pakistan Development Review*, Volume 30, pp. 1159-66.

Sinha, Dipendra (1996), An aggregate import demand function for India. *Rivistu Internazion & di Scienze Economiche e Commerciali*, pp. 163-173.

Sinha, D. (1997), Determinants of import demand in Thailand. *International Economic Journal*, Volume 11(4), pp. 73-83.

Sinha, D. (2001), A note on trade elasticities in Asian countries. *International Trade Journal*, Volume 15(2), pp. 221-237.