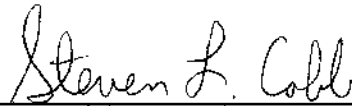


PRICE ELASTICITY, J - CURVE, AND THE BALANCE OF TRADE:
AN ECONOMETRIC STUDY OF BANGLADESH

Mehboob U. Ahmed, BBA.

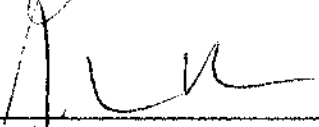
APPROVED:



Major Professor



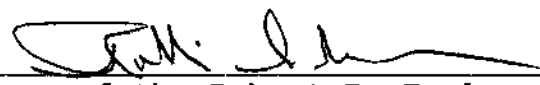
Minor Professor



Committee Member



Chair of the Department of Economics



Dean of the Robert B. Toulouse School of
Graduate Studies

Ahmed, Mehboob U., Price Elasticity, J-Curve, and the Balance of Trade: An Econometric Study of Bangladesh.

Master of Science (Economics Research), May, 1991, 72 pp., 3 tables, 3 illustrations, bibliography, 21 titles.

The question for this thesis is whether the static and the dynamic theory of international trade stability holds in reality in Bangladesh. The study period runs from 1959 to 1988, with the International Financial Statistics, Statistical Yearbook of Bangladesh, and Foreign Trade Statistics of Bangladesh as the data sources. The OLS model under simple lag structure has been run to test the static theory. The dynamic theory was tested using a third degree polynomial with no end point restrictions.

The thesis is divided into five chapters: (I) Introduction, (II) Literature Review, (III) Methodology, (IV) Results, and (V) Conclusions.

The overall findings of this thesis indicate that the static theory of international trade stability and the dynamic J-Curve approach may not hold in reality in Bangladesh. It does identify several conditions under which devaluation may provide stability in the long run.

PRICE ELASTICITY, J - CURVE, AND THE BALANCE OF TRADE:
AN ECONOMETRIC STUDY OF BANGLADESH

THESIS

Presented to the Graduate Council of the
University of North Texas in Partial
Fulfillment of the Requirements

For the Degree of

MASTER OF SCIENCE

By

Mehboob U. Ahmed, BBA.

Denton, Texas

May, 1991

TABLE OF CONTENTS

	Page
LIST OF TABLES	v
LIST OF ILLUSTRATIONS	vi
 Chapter	
I. INTRODUCTION AND PRESENTATION OF THE PROBLEM	1
Chapter Overview	
Introduction	
Statement of the Importance of the Problem	
Stability and Comparative Static in the Basic Trade Model	
Marshall-Lerner Condition and International Stability	
Equilibrium Condition	
Stability and the Marshall-Lerner Conditions	
The Balance of Payment Viewpoint	
II. LITERATURE REVIEW	17
Past Studies	
Some Problems of Measuring Price Elasticities	
Price Elasticities and the J-Curve	
Studies on the J-Curve	
Absorption Approach to the Balance of Trade	
Monetary Approach to the Balance of Payment	
Summary	
III. METHODOLOGY	45
Chapter Overview	
Objectives	
Statement of Hypotheses	
Discussion of Econometric Models	
Distributed Lag Model	
Polynomial Distributed Lag	
Data Collection	
Summary of Models	
IV. RESULTS AND INTERPRETATION	56
Chapter Overview	

Multivariate Regression Results of Aggregate
Import Models
Interpretation of Disaggregated Import
Functions
Multivariate Regression Results of Aggregate
Export Models
The Marshall-Lerner Condition
Interpretation of Disaggregate Export
Equations
Interpretations of the J-Curve Coefficients

V. CONCLUSIONS 68
 Analysis of Findings

LIST OF TABLES

Tables		Page
1.	Import Demand Equations	57
2.	Export Demand Equations	61
3.	J-Curve Equation Results	66

LIST OF ILLUSTRATIONS

Figure		Page
1.	Two Country, two good, Offer Curve	5
2.	Trade Elasticities	7
3.	Stability Conditions	11

CHAPTER I

INTRODUCTION AND PRESENTATION OF THE PROBLEM

Chapter Overview

This chapter introduces the reader to the study undertaken. The chapter includes: (1) an introduction to the problem, (2) a statement of the problem, (3) research objectives, and (4) a statement of the hypotheses.

Introduction

In the annals of International Economics, international economic stability has always been a highly debated and controversial topic. Ever since the seminal article by Orcutt was published in 1959, the field of International Economics has experienced a tremendous growth. Numerous studies have been undertaken using developed and middle income developing countries as the areas of research. In a very non-technical sense the basic assumption of stability theory (a necessary and sufficient condition) is that the elasticity of demand for imports plus the elasticity of demand for exports is greater than unity--also known as the Marshall-Lerner condition. The Marshall-Lerner condition is necessarily a static model because it primarily relies on a comparative static trade model and assumes exports and imports adjust automatically to prices without any lags.

Leading economists and experts disagree with the static model, arguing that the elasticity approach to international trade does not take into account its dynamic nature and incorrectly assumes that trade adjusts instantaneously to price changes, arising from a depreciation or appreciation of the exchange rate. They assert that trade response will trail behind any price change; therefore, if there is any devaluation, trade volume will adjust and stability will be achieved, but with a time lag. This adjustment process is also known as the J-curve phenomenon.

Unfortunately, both approaches fail to address the level of development required for such a stability condition: the problem of big versus small country trade, and the types of exports and imports. When these problems are discussed in the context of a developing country, it is not certain how the stability theory will behave. From a less developed country's (LDC) point of view, any analysis of stability theory would reveal these limitations as well as the pros and cons of the static and the dynamic theories of international trade.

Statement of the Importance of the Problem

The problem above is most important in formulating trade policies and studying the feasibility of any conditional policies imposed by the international lending organization for developing countries and LDC's. The

current research focuses on Bangladesh. This country has been plagued with severe trade and balance of payments problems despite several attempts to devalue the local currency to cure a persistent external balance of payments problem. If the static model is relevant in the case of Bangladesh, then a devaluation strategy should restore the external balance. If, on the other hand, the J-curve phenomenon is relevant, then the trade imbalance may initially worsen but will eventually restore external balance. An analysis of these problems would also reveal information that would determine the effectiveness of any trade policies initiated by either the government or any international organizations such as the IMF or the World Bank. In this context, the writer attempts to answer the questions at hand by applying multivariate regression techniques, and polynomial distributed lag models to a structural time series data set.

The results support the theoretical foundations of the static model of international trade, but appear to refute the dynamic J-Curve approach. It has often been argued that import and export price elasticities tend to be price inelastic for developing and least developing countries. The reasons are quite simple. Developing countries and LDC's primarily import the consumer and capital goods required to sustain economic growth. On the other hand, they typically export primary commodities and raw materials

whose prices have recently declined sharply due to the availability of substitutes, making their exports noncompetitive. In the case of Bangladesh, exports and imports are price inelastic.

The objective of this research is two-fold. The first is to kindle an interest in the mechanism of devaluation and balance of payment adjustments; and second, to inquire into the validity of the disequilibrium hypothesis and stability condition. Specifically, the researcher questions whether the excess supply of imports and exports take international trade to the equilibrium level after price adjustments.

In this context the research will analyze various trade statistics and estimate price elasticities of several commodities, especially primary export and import items of Bangladesh. Once the price elasticities are estimated, the Marshall-Lerner condition will be easier to observe. The next step will be to analyze the effect of devaluation based on the Marshall-Lerner condition.

Stability and Comparative Static in the Basic Trade Model

At this stage it is necessary to take a closer look at the theoretical foundations of the international stability and the Marshall-Lerner conditions. Since it is preferable to explore the theoretical premises before analyzing whether the condition holds in reality, this section begins by analyzing an offer curve and stability condition. The basic

model examines the relationship in a simple format by assuming that only two countries are participating in world trade and trading two goods, namely, food and clothing.

In Figure 1 presented here, let us assume that the home country exports of clothing in a free trade equilibrium.

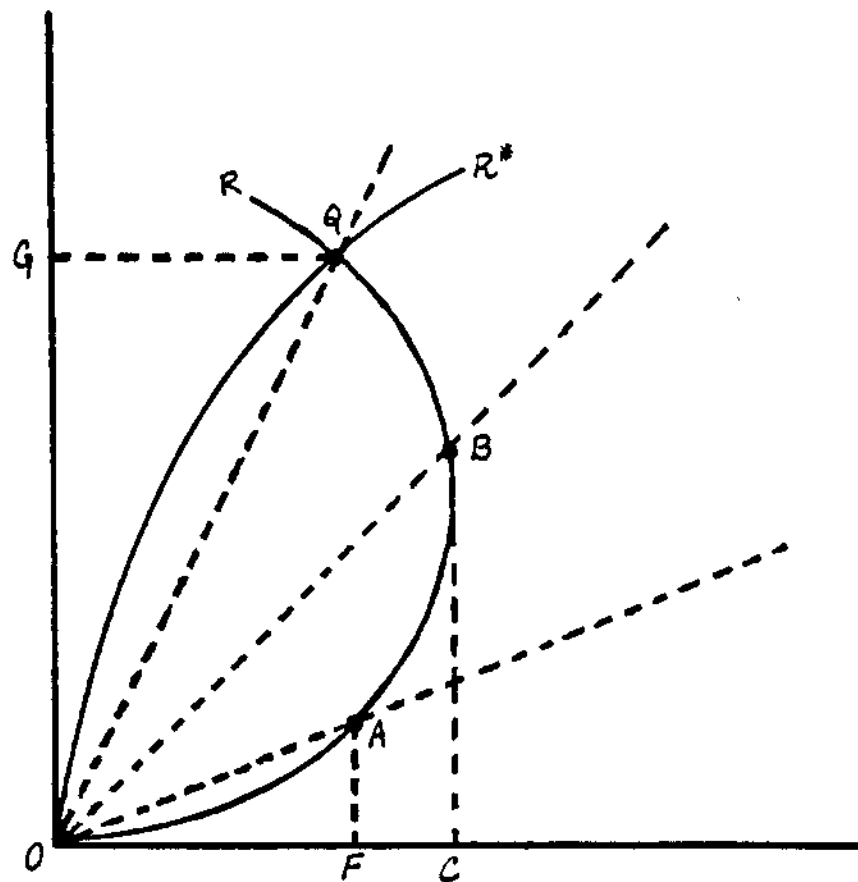


Figure 1

The world relative price of clothing is shown by the slope of the ray OA. At this price the home country chooses to import AF amount of food and export OF amount of clothing. If the relative price of food falls to the level OB, home

demand for import of food rises. New import demand is BC amount of food and the home country is willing to export OG amount of clothing. In this range it can be clearly seen that home import demand is relatively elastic since the quantity of clothing exports it is willing to give up increases from A to B.

On the other hand, another reduction of relative price is shown by the ray OQ. At OQ there is a reduction of clothing exports and more food imports are demanded at Q than at B. There are two important effects noticeable at Q; the substitution effect and the income effect. As food is relatively cheaper than clothing, there is a lower local demand for clothing because consumers will tend to substitute cloth for food. On the other hand, the income effect raises the income of the clothing exporting country since cloth is relatively more expensive than food. These effects can be shown on the graph. Movement from B to Q is the income effect, and the substitution effect can be seen as a movement from A to B. Therefore OR* is the foreign offer curve. (Caves, Jones, 1977, 49)

Marshall-Lerner Condition and International Stability

Before the Marshall-Lerner condition can be derived, it is necessary to examine the three important elasticities that comprise the Marshall-Lerner condition. The first elasticity is the elasticity of the offer curve, defined as:

$$\begin{aligned}
 E &= \frac{\% \Delta \text{ IN IMPORTS}}{\% \Delta \text{ IN EXPORTS}} \\
 &= \frac{dy/y}{dx/x} \\
 &= \frac{dy}{dx} \cdot \frac{x}{y}
 \end{aligned}
 \tag{1}$$

Referring to the offer curve in Figure 2 which follows, the elasticity may be measured at any point along the offer curve, for example, K. First draw a tangent to the offer curve at K and let it intersect the horizontal axis at point

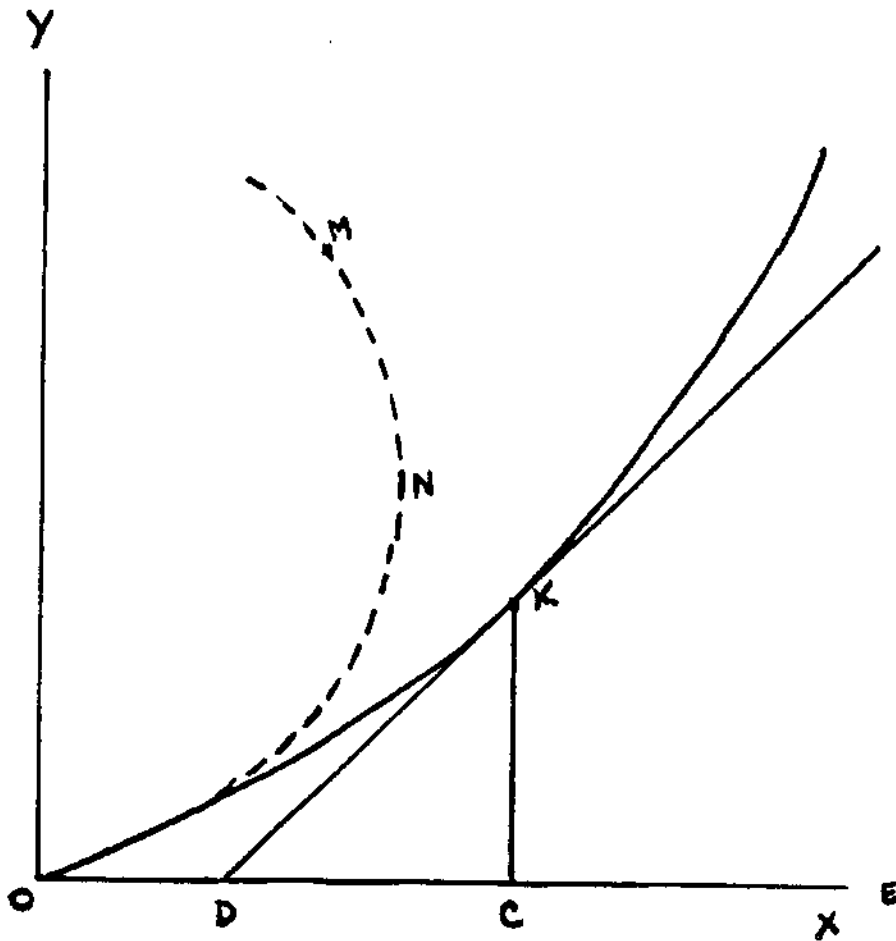


Figure 2.

D. Then extend a vertical from K and let it intersect the horizontal axis at point C. Now the slope of the tangent to the offer curve at K can be written as:

$$E = \frac{CK}{DC} \cdot \frac{OC}{CK} = \frac{OC}{DC} \quad (2)$$

As long as D lies between the origin and point C in Figure 2 above, the elasticity of the offer curve will be positive and greater than one. If the offer curve were a straight line with the tangent, the offer curve would coincide with the straight line and E would be equal to one at all points. The elasticity of the offer curve could also be estimated at M and N. At M, D would lie to the right of point C, then the distance DC would be negative and so would E. At point N, the tangent becomes perpendicular and E becomes infinite because OC is positive, while DC is zero.

The second elasticity is the elasticity of the demand for imports, which is defined as:

$$\epsilon = \frac{\% \Delta \text{ IN IMPORTS}}{\% \Delta \text{ IN RELATIVE PRICE OF IMPORTS}}$$

Along the offer curve, the value of the exports equals the value of imports, or $P_x x = P_y y$, which implies that the relative price of imports is equal to P_y/P_x . Therefore, $P_y/P_x = x/y$. Thus, the above formula becomes:

$$\begin{aligned}
 \epsilon &= \frac{\frac{dy/y}{d(x/y)}}{(x/y)} = \frac{dy}{d(x/y)} \cdot \frac{x}{y^2} = \frac{dy}{\frac{(ydx - xdy)}{y^2}} \cdot \frac{x}{y^2} \\
 &= \frac{\left(\frac{dy}{dx}\right) \cdot \left(\frac{x}{y}\right)}{1 - \left[\frac{\left(\frac{dy}{dx}\right)}{\left(\frac{x}{y}\right)}\right]} = \frac{E}{1-E} \quad (3)
 \end{aligned}$$

The elasticity of demand for imports can be measured using equation (2). We know $E = OC/DC$. Therefore, ϵ becomes $1 - OC/DC$. The final elasticity is the elasticity of supply of exports, which is defined as:

$$n = \frac{\% \Delta \text{ EXPORTS}}{\% \Delta \text{ RELATIVE PRICE OF EXPORTS}}$$

The relative price of exports is simply the ratio P_x/P_y , which along the offer curve equals y/x . Substituting the ratio for the relative price and the percentage change results in:

$$\begin{aligned}
 n &= \frac{\frac{dx/x}{[(d(y/x))]}{(x/y)}}{d(y/x)} \cdot \frac{y}{x^2} \\
 &= \frac{\frac{dy}{(xdy - ydx)}}{x^2} \cdot \frac{y}{x^2} \\
 &= \frac{1}{[(dy/dx)(x/y)] - 1} \\
 &= \frac{1}{E-1} \quad (4)
 \end{aligned}$$

Using the elasticity of the offer curve derived earlier, the equation (4) could be rewritten as:

$$\frac{1}{OC/DC-1} = \frac{DC}{OC-DC} \quad (5)$$

Finally, add the elasticity of demand for imports and the elasticity of supply of exports to obtain:

$$\begin{aligned} \epsilon + n &= -1 \\ n &= -(1+\epsilon) \end{aligned} \quad (6)$$

That is, the sum of the elasticities of the demand for imports and supply of exports is always equal to minus one.

Equilibrium Condition

Following Walras' Law, the general equilibrium of a two country, two commodity model can be demonstrated by a single market. Let us assume a two country model. By Walras' law:

$$(E_X^A + E_X^B) = (E_Y^A + E_Y^B) \quad (7)$$

where E_X^A = represents A's excess demand for product X (positive or negative). E_X^B = represents B's excess demand for product X. The same is true for E_Y^A and E_Y^B . It is true from equation (7) that if

$$(E_X^A + E_X^B) = 0 \quad (8)$$

then, $(E_Y^A + E_Y^B) = 0$. This implies that general equilibrium in a two country, two commodity model can be determined by a single market model. Therefore, if A experiences excess demand for product X, B must be experiencing negative excess demand, or:

$$E_x^A = -E_x^B \quad (9)$$

Figure 3 is a graphical representation of the stability condition. For stability it is required that the aggregate demand curve for X at the equilibrium point be downward sloping. At a price P_2 in Figure 3 there is a negative excess demand (positive excess supply) equal to the distance OP_2 , and in general excess supply will drive down prices to the equilibrium level P_0 . At a price P_1 , there is a positive excess demand to the distance NP_1 and prices will tend to rise to the equilibrium level P_0 .

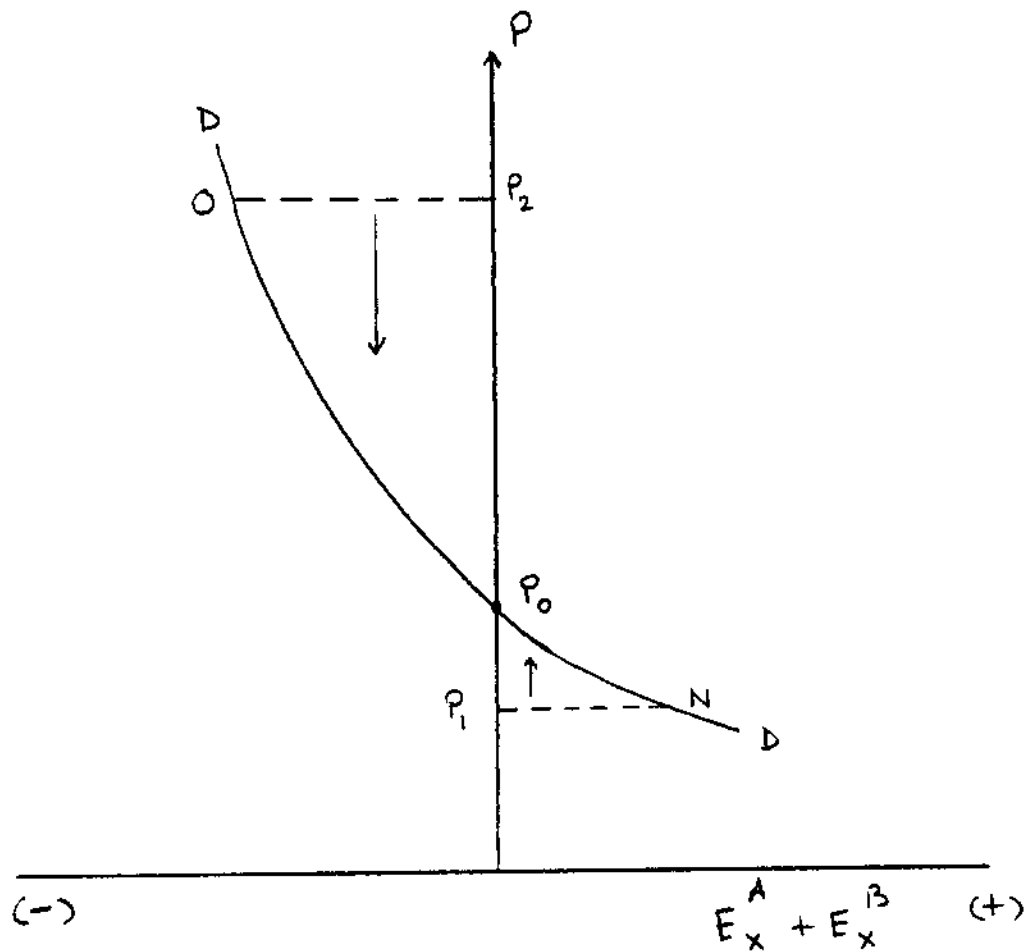


Figure 3.

The slope of the aggregate demand of DD is given by the first derivations of the function $(E_x^A + E_x^B)$ with respect to P . For stability it is required that:

$$\frac{dE_x^B}{dp} + \frac{dE_x^A}{dp} < 0 \quad (10)$$

or

$$\left(\frac{dE_x^A}{dp} \cdot \frac{P}{E_x^A} \right) \cdot \frac{E_x^A}{P} + \left(\frac{dE_x^B}{dp} \cdot \frac{P}{E_x^B} \right) \cdot \frac{E_x^B}{P} < 0 \quad (11)$$

The first term in equation (11) is the elasticity of A's demand for imports and the term in the second pair is the elasticity of B's supply of exports. Therefore, inequality (11) can be rewritten as:

$$e_A \frac{E_x^A}{P} + n_B \frac{E_x^B}{P} < 0 \quad (12)$$

$$\frac{1}{P} (e_A E_x^A + n_B E_x^B) < 0$$

Recall, however that $E_x^A = -E_x^B > 0$, implying that inequality (12) reduces to:

$$\begin{aligned} \frac{1}{P} [(e_A)(-E_x^A) + n_B E_x^A] &< 0 \\ -\frac{1}{P} E_x^B (e_A - n_B) &< 0 \\ e_A - n_B &< 0 \end{aligned} \quad (13)$$

But $n = -(1 + \epsilon_B)$ from equation 6 so that inequality 13 becomes:

$$e_A - [-(1 + e_B)] < 0$$

or

$$e_A + e_B < -1 \tag{14}$$

Inequality (14) is known as the Marshall-Lerner condition (Chacholiades, 1973). Therefore, stability of the present trade model requires that the elasticity of A's demand for imports, plus the elasticity of B's supply of exports, is less than negative unity.

Stability and the Marshall-Lerner Conditions

An equilibrium condition is stable if the economy will adjust automatically and return to the original equilibrium after devaluation. In a simple microeconomic sense, if the price is above the equilibrium level, there will be a downward pressure on price toward the equilibrium level. The reverse is true if the price is below the equilibrium level or if the economy experiences excess demand. From this a disequilibrium hypothesis may be deduced. When a market is in excess demand, price will be rising, while a market in excess supply will have falling prices (Ethier, 1983,96).

Assume two countries, the United States and the United Kingdom. The United States imports (demands) British whiskey and the United Kingdom exports (supplies) it. Excess demand is $M^{u.s} - X^{u.k}$, the U.S. demand over the British

supply. The market will be stable if a fall in p (relative prices) causes M^{u*} to rise relative to $X^{u.k}$

Returning to the definition of elasticities, the elasticity of import demand is $e = \% \text{ change in } M^d / \% \text{ change in } p$. Elasticity of import demand is elastic if $e > 1$ and inelastic if $e < 1$. Therefore, if p (or terms of trade) falls by 1% and $e > 1$ the volume of imports will increase by more than 1%. Thus an international equilibrium will be stable if the elasticities of the offer curve summed together are greater than one.

The Balance of Payment Viewpoint

The alternative of the elasticity approach is the effect on balance of payment as the exchange rate is devalued. This viewpoint presented by Chacholiades, establishes the condition under which devaluation of A's currency improves the balance of trade expressed in either foreign currency or domestic currency (Kindelberger, 1965). The writer derives a balance of trade equation (in a two country model) expressed in B's currency as:

$$B^f = (Px/r) Mb - Pm^* Ma$$

where

B^f = A's balance of trade in foreign exchange

P = Price of A's export in A's currency

r = Exchange rate; unit of a's currency paid per unit of B's currency.

M_b = B's quantity of imports

P_m^* = P_m/r where P_m is A's import in A's currency

M_a = A's quantity of imports.

After drawing several assumptions about elasticities and identities, Chacholiades differentiates B with respect to r . Notice that the objective is to find out what happens to B when r increases (when A's currency is devalued). The issue is the sign of dB^f/dr . If $dB^f/dr > 0$ the balance of trade improves; if $dB^f/dr < 0$ the balance of trade deteriorates and if $dB^f/dr = 0$ it remains the same.

The main conclusion is that if B's demand for imports is elastic then A's balance of trade will always improve with devaluation. Simply speaking, when $e > 1$ total revenue increases as price decreases. Similarly as we devalue our currency exports are less expensive and if the importing country is relatively sensitive to a change in price the balance of trade will improve, because more revenues will be generated from merchandise exports. In this research the focus is primarily on the J-curve phenomenon, because it addresses similar effects using a dynamic structure.

Next is a more extensive review and the technical problems involved in measuring import price elasticities.

CHAPTER BIBLIOGRAPHY

- Chacholiades, Milatiades. 1973. The Pure Theory of International Trade. Aldine Publishing Company.
- Caves, Richard E., and Ronald W. Jones. 1977. World Trade and Payments. 3rd Edition, Little, Brown, and Company.
- Ethier, Wilfred J. 1988. Modern International Economics. 2nd Edition, W.W. Norton and Co.
- Kindelberger, Charles P. International Economics. Macmillan Publishing.

CHAPTER II

LITERATURE REVIEW

Past Studies

Econometric analyses of international trade emphasize determining price elasticities in a comparative static framework. This literature review summarizes the past studies conducted on estimating import and export price elasticities. The next section reviews the dynamic aspects of international trade and stability. Johnson demonstrated that if trade is initially balanced in a two-country model, prices are constant, and income growth is the same in both countries, then the trade balance between them can still change through time if their respective income elasticities of demand for other exports differ (Houthakker, 1969).. Therefore, if country A has a higher income elasticity of demand for its imports, it will experience more rapid income growth than export growth. The ultimate result will be a deterioration of its trade balance and eventually a pressure on its exchange rates.

Probably the single most important study in estimating export and import price elasticities was undertaken by Houthakker and Magee. They used the OLS technique to measure elasticities in international trade instead of resorting to

more sophisticated simultaneous-equation models. The results are still very interesting and shed some light on our problem. Their research used double logarithmic equations because of their superior fit and ease of estimation. The OLS import equation is given by:

$$\log M_{it} = A_{0i} + A_{1i} \log Y_{it} + A_{2i} \log \left(\frac{PM_{it}}{WPI_{it}} \right) + \epsilon_{it}$$

where M_{it} is the i th country's imports of merchandise during year t in constant dollars (1958 dollars), Y_{it} is an index of the country's GNP, PM_{it} is a price index of imports into the i th country, WPI_{it} is the wholesale price index and ϵ_{it} is the error term. A_{1i} is the income elasticity and A_{2i} is the price elasticity, both of import demand.

The OLS export equation is given by

$$\log X_{jt} = B_{0j} + B_{1j} \log YW_{jt} + B_{2j} \log \left(\frac{PX_{jt}}{PXW_{jt}} \right) + \epsilon_{jt}$$

where X_{jt} is the j th country's exports of merchandise to all other countries during year t in constant dollars (1958 dollars), YW_{jt} is an index of GNP for importing countries (excluding country j , and each weighted by its 1958 share in the total exports of country j), PX_{jt} is an index of the export prices of 1958 dollars, PXW_{jt} is an index of the export prices of other exporting countries.

The results were mixed. In their research, Houthakker and Magee found that most of the R^2 showed a good fit. Low

Durbin-Watson coefficients suggest that the static import and export equation are too simple to capture the dynamics of import and export demand.

Houthakker and Magee then computed the sum of import and export price elasticities in absolute terms. Countries whose sum of import and export price elasticities were greater than one experienced stability and improvement in their balance of payments. This is in essence the Marshall-Lerner Condition. For further research in this area Houthakker and Magee suggested a disaggregated approach. They suggested import and export demand equations for a single country and export and import demand equation by several important commodity classes, which will reveal the problems associated with aggregate export and import models.

In a similar study by Ball and Marwah (1962), distributed lag models were constructed to analyze U.S. demand for imports using quarterly data from 1948-1958. Instead of using an aggregate import sector, they divided total imports into six categories. They were crude foodstuffs, crude materials, semi-manufacturers, manufactured foodstuffs, manufacturers, and services. In order to obtain real values, they deflated current value figures by appropriate price indexes published by the Department of Commerce.

The functional relationship examined by Ball et al. is given by:

$$M_d = f(\text{GPO}, \text{Relative Prices})$$

where M_d is U.S. demand for imports, GPO is gross private output (proxy for income variable and relative prices). The dummy variable z was used to reduce the effect of the Korean War.

Ball and Marwah (1962) used this functional form on each disaggregated import category, sometimes adding relevant variables to the model for each specific sector. Crude foodstuff imports were found to be relatively price inelastic, and income elasticity is less than 0.5, a conclusion that follows Engel's law.

Their next step was to reduce the level of aggregation and regroup the six basic categories into three categories of food (crude and manufactured), materials (crude and semi-manufactured) and manufactured (including services) goods. The results were similar with higher price and income elasticities, but significantly lower first order autocorrelation. The variable time was introduced into the regression for manufacturing and services. A one-period, distributed lag model fitted well for this group, as evidenced by an increase of coefficient of multiple determination from 0.87 to 0.93, using disposable income as the independent variable.

In their research, Ball and Marwah found that manufactured goods with numerous domestic substitutes have the largest elasticity, followed by manufactured foods and

semi-manufactureds. Crude food stuff had the lowest elasticities, as might be expected. It is probably fair to conclude that the volume of import demand of basic necessities such as food are relatively insensitive to relative prices in determining their volume of imports. On the other hand, as we move towards more manufactured goods, the elasticities get larger in the United States because of domestic and foreign substitution.

In a short but remarkable article, Kreinin refined the Ball and Marwah approach of computing price elasticities (Kreinin, 1967). A shortcoming of earlier studies used to calculate price elasticities in international trade is that of treating all goods as total imports or exports whereas individual commodities may have different price and income elasticities. Moreover, estimates vary widely depending on the method of estimation.

Disaggregated or individual commodity measurements of imports and exports are rare. In the export area very little research exists, primarily because of the complication involved. For example, real GNP and relative price level has been found to explain most variations in imports. However, there are other factors that influence exports, such as country destinations, shifts in demand, improvement (decline) in competitiveness. Therefore, Kreinin did not attempt to measure export price elasticities; rather, he refined the Ball and Marwah

approach by estimating elasticity of substitution in international trade. His regression model for elasticity of substitution for commodity subgroups can be summarized as:

$$\% \Delta Q = f(\% \Delta P)$$

where $\% \Delta Q$ represents percentage change in quantity and $\% \Delta P$ represents percentage change in price. The results were significant. Elasticity of substitution was considerably higher in the short run (3 years).

In the next step, Kreinin attempted to refine the Ball and Marwah approach by avoiding the Korean War period and using data from 1954-1964 with 43 quarterly observations. Adjusting for seasonal variations, his model can be summarized as:

$$y = a + bx - cz + u$$

where y is the volume of import index, x is the value of real NP, and z is the ratio of import price index to the domestic wholesale price index. Independent variables were lagging one quarter behind the dependent variables; b and c represent income and price elasticities. Using non-lagged regressions Kreinin found that the only difference was in price parameters. They were somewhat larger.

In a similar study, Goldstein and Khan (Goldstein and Khan, 1976) provided new estimates of the aggregate import demand equation for 12 countries. The highlight of this study is the test of independence of elasticity of imports and actual adjustment of imports to a change in relative

price. Previous studies implicitly assume that elasticities of import demand with respect to relative prices and real domestic income are constant for all values.

In this paper, Goldstein and Khan modelled Orcutt's argument of price elasticities in international trade. Several writers including Orcutt argued price elasticity of demand for imports will be different (larger) for large price changes than for small price changes. One possible interpretation is that the price changes must be large enough to induce buyers to switch suppliers. A second interpretation is that the adjustment of import quantity to large price changes is more rapid than adjustment to small changes.

Goldstein and Khan then develop and present four alternative aggregate import demand functions. Two of these are identical and have been widely used in previous studies. The other two specifications allow the relative price elasticities to vary with relative price changes. Their aggregate import functions are examined in the discussion below.

Probably the simplest form of import demand function and one of the most widely used is the log-linear model. The functional form can be specified as follows:

$$\log M_t^d = a_0 + a_1 \log P_t + a_2 \log Y_t + u_t$$

where

M = quantity of imports in period t

P = ratio of import prices to domestic prices.

(Generally import and wholesale prices are used.)

Y = level of GNP (real terms) in period t .

Since the above model has been transformed from the form $M_t^d = a_0 P_t^a Y_t^a$ by taking the log of both sides, the coefficients a_1 and a_2 are the relative price and income elasticities. One would expect a_1 to have a negative sign, and a_2 generally to be positive. The sign of a_2 can be negative. If imports are the difference between the consumption and domestic production of imported goods, and if domestic production rises faster than domestic consumption as real income rises, imports could easily fall. Therefore, there is not a prior reason to believe that a_2 would be positive. The difficulty with the above equation is that it is a static model. It does not incorporate time lag and adjustment of actual imports (M_t) to import demand (M_t^d). Goldstein and Khan then adjusted the generic model to incorporate time lag adjustment by using a partial adjustment structure.

In determining export demand function, most researchers used similar approaches. Among them Malach (Malach, 1957) and Horner (Horner, 1952) are notable. However, recent research in international trade emphasizes imports rather than exports primarily because identifying an export

equation with all the explanatory variables is even more difficult.

A country's exports depend on a large number of qualitative variables as well as quantitative variables such as the rate of tariff faced by country i , level of domestic production, and competition in the international market. The current market share determines the level of export. Among the qualitative variables, export quality is the most important determinant. These variables are very difficult if not impossible to quantify. The variables such as level of export financing, domestic economic policies to promote exports, etc. can be identified. Therefore, since most of the variables are difficult to quantify or data is not available, one may run into the problem of specification bias that causes impure serial correlation. At this stage, however, we can analyze the simple models suggested by several authors and include additional explanatory variables later if feasible. Khan's 1974 simple export function may be identified as:

$$\log X_{it}^d = \beta_0 + \beta_1 \log \left(\frac{PX}{PW} \right) + \beta_2 \log W_t + u_t$$

where X_{it} = quantity of exports of country i
 PX = value of exports of country i
 PW = world price level
 W_t = real world income

β_1 and β_2 are the price and income elasticities where β_1 is < 0 , $\beta_2 > 0$. This type of export demand function is very popular because of its simplicity. Many authors including Houthakker and Magee (1969) estimated this equation for number of developing countries.

Export functions may also be identified as a disaggregated export function as Malach pointed out. Sometimes disaggregated export function may shed more light on the international trade situation. In his article, Malach used a simple log-linear model to estimate the demand for Canadian exports, and to measure price and income elasticities of demand. The model is as follows:

$$\log Q = a + b \log \text{RGDP} + c \log \text{Relative Price}$$

He used the value of U.S. real GNP and the export price index to estimate the export demand function for primary exports to the U.S. and U.K. real GNP for primary exports to the U.K.

Once the disaggregated export function has been identified, price and income elasticities may be computed for several classes of commodities as opposed to an aggregate export function. Additionally, disaggregate export functions may reveal individual items that will generate more revenues as the exchange rate is devalued.

Some Problems of Measuring Price Elasticities
in International Trade

Probably the most critical part of measuring price elasticity is the estimation technique itself. Ordinary Least Square methods may be inefficient in some cases when the assumption of non-autocorrelation does not hold. Assumptions of linearity may be too simplistic and perhaps the most crucial problem is simultaneous equation bias. A researcher might get a good R^2 and significant t-ratios, but incorrect signs of coefficients. Simultaneous equations' bias may be the source of this problem.

Two leading articles identify the sources of errors (Orcutt, 1950). The problems associated with measuring price elasticities are:

- A. Errors and bias due to the shifts in demand surface.
- B. Errors due to measurement errors.
- C. Historical price and quantity indices reflect price changes of commodities with very different price elasticities.
- D. Usually short run price elasticities have been estimated instead of long run.
- E. The price elasticity of demand for imports or exports is probably much larger for large price changes than for small price changes.

Orcutt concludes that all the sources of errors and biases cannot be eliminated even by employing advanced statistical techniques. However, some of them may be removed easily. For example, by using individual commodity data C can be avoided. This may be limited due to the fact that international data is hard to find, especially at such a disaggregated level. D can be avoided by looking for cumulative instead of current effects of price changes. Harberger (Harberger, 1953) suggests an alternative method in order to avoid Source A. Since shifts in demand, though inobservable, are so important in the process of estimating, we should certainly try to define them in the most meaningful way. The usual procedure of taking regressions of absolute quantities of imports against absolute levels of real income and relative prices defines any year's shift in demand as the difference between the position of the demand curve in a particular year and its average position over the whole period of estimation. Therefore, this researcher takes variables as year-to-year percentages changes rather than as absolute quantities.

Price Elasticities and the J-Curve

It is imperative at this juncture to review the dynamic aspects of international trade adjustments. A great deal of time and effort has been devoted by economists in an attempt to measure price elasticities for exports and imports. In

most cases, it has been found that demand elasticities are sufficiently large so that the Marshall-Lerner conditions are met. However, a major difficulty does exist in these elasticity measurements. It takes time for trade flows to adjust to relative price changes--another way of saying that elasticities are low in the short run, and higher in the long run.

The low short-run elasticities suggest that initially a devaluation may have quite unfavorable effects in both the balance of payments and the local economy. If the quantitative response to lower foreign prices is slight in the short run, the proportionate increase in the quantity of exports will be smaller than the proportionate fall in foreign price, and less foreign exchange will be earned from exports after devaluation (Dernburg, 1989).

Eventually, elasticities will tend to increase, trade volume response should increase, and the current account balance will then improve. This time pattern of foreign exchange earnings in response to devaluation may, therefore, follow a J-curve, first declining trade balance and then improving over time. If the balance of trade is examined over time, the initial decrease in the trade balance because of inelastic demands followed by a growing trade balance, results in a time pattern of trade balance which follows a path similar to the letter J.

Assume that a hypothetical economy's trade balance is initially negative, falling over time. The devaluations occurs at point t_0 . Following the devaluation, the balance of trade deteriorates for a while before finally turning upward. The initial fall results from low short run elasticities. Over time, elasticities tend to be higher and the trade balance improves.

Before reviewing the evidence on this matter, it is imperative that the factors influencing foreign trade elasticities in the short run be investigated, and the possible underlying reasons for a J-curve be analyzed. There are times when the ability of trade to respond to a new set of prices is at first very limited, but over time becomes complete. Initial limitations are due to the following factors:

Currency Contract Period. Following a devaluation, contracts negotiated prior to the exchange rate devaluation become due. If the export contract was written in terms of foreign currency, then the exporter would receive an unexpected gain. On the other hand, if an import contract is written in terms of foreign exchange, the importer faces a loss. It is important to bear in mind that such currency contracts in international trade prohibit traders from responding immediately. (Melvin, 1989)

Pass-Through Analysis. Following a devaluation, goods prices do not adjust instantaneously to the change in

exchange rate. The pass through analysis considers the ability of prices to adjust in the short run. The kind of adjustment expected is an increase in the price of import goods in the devaluing country and a decrease of this country's exports to the rest of the world. (Melvin, 1989)

Most of the third world countries may find out that their balance-of-trade deficit does not improve in the short run because of the absence of the Marshall-Lerner condition and the presence of the J-curve phenomenon. Typical third world imports such as capital equipment, food, and energy resources are necessary for the development program, and hence have very low price elasticities. Thus, the total import bill may go up. On the other hand, export price elasticity for typical third world exports may be inelastic, causing a reduction in export revenues.

Studies on the J-Curve

The preceding discussion has shown the possible short run effect of a devaluation on the trade balance of a country. It is now time to look at some literature and evidence of past devaluations and its repercussions on the trade balance.

Miles analyzed 16 devaluations for several countries and found little evidence that devaluation improves trade balance (Miles, 1979). He found out there was a clear evidence of the balance of payments improving following

devaluation. The other implication was the monetary nature of adjustment to devaluation. While several authors have suggested that devaluation will be accompanied by changes in real variables such as the trade balance, Miles' test finds little evidence of such changes. There is no evidence of a real balance effect when trade balance behavior is combined with the tests of monetary variables. This can be explained as Miles points out by assuming that fiat money is not perceived as net wealth, or nominal money balances could be a small fraction of total wealth, or there are only small reactions to changes in monetary variables. Since balance of payment is improving by definition, capital account must be improving. Miles then suggests devaluation and therefore there seems to be a simple portfolio adjustment. Rather than affecting net wealth, devaluation causes excess demand for money and excess supply of bonds.

Oskooee specifically investigated the existence of the J-curve phenomenon for the balance of trade of Greece, India, Korea, and Thailand over the period from 1973 to 1980. The J-curve phenomenon was present for all countries except Thailand. The only difference is in the duration of the deterioration and then the improvement of trade balance. Unlike Miles, Bahmanis' monetary variable is not M1 or M2. Rather it is the domestic portion of high powered money that is under control of the monetary authorities. An increase in money supply leads to an increase in the level of real

balances. Individuals perceive their wealth to rise causing the level of expenditures to rise relative to income and the trade balance to deteriorate, therefore a negative relationship exists between trade balance and domestic high powered money (Oskooee, 1984).

Miles argued that this negative relation may not be observed for several reasons. Nominal money balances may only be a small part of total wealth. Second, money may not be perceived as net wealth. In this case there is no real balance effect and the trade balance does not deteriorate. Finally, response in expenditures to changes in wealth could be insignificant. (Miles, 1979)

Following the Keynesian aggregate demand model originally suggested by Kreuger (Kreuger, 1983), Oskooee's multiplier based model can be summarized as:

$$TB = f(Y, E/P)$$

where TB is the trade balance, Y is the level of real output, E is the exchange rate and P is the domestic price level. However, after integrating the monetary component (domestic, high powered money) the final model will now provide some information about the relationship between monetary variables and trade balance. After imposing lag structure on the exchange rate variable the modified Oskooee model that has been slightly modified for this research may be summarized as:

$$TB_t = \alpha_0 + \alpha_1 Y_t + \alpha_2 M_t + \sum_{i=1}^n \beta_i \left(\frac{E}{P} \right)_{t-1} + \epsilon_t$$

where TB_t is defined as excess of exports over imports, Y_t is real GNP expressed as an index, M_t is the level of domestic high powered money, E is the number of units of domestic currency per unit of foreign currency expressed as an index, and P is the index of domestic price level. It is expected that the sign of the coefficients in this modified Oskooee model will be as follows: $\alpha_1 < 0$, α_2 either > 0 or < 0 , and $\beta_1 > 0$. With regard to α_1 , it is expected to have a negative sign because a rise in real income will increase imports which in turn will deteriorate the trade balance. Regarding the sign of α_2 it is assumed that it will be negative because an increase in money supply leads to an increase in real balances. Individuals perceive their wealth to rise, causing the level of expenditure to increase and the trade balance to deteriorate. The sign of β_1 is positive because as E/P increases, imports are discouraged and exports are supposed to get a boost from the local currency devaluation. Hence, an improvement in the trade balance. Since a monetary variable has been included in this model, it is imperative to study the counter argument of the absorptionist approach and monetary approach of effects of devaluation.

Absorption Approach to the Balance of Trade

The elasticities approach has been widely criticized because it ignored the income expenditure effects of devaluation (Dernburg, 1989). Typically, devaluation should increase production in export oriented industries and import substituting industries. Therefore, it raises a nation's income and to some extent, its price level. As national income goes up, there is an increase in import demand, so excess demand for foreign currency may persist.

We know that national income equals domestic absorption sectors plus net exports; that is:

$$Y = C + I + G + (X - M) \quad (15)$$

where $A = C + I + G$ or the domestic absorption. Rewrite equation (15) as

$$Y = A + X - M$$

$$\text{or } Y - A = X - M \quad (16)$$

Devaluation raises exports and reduces demand for imports. If the economy is not at full employment then expansion of net exports can be sustained by mobilizing idle resources. Therefore, from equation (16) we can write;

$$\Delta(X-M) = \Delta Y - \Delta A$$

The rise in income raises consumption spending and therefore total absorption. The rise in consumption, however, equals the marginal propensity consumed times the change in income; therefore, if all $\Delta A = \Delta C$ then

$$\Delta A = b(1-t)\Delta Y$$

thus

$$\Delta Y - \Delta A = [1 - b(1-t)]\Delta Y = s\Delta Y \quad (17)$$

or

$$\Delta(X-M) = s\Delta Y$$

Equation (17) emphasizes that trade balance can improve only to the extent that devaluation raises domestic saving (Dernburg, 1989). An expansion of production will not help the economy if the resulting increase in income raises consumption by an equal amount. As Dernburg argues, resources will be released to expand net exports only if there is a rise in savings due to a rise in income. This requires a positive mps and a positive tax rate, provided the government does not increase absorption by increasing expenditure. It is not quite clear how these conditions will be met in a developing country; however, once devaluation goes into effect, it reduces the price of exports and increases the price of imports. If the prices of exports decline more than the prices of imports, fewer units of imports can be purchased with a given quantity of exports; thus there is a deteriorating effect on the terms of trade and an adverse effect on the devaluing country's economy.

Monetary Approach to the Balance of Payment

The elasticities approach and the absorption approach have been popular for over thirty years; however, these

theories do not address the capital account issue. During the 1970's the world economy saw the development of sophisticated money and capital markets. It became necessary to study international economic linkages through the monetary approach.

The basic premise of the monetary approach of balance of payment (MABP) is that any balance of payment disequilibrium is based on a monetary disequilibrium; that is, disequilibrium existing between money demand and money supply. In very simple analogy, if people demand more money than is being supplied, then the excess demand for money will be met by foreign inflows. In a reverse situation outflow will take place.

The most popular monetary approach is the IMF approach initiated by Polaka (Dernburg, 1989). It begins with the standard monetarist assumption that the cash balance ratio is constant.

Assume the model:

$$Y_t = \left(\frac{1}{K}\right) M_t \quad (18)$$

where Y_t and M_t are nominal money income and nominal money stock time period t . The second assumption is that imports, are proportional to the preceding periods income level.

Therefore,

$$I_t = c Y_{t-1} \quad (19)$$

where c is the marginal propensity to import with respect to money income. Assume that exchange rates are fixed, capital is immobile, and exports exogenously determined. Therefore, it follows that the balance of payment can be changed only by changing the level of imports. Combining (18) and (19) we get:

$$I_t = \left(\frac{C}{K}\right) M_{t-1} \quad (20)$$

By definition the export function can be written as:

$$\begin{aligned} NX_t &= X_a - I_t \\ NX_t &= X_a - \left(\frac{C}{K}\right) M_{t-1} \end{aligned} \quad (21)$$

where X is the autonomous level of exports and I_t is the level of import, and M_{t-1} is the money stock of the preceding period. From this expression we can see that:

$$\begin{aligned} NX_t &= X_a - \left(\frac{C}{K}\right) M_{t-1} \\ &\text{if} \\ X_a &> \left(\frac{C}{K}\right) M_{t-1} \end{aligned} \quad (22)$$

it implies a small money supply. If $X_a < (C/K) M_{t-1}$, then there is a large money supply. The first condition is a balance of payment surplus, the latter a balance of payment deficit. In this simple model, it is obvious that to cure the balance of payment deficit, it requires tight control of the money supply. The balance sheet identity of a country's

monetary survey requires that:

$$M_s = D + R$$

where M_s is the money stock, D is the domestic credit component, R is the international component of the nation's money stock or foreign reserves. Presumably, D is controlled by the domestic monetary authorities and is therefore an autonomous variable. However, the change in R depends on the balance of payments, thus:

$$\Delta R_t = NX_t = X_a - \left(\frac{C}{K}\right) M_{t-1} \quad (23)$$

Recall $M_s = D + R$. If there is a small change in money stock

$$\Delta M_t = \Delta D_t + \Delta R_t = \Delta D_t + X_a - \left(\frac{C}{K}\right) M_{t-1} \quad (24)$$

However,

$$\Delta M_t = M_t - M_{t-1}$$

Therefore,

$$\begin{aligned} M_t &= \Delta D_t + X_a + M_{t-1} - \left(\frac{C}{K}\right) M_{t-1} \\ M_t &= \Delta D_t + X_a + M_{t-1} \left(1 - \frac{C}{K}\right) \\ M_t &= \left(1 - \frac{C}{K}\right) M_{t-1} + X_a + \Delta D_t \end{aligned} \quad (25)$$

If money supply equals money demand, then it is possible that $M_t = M_{t-1} = M_e$ where M_e is the equilibrium money stock. Equation (25) expresses that money stock is determined by

the preceding year's money stock, the level of exports, and the growth of domestic credit. (Dernburg, 1989)

From the balance sheet identity $M = D + R$ several important scenarios can be explored.

$$\begin{aligned} & \text{if} \\ & \Delta M = \Delta D + \Delta R \end{aligned}$$

If the money supply ΔM is constant then $\Delta M = 0$. Therefore we have:

$$\begin{aligned} 0 &= \Delta D_t + \Delta R_t \\ \text{or } \Delta R_t &= -\Delta D_t & (26) \\ \text{or } \Delta D_t &= -\Delta R_t \end{aligned}$$

Equation (26) expresses that to solve the problem of balance of payment deficit, an economy must reduce the domestic credit creation. On the other hand, this equation also expresses that a balance of payment deficit (hence the foreign exchange reserve) can only exist if there is a positive domestic credit creation. If policy reduces ΔD to zero, monetary authority will be forced to sell foreign exchange reserves. That action will cause the money stock to go down and imports will decline; thus the balance of payments is brought into equilibrium.

This model is very naive and overly simple, but it appears to have a rather profound influence on IMF policies. When a country seeks a loan from the IMF to finance its deficits, the IMF imposes a so-called "IMF conditionality"

which requires the reduction of the domestic credit growth. The model however is totally silent about exchange rate variations.

In the case of a fixed exchanged rate, the monetary authority has no control whatsoever over the money supply and monetary policy. Because any action by the monetary authority is automatically matched by an equal and opposite change in the international component of the nation's money stock.

In the event of floating exchange rates, the equilibrium exchange rate occurs at a point where the flow of exports are equal to the flow of imports. Therefore, in a fixed exchange rate regime, adjustments to the balance of payments comes through capital inflow and outflow, it comes through exchange rate changes in a flexible exchange rate system. Moreover, monetary policy is rather impotent under a fixed exchange rate system.

Summary

In the preceding section a thorough investigation of the most important contributions in the field of export and import demand estimation, and of the dynamic approach was conducted. Most studies on trade elasticities found that price elasticities of exports and imports are sufficiently large for the Marshall-Lerner condition to hold. As

mentioned earlier, most of the countries that were examined were developed and middle income developing countries.

Studies on the J - curve phenomenon showed mixed results in most of the studies. Some authors concluded that devaluation does improve the trade balance over time, and others concluded the contrary.

In the research of this writer, the elasticity approach is not applicable because of Bangladesh's nature of exports and imports. The only model that may reveal the effect of devaluation on Bangladesh's external balance is the J-curve effect which measures the pattern of trade balance over time.

In the following section, a brief theoretical survey of the estimation techniques and the model that has been used to analyze Bangladesh's trade statistics is presented. It builds primarily upon the works of Mohsin Khan, Morris Goldstein, and Mohsin Bahmani Oskoe.

CHAPTER BIBLIOGRAPHY

- Ball, R.J. and K. Marwah. 1962. The U.S. demand for imports, 1948-58. Review of Economics and Statistics. (November): 395-401.
- Dernburg, Thomas F. 1989. Global Macroeconomics, Harper and Row Publishing Company.
- Goldstein, M. and Mohsin Khan, 1976. Large versus small price changes and the demand for imports. IMF Staff Papers. 200-224.
- Harberger, Arnold, C, 1953. A structural approach to the problems of import demand. American Economic Review. VOL XLIII. 148-159.
- Horner, F.B. 1952. elasticity of demand for the exports of a single country. Review of Economics and Statistics. VOL XXXIV. 326-342
- Houthakker, H.S. and Stephen Magee. 1969. Income and price elasticities in world trade. Review of Economics and Statistics. 2, 111-123.
- Kreinin, Mordechai E. Price elasticities in International Trade. Review of Economics and Statistics. 49 510 - 516
- Kreuger, Anne O. 1983. Exchange-Rate Determination. Cambridge University Press.
- Malach, Vernon W. 1957. Elasticity of demand for Canadian Exports. Review of Economics and Statistics. VOL XXXIX. 23-30
- Melvin, Michael 1989. International money and Finance. 2nd Edition. New York. Harper and Row Publishers.
- Miles, Marc A. 1979 The effect of devaluation on the trade balance and the balance of payments: Some new results. Journal of Political Economy. (June). 600-620.
- Orcutt, Guy H. 1959. Measurements of Price Elasticities in International Trade. Review of Economics and Statistics. (May) 117-131

Oskooee, Bahmani Mohsin. 1984. Devaluation and J-curve:
Some evidence from LDC's. Review of Economics and
Statistics. (August) 500-504

CHAPTER III

METHODOLOGY

Chapter Overview

The goal of this chapter is to outline the empirical objectives of this research and the statistical methods employed to achieve these objectives.

Objectives

The objectives are as follows: (1) to estimate aggregate and disaggregate export and import models, and obtain price and income elasticity measurements; (2) to derive the Marshall-Lerner condition of international equilibrium; and (3) to test the effect of devaluation on balance of payment stability using the J-curve model on Bangladesh's foreign trade statistics.

Statement of Hypotheses

The hypotheses examined by this research are as follows:

- 1) Aggregate import and export models are inelastic with the price elasticity of exports and imports possessing negative sign. This will identify the nature of foreign trade and establish the Marshall-Lerner condition.

- 2) Disaggregated import price elasticities are relatively inelastic for basic materials required by the economy.
- 3) Disaggregate export price elasticities should reveal similar patterns.
- 4) The J-Curve phenomenon may not be clearly observable in Bangladesh.

Discussion of Econometric Models

In this section, the objective is to discuss briefly the theoretical foundation and implied application of several econometric models used in the research. The application of an econometric model shed more light on a problem, but the underlying theoretical basis cannot be ignored. Most of the earlier research in this field has been conducted using OLS, and a log linear functional form. This type of model is non-linear in the variables, but linear in coefficients. Taking the time series approach to begin with, it can be assumed that the volume of imports, M , is dependent on several variables, such as real gross national product Y , of the importing country, the relative price of imports to domestic products (PM/PD), in the form

$$M = a_1 Y^{a_2} (PM/PD)^{a_3}$$

This type of functional form can be estimated by using logarithmic transformation such as:

$$\text{Log}M = a_0 + a_2 \text{Log}Y - a_3 \text{Log}(PM/PD) + u$$

where $a_0 = \log a_1$ and u is the error term that is multiplicative by assumption. It is important to note that the logarithmic transformation has the advantage that a_2 and a_3 are estimates of income and price elasticities of import demand.

The dynamic model of this functional form can be specified by simply introducing a one period lag on the independent variables. It can be specified as:

$$\text{Log}M = a_0 + a_2 \text{Log}Y_{t-1} - a_3 \text{Log}(PM/PD)_{t-1} + u_t$$

In a similar way the export model can be estimated using total exports of a country as the dependent variable and gross national product, export price index, et cetera as the independent variables.

The precise model that has been used to estimate the export and import model are as follows:

$$\text{Log}M = a_0 - a_2 \text{Log}P_{t-1} + a_3 \text{Log}Y_{t-1} - a_4 \text{Log}ER_{t-1}$$

where P is the relative price of imports, Y is the real gross national product and an additional variable exchange rate, ER , has been introduced to reduce any errors due to omission of variables. It is expected that the coefficient of price elasticity will be negative, real GNP should have a positive effect on imports, hence a positive coefficient for real GNP, exchange rate should have a negative sign

signifying that as the exchange rate deteriorates imports should go down because imports then become costly. This model has been run on aggregate and disaggregate data sets.

In order to estimate the export models, a similar functional format has been used except the dependent variable is total exports, and the independent variables are gross domestic product Y_g , export price index EP, and the exchange rate ER. All the models have been estimated using lag structures. The same functional form was used on disaggregated data sets to estimate the disaggregate models. Exports were broken down in three main sectors for disaggregation. They are jute, tea, and leather. Imports were also broken down into three primary categories. They are intermediate goods, consumer goods, and capital imports.

Distributed Lag Model

In an attempt to capture the dynamics of the J-curve effect in international trade, a polynomial distributed lag model has been used. Therefore, it is important at this stage to briefly explore the theoretical foundations of the distributed lag model. When constructing a model it is important to recognize that some amount of time usually lapses between the movement of independent variables and the response of the dependent variable. In a time series model, a substantial period of time may pass between the economic decision making period and the final impact of a change in a

given policy (Pindyck, 1976, 231). If the lag time between the decision period and response period is sufficiently long, explanatory variables should be lagged in the model. The fact that the impact of a variable can be distributed over a number of time periods is one of the foundations of the distributed lag model. A distributed model therefore explains the value of Y as a function of the current (and a number of past) values of X , thus "distributing the impact" of X over a period of time. For example, an equation may be hypothesized as:

$$Y_t = \alpha + \beta_0 X_{1t} + \beta_1 X_{1t-1} + \dots + \beta_k X_{1t-k} + \epsilon_t$$

In this equation B_0, B_1, \dots, B_k shows the impact of various lagged values of X on Y . In most cases, the impact of X on Y diminishes as lag increases. Therefore, the value of β 's will decrease as the length of the lag increases. In this case, β_0 will have a higher value than β_1 and β_1 will have a higher value than β_2 and so on.

Unfortunately, econometric estimation techniques do not guarantee a perfect model. As with any other model, the distributed lag model has its disadvantages when estimated with ordinary least squares. These are:

1. The lagged values of X are likely to be severely multicollinear, making coefficients imprecise.
2. Estimated β 's may not follow a declining pattern as lag period increases.

3. Estimation of a lengthy log structure uses up a large number of degrees of freedom, which are often in short supply in a time series model (Studenmund 1987, 239).

As a result of the problems that the OLS estimation encounters, it is customary to use simplified models such as the Koyck distributed lag model, Almon Polynomial Distributed lag model, Stock adjustment model, etc. This paper will present a discussion of the appropriate lag model in the next section where the theoretical basis of a sophisticated lag model is explored.

Polynomial Distributed Lag

The Almon log technique enables us to relax the rigid relationship among the β 's imposed by the Koyck log. Instead, Almon log assumes that whatever the pattern of β 's are, that pattern may be described by a polynomial. In mathematics there is a theorem which states that under general conditions a curve may be approximated by a polynomial. A general rule of thumb is that the degree of polynomial should be at least one greater than the number of turning points in the curve. Assume the following technique:

$$\beta_i = a_0 + a_1 i + a_2 i^2 \quad (27)$$

where a_0 , a_1 , a_2 are constants that must be estimated. If equation (27) approximates a curve, it must be:

$$\begin{aligned}\beta_0 &= \alpha_0 (i=0) \\ \beta_1 &= \alpha_0 + \alpha_1 + \alpha_2 (i=1) \\ \beta_2 &= \alpha_0 + 2\alpha_1 + 4\alpha_2 (i=2) \\ &\quad \cdot \\ &\quad \cdot \\ \beta_k &= \alpha_0 + k\alpha_1 + k\alpha_2 (i=k)\end{aligned}$$

Therefore, to use the Almon method, all that is necessary is to count the number of turning points for the β 's, and then express β 's as a polynomial in i (Kelejian, 1981, 160).

Assume the following distributed lag model:

$$Y_t = \alpha + \beta_0 X_t + \beta_1 X_{t-1} + \dots + \beta_k X_{t-k} + u_t$$

Suppose we argue that a second degree polynomial is appropriate to describe the lag structure. We could take equation (27) and replace the expression in this equation. We may obtain:

$$Y_t = \alpha + \alpha_0 X_t + (\alpha_0 + \alpha_1 + \alpha_2) X_{t-1} + (\alpha_0 + 2\alpha_1 + 4\alpha_2) X_{t-2} + \epsilon_t \quad (28)$$

Rearranging terms in (28) gives us:

$$Y_t = \alpha + \alpha_0 \left(\sum_{i=0}^k X_{t-i} \right) + \alpha_1 \left(\sum_{i=1}^k i X_{t-i} \right) + \alpha_2 \left(\sum_{i=1}^k i^2 X_{t-i} \right) + \epsilon$$

or

$$Y_t = \alpha + \alpha_0 Z_{1t} + \alpha_1 Z_{2t} + \alpha_2 Z_{3t} + \epsilon_t$$

There are two important observations about Almon lag. First, there should always be some "end-point" restrictions imposed. This means that if $\beta_0 = 0$ is specified, the

suggestion is made that the value of the independent variable has no effect on the current period. One might also specify $\beta_k = 0$. This means that values of X lagged K or more periods have no effect on ϵ . Second, the appropriate degree for the polynomial must be chosen. Most economic behavior can be explained by a third or fourth degree polynomial. The number of lags may also be chosen. If using annual data, the lag would be a year or two. If quarterly data is used the lag could be 12 or 16 where a 3 to 4 year lag is used. However, the length of the lag should be greater than the degree of polynomial.

Data Collection

Probably the single greatest problem a researcher might face while analyzing third world scenarios is the problem with data inadequacy, data completeness, etc. Bangladesh was no exception. Data inadequacy, distorted data, and missing data have plagued this research.

The only source of complete data sets available is from International Monetary Funds (IMF) International Financial Statistics. However, IMF data set starts from 1978, seven years after the independence of Bangladesh. A sufficient time series data base cannot be formed from 1978 observations; therefore, this writer used the IMF published quarterly data from 1978 whenever it was necessary. The Research on National Income and expenditures of Bangladesh

published by the Bangladesh Institute of Development Studies was also used for a more lengthy time series data which dates back to 1949/50. Several issues of the Statistical Yearbook of Bangladesh, Foreign Trade Annual reports were used to complete aggregated and disaggregated data sets on imports, exports, trade balance, gross national product gross domestic product, national income deflator, domestic high powered money, etc. The task was difficult if not impossible given the large amount of data sources, but not having all the series in a single source.

Summary of Models

A summary of models used in this research is imperative at this stage. All the models except the J-curve model has been estimated using OLS technique and log-linear as the functional form. It is probably the most common functional form that is non linear in the variables, but still linear in the coefficients. Log-linear form is often used in computing elasticities in economic research.

Therefore, I ran multiple regression using OLS technique and log-linear functional form. All standard statistical tests have been performed on each import and export model to test the validity of the model. Once the model is statistically significant, it is then examined against the theoretical aspects. It is often argued that a good fit and significant t-ratios doesn't necessarily imply

that a model is accurate. It must make economic sense. In this research, every attempt has been made to explain the models, both statistically and theoretically. The following steps have been used in the empirical part of this research:

- (1) Use OLS technique and log-linear as the functional form.
- (2) Check for statistical significance and interpret parameter estimates, R^2 , standard errors, etc.
- (3) Check for autocorrelation and take necessary steps to correct it.
- (4) Check the model against economic theory.

CHAPTER BIBLIOGRAPHY

- Kelijian, Harry H. and Wallace E Oates 1981. Introduction to Econometrics. 2nd edition. Harper and Row Publishing.
- Krueger, Anne O. 1983. Exchange Rate Determination. Cambridge University Press.
- Miles, Marc A. 1979. The effect of devaluation on the trade balance and the balance of payments: Some new results. Journal of Political Economy. (June) 600 -620
- Orcutt, Guy H. 1959. Measurements of Price Elasticities in International Trade. Review of Economics and Statistics. (May) 117 - 131
- Pindyck, Robert S. and Daniel Rubinfeld. 1976. Econometrics Models and Economic Forecast. McGraw - Hill Book Company.
- Studenmund, A. H. and Henry J. Cassidy. 1987. Using Econometrics: A Practical Guide. Little, Brown, and Company.

CHAPTER IV

RESULTS AND INTERPRETATION

Chapter Overview

This chapter reports the results of the multivariate regression models using lag structures, and the polynomial lag distributed model formulated in Chapter 3. Interpretations of these results are also incorporated. The discussions have been carried out in a sequential approach. The first two sections analyze the aggregate import and export models. The next two sections discuss the aggregate and disaggregate import and export models. Finally, the J-curve model with different degrees are discussed at length.

Multivariate Regression Results of

Aggregate Import Models

The process of estimating aggregate import demand models was accomplished by using OLS methods with simple lag structure. The primary reason for using the lag approach is its ability to reflect the dynamic characteristics of import and export demand equations. The static log linear format fails to capture the dynamic features. To give the models more dynamic flair, quarterly data sets were used where possible. The following table analyzes the aggregate and disaggregate import equations:

TABLE 1
IMPORT DEMAND EQUATIONS

				AGGREGATE	
	Intermediate Goods	Consumer Imports	Capital Imports	Annual	Quarter
INTERCEPT	5.36	5.10	3.83	-36.79	-1.66
PRICE	-0.60 (-2.65)	-0.33 (-0.428)	-1.24 (-1.42)	-0.481 (-1.54)	-0.391 (-1.56)
GNP	0.34 (2.48)	0.28 (0.59)	0.67 (1.27)	5.401 (6.72)	1.14 (6.53)
ER	-1.28 (-7.91)	-0.82 (-1.50)	-2.71 (-4.35)	-0.301 (-1.07)	-1.18 (-3.01)
R ²	0.87	0.20	0.69	0.97	0.86
DW	2.78	2.86	1.64	1.51	1.93
F	21.33	0.788	6.689	167.53	39.473
N	13	13	13	15	23

As expected, the price elasticity coefficients, both in the annual model and the quarterly models, are statistically significant with the right sign. It is clearly indicative from the above equations that imports are relatively price inelastic, with a low price elasticity coefficient in the

short run. This explains why so many developing countries are extremely dependent on imports for their economic growth. Bangladesh is no exception. In Bangladesh, imports are excessively controlled by a complicated system of exchange control and import licensing. Thus import demands are never satisfied. Most of Bangladesh's imports are imported by the government, hence the public has very little choice of exchange rate changes. Finally, an automatic switch from imported goods to domestically produced goods is not possible because of very little or no available substitutes. Combining these factors, with the country's insatiable desire for foreign goods, one would expect a high priced inelastic import demand.

Income elasticity with respect to the import demand possesses the right sign (positive) for both the annual and the quarterly model. On the other hand, the exchange rate is not statistically different from zero in the annual model, but is statistically significant in the quarterly model. This suggests that in the short run, exchange rate fluctuations may explain the variations in imports, but in the long run the exchange rate does not play an important role because imports are relatively inelastic and to some extent autonomous. Price elasticities in our models suggest that the price elasticities are negative and inelastic but only at a 10% level of significance. A 5% or 2.5% level of significance would be desirable. Since most of the

devaluations (price effects) in Bangladesh have been carried out under the direct supervision of an IMF conditionality program, and not as an effort to be the government for a large scale trade liberalization strategy or an expansionary trade policy, it is unlikely that government trade policies have caused any distortions in the estimates.

Economists often encounter difficulties in estimating import demand equations due to specification errors, omission of variables, etc. It is even more difficult in the case of Bangladesh when there are quantitative controls due to presence of import licensing and quota restrictions. Price is not the only variable that determines the level of imports. Price elasticities may be slightly distorted and sometimes may even generate wrong signs. Nevertheless, estimates are run and whatever information is received sheds some light on the matter.

Interpretation of Disaggregated Import Functions

Using the reasoning for disaggregating aggregate models, we have attempted to estimate disaggregated import functions. Imports have been classified as intermediate goods, consumer imports, and capital imports. Table 1 above summarized the disaggregate import models.

The results of the disaggregate import models are mixed. Price elasticity coefficients are significant for intermediate and capital goods at 2.5% and 10% respectively.

From the coefficients it is obvious that intermediate goods are inelastic and capital goods are relatively elastic. The consumer import model has a poor fit due to low R^2 and insignificant t-ratios; however, it does provide a general view about elasticity. Consumer imports are probably inelastic in Bangladesh, partly due to the high marginal propensity to consume and the insatiable desire for foreign imports. All the models possess the right sign, which is a marked improvement over other studies conducted.

Multivariate Regression Results of Aggregate Export Models

Aggregate export models were estimated using multivariate regression techniques on annual and quarterly observations. Table 2 which follows summarizes the annual and quarterly export models.

All the coefficients in the export models are significant at the 1% level except the elasticity coefficient and the exchange rate coefficient in the quarterly model. It is expected that the price elasticity coefficient will be negative, income elasticity will be positive, and the exchange rate will be positively correlated with exports. A wrong sign for a coefficient implies omission of important variables or specification error. The aggregate export equations perform very well in tests of R^2 . As a matter of fact the R^2 's show a vast

improvement over other elasticity estimates by other writers. It appears that the demand for Bangladesh's exports, which are traditional in nature, are highly inelastic. Even though the income elasticity has the wrong sign, it is relatively inelastic. This suggests that Bangladesh, being a price taker in the international market, faces constraints in expanding exports even though GDP may go up in a certain year. Thus devaluations, even though reducing the price of exports, will not be successful if there is no supply response from its trading partners.

TABLE 2
EXPORT DEMAND EQUATIONS RESULTS

				AGGREGATE	
	JUTE	LEATHER	TEA	ANNUAL	QUARTER
INTERCEPT	-16.79	-48.888	1.2267	-2.89	-4.47
PRICE	.500 (3.376)	1.364 (3.398)	-1.735 (-2.005)	0.26 (2.57)	.24 (.97)
GDP	2.110 (12.084)	4.84 (10.304)	.538 (.552)	.77 (6.46)	.80 (2.83)
ER	-.24 (1.369)	1.66 (3.41)	2.705 (2.667)	.81 (6.52)	.48 (.76)
R ²	.98	.97	.84	.99	.72
DW	1.835	1.36	2.21	1.939	2.19
F	678.69	299.966	40.83	1018.14	14.838
N	27	27	26	26	21

The Marshall-Lerner Condition

For Bangladesh, it is obvious from Table 1 and Table 2 that the Marshall-Lerner condition does not hold. If we take the sum of the absolute value of import and export price elasticities, it can be readily seen that it is not greater than one, a condition which is not conducive for balance of payment stability. Theoretically, international trade would be stable and devaluation would improve trade balance if the sum of the absolute value of export and import price elasticities is greater than 1.

Interpretation of Disaggregate Export Equations

It is imperative that exports are broken down into several categories to estimate disaggregated export equations. The reason for disaggregation has been pointed out by Orcutt (1950). He argues that most of the equations estimated so far are total demand for imports and exports only. Historical price changes have been largest for goods that have low price elasticity. For example, one might expect traditional items to show a wider range of price fluctuations. This means when a general index is formed, and individual price indices are lumped together, a change in aggregate price index may be due to a price change of inelastic items. Since the price changes were followed by a small change in quantity, the price elasticity coefficients may be distorted and underestimated (Orcutt, 1959, 125). It

is imperative that the research examines the disaggregate functions. Exports have been disaggregated based on the share of each item in total exports and availability of data. The country's main exports are jute (a natural fiber), tea and leather.

It is apparent from Table 2 that price elasticities are markedly different. Jute, which has been the traditional source of export earnings, is relatively inelastic as suggested by Orcutt. Although Bangladesh is one of only a few countries that produce jute, and it may well be an oligopoly, the discovery of synthetic fiber and other close substitutes has drastically reduced its share of exports and its eminence status. On the other hand, tea and leather are relatively non-traditional items and possess relatively elastic price coefficients but with the wrong sign, which again could be due to specification error, simultaneity or omitted variables. All the other variables perform as expected with the exception of income and exchange rate in the tea and jute functions.

Interpretations of the J-Curve Coefficients

The J-curve model from chapter III in the form of

$$TB_t = \alpha_0 + \alpha_1 DM_t + \alpha_2 Y_t \sum_{i=0}^n \beta_i (E/P) + \epsilon_t$$

was estimated for Bangladesh using quarterly data from the International Financial Statistics for the period 1975 to

1988. In this model DM_t is the domestic component high-powered money, Y_t is the quarterly real gross national product, E is the exchange rate, and P is the price level. An expanded model with 12- to 16-quarter lags seems to present better estimates of the coefficients. The model used in this research is mainly in line with the model suggested by Krueger (Krueger, 1983).

With regard to the signs of the coefficients in the J-curve model, it is expected that $\alpha_1 < 0$. This is due to the fact that a rise in income will increase the demand for imports and hence deteriorate the trade balance. However, Magee (Magee, 1973) suggested that sign of α_1 could easily be positive if the country starts to increase production in the import substitute sector as income rises.

The sign of α_2 depends on several factors. First, individuals may perceive their wealth to rise as domestic money supply increases. This may cause their expenditure levels to go up and hence trade balance may deteriorate. Therefore, α_2 may have a negative impact on trade balance. Second, the negative impact may not be observable if nominal money balances are only a small fraction of total wealth. Furthermore, money may not be seen as a component of net wealth by the private sector, and expenses may not respond to a change in wealth. There may not be any real balance effect and the trade balance may not deteriorate. (Miles, 1979).

The exchange rate coefficient should possess a negative sign initially indicating deterioration of the trade balance and followed by a positive sign as the lag period increases. This is consistent with the J-curve hypotheses. Table 3 presents the most satisfactory results and the estimated lag structures.

The results summarized in Table 3 are very interesting and agrees with that of Oskooee's.(1984). Domestic high powered money has a positive sign and is statistically significant. It's sign is consistent with Miles's argument. It is probable that nominal money balances are a small fraction of nominal wealth, and expenditure may respond slowly to a change in income. Therefore, it is safe to conclude that the Keynesian real balance effect is insignificant in Bangladesh. The real income coefficient Y_t has the right sign with a good degree of statistical significance.

The exchange rate coefficients are rather interesting. Trade balance improves in Bangladesh for at least five quarters following devaluation (positive exchange rate coefficient). It then starts to deteriorate from the sixth quarter (negative exchange rate coefficients), and the coefficients are statistically significant in quarters 8 and 9. This may seem to be conforming to the so-called inverse of the J-curve hypotheses initially. When the model

continues beyond the 9th quarter threshold the trade balance starts to improve again. The behavior of the trade balance

TABLE 3
J-CURVE EQUATION RESULTS

$R^2 = .89$	$F = 45.37$	$DW = 1.62$	$N = 55$
VARIABLE		VARIABLE	
INTERCEPT	-24860.39	ER_{t-7}	-24637.73 (-1.2)
DM_t	.60 (7.55)	ER_{t-8}	-24965.87 (-1.8)
Y_t	-.063 (-9.53)	ER_{t-9}	-19201.32 (-1.7)
ER_t	281955.42 (3.25)	ER_{t-10}	-8935.7 (-.068)
ER_{t-1}	194411.2 (3.43)	ER_{t-11}	4239.5 (0.25)
ER_{t-2}	124101.97 (3.13)	ER_{t-12}	18731.61 (1.00)
ER_{t-3}	69435.2 (2.10)	ER_{t-13}	32950.10 (1.88)
ER_{t-4}	28819.5 (0.92)	ER_{t-14}	45302.87 (2.98)
ER_{t-5}	663.3 (0.02)	ER_{t-15}	54198.5 (2.52)
ER_{t-6}	-16625.23 (-0.6)	ER_{t-16}	58044.5 (1.37)

seems to be more like a cyclical fluctuation than a J-curve. It is safe to conclude that devaluation has a favorable impact only in the short term. After the initial period the trade balance behaves more cyclically. Therefore there are no evidences of a J-Curve type adjustment in Bangladesh.

CHAPTER BIBLIOGRAPHY

- Krueger, Anne O. 1983. Exchange - Rate Determination
Cambridge University Press.
- Miles, Marc A. 1979. The effect of devaluation on the trade
balance and the balance of payment: Some new results.
Journal of Political Economy. (June). 600 - 620.
- Orcutt, Guy H. 1959. Measurements of price elasticities in
International Trade. Review of Economics and
Statistics. (May) 117 - 131
- Oskooee, Bahmani. Mohsin. 1989. Devaluation and J - Curve:
Some evidence from LDC's. Errata. Review of Economics
and Statistics. (January) 553.

CHAPTER V

CONCLUSIONS

Analysis of Findings

The overall findings of this study lead to the conclusion that, based on the elasticity approach, the Marshall-Lerner condition for stability may not hold for Bangladesh. This is due to the fact that both imports and exports are relatively price inelastic and devaluation would not improve trade balance. This is not supported by the J - Curve results, however, where it has been found that the inverse of the J-curve phenomenon exists only in the short run. Overall, the J-Curve shows a cyclical pattern in the trade adjustment of Bangladesh. Therefore devaluation may not be a feasible solution to the balance of trade problems in Bangladesh. The findings of this research should be relevant in formulating trade policies. Hence, the results should assist any concerned authority of international commerce of Bangladesh.

From a policy option point of view, it is imperative to realize that price inelastic imports and exports, and an inverse J-curve effect leaves Bangladesh in a vulnerable position. Policies should be designed to make exports more competitive, efficient, productive, and gradually move to

the non-traditional exports. Import substitution policies should be replaced by export promotion, and a long-due revision of the exchange rate policy should be undertaken in order to avoid the cyclical swings in the trade balance.

The final analysis indicates that over the period which spans from the mid 50's roughly to the mid 80's, aggregate import estimates do conform to the stated hypothesis. The export equation, however, did not provide the correct sign for the price coefficient. Due to the reasons mentioned in the previous chapters, it would be safe to conclude that exports are relatively price inelastic.

Disaggregate import models reveal that basic commodities are relatively more price inelastic than capital goods. Disaggregate export functions show mixed results with jute being relatively price inelastic and the non-traditional exports showing a larger price elasticity coefficient. This has been found to be true for many developing countries. The J-curve effect is not observable in Bangladesh; however, the long run, steady-state effect of devaluation is favorable so that devaluation improves the trade balance for Bangladesh in the very long run. The short run effects are rather cyclical in nature and inverse of the traditional J-Curve approach.

The final results of this research are an addition to the existing body of knowledge in this field; however, their uniqueness rests on the fact that the research investigates

empirically the trade statistics of a less developed country, and traces the pros and cons of the mainstream theory from a developing country's point of view.

BIBLIOGRAPHY

- Ball, R.J. and K. Marwah. 1962. The U.S. demand for imports, 1948-58. Review of Economics and Statistics. (November): 395-401.
- Caves, Richard E., and Ronald W. Jones. 1977. World Trade and Payments. 3rd edition. Little, Brown, and Company.
- Chacoliades, Miltiades. 1973. The Pure Theory of International Trade. Aldine Publishing Company.
- Dernburg, Thomas F. 1989. Global Macroeconomics, Harper and Row Publishing Company.
- Ethier, Wilfred J. 1988. Modern International Economics. 2nd edition. W. W Norton and Company.
- Goldstein, M. and Mohsin Khan, 1976. Large versus small price changes and the demand for imports. IMF Staff Papers. 200-224.
- Harberger, Arnold, C, 1953. A structural approach to the problems of import demand. American Economic Review. VOL XLIII. 148-159.
- Horner, F.B. 1952. elasticity of demand for the exports of a single country. Review of Economics and Statistics. VOL XXXIV. 326-342.
- Houthakker, H.S. and Stephen Magee. 1969. Income and price elasticities in world trade. Review of Economics and Statistics. 2, 111-123.
- Kelijian, Harry. H. and Wallace E. Oates. 1981. Introduction to Econometrics: Principles and Applications. 2nd edition. Harper and Row Publishing Company.
- Kindelberger, Charles P. 1953. International Economics. Macmillan Publishing Company.
- Kreinin, Mordechai E. Price elasticities in International Trade. Review of Economics and Statistics. 49 510 - 516.
- Kreuger, Anne O. 1983. Exchange-Rate Determination. Cambridge University Press.

- Malach, Vernon W. 1957. Elasticity of demand for Canadian Exports. Review of Economics and Statistics. VOL XXXIX. 23-30.
- Melvin, Michael 1989. International money and Finance. 2nd Edition. New York. Harper and Row Publishers.
- Miles, Marc A. 1979 The effect of devaluation on the trade balance and the balance of payments: Some new results. Journal of Political Economy. (June). 600-620.
- Orcutt, Guy H. 1959. Measurements of Price Elasticities in International Trade. Review of Economics and Statistics. (May) 117-131.
- Oskooee, Bahmani Mohsin. 1984. Devaluation and J-curve: Some evidence from LDC's. Review of Economics and Statistics. (August) 500-504.
- 1989. Review of Economics and Statistics. (January). 553.
- Pindyck, Robert S. and Daniel Rubinfeld. 1976. Econometric Models and Economic Forecast. McGraw - Hill Book Company.
- Studenmund, A.H. and Henry J. Cassidy. 1987. Using Econometrics: A Practical Guide. Little, Brown, and Company.