EXCHANGE RATE PESSIMISM IN TANZANIAN MACROECONOMIC POLICY

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To correct balance of payments disequilibria many developing countries are experiencing, attention is focussed on visible trade deficit because capital markets are almost non-existent, capital mobility is strictly controlled and service trade is underdeveloped. Economic theory recommends devaluation if quicker response is needed and the destabilizing effects of contraction of money supply is to be avoided. Results of Marshall-Lerner condition test of some empirical studies indicate that devaluation may not be effective in developing countries thus making policy makers pessimistic on its use.

This study resolves the contradiction between theory and empirical findings by using modified assumptions of Marshall-Lerner condition which suit developing economies. It studies the stability of price elasticities of demand for imports in the Tanzanian economy during the period 1954-1981 with respect to changes in trade policy during the period. The study takes a trade deficit as the initial condition and denominates all trade in local currency. Lagged regression models are used to capture the delay between price change and response for both exports and imports. Real producer prices and quantity of agricultural export crops produced are used. For imports, relative unit value and quantity of commercial imports are used.

The study finds that elasticity of supply of exports are positive 0.68 with a standard error of 0.247. Elasticity of demand for imports are positive, long-run two year elasticity is 1.156 with standard error of 0.399 and for period 1972-1981, the three year elasticity is 1.528 with a standard error of 0.599. Trade policy and abnormal rise in prices of petroleum products had no effect on the elasticities. For devaluation to be effective if the response of only exporters is to be relied on the ratio of value of imports to value of exports has to be less than 1.2. If the response of only consumers of imports is to be relied on, the ratio should be less than 1.9.

The findings confirm the potential for devaluation to correct a trade deficit in Tanzania.

CHAPTER 1

Introduction

1.1 Overview

Balance of payments equilibrium is one of the goals of economic policy of sovereign states with open economies. A balance of payments disequilibrium can originate from any one of the components of balance of payments. The major components are the current account, which consists of the visible trade and the service trade, and the capital account. With modern developments of capital markets and information transfer, capital mobility is high and the capital account has assumed increased importance in developed countries. In developing countries, capital mobility is still low resulting in more attention continuing to be given to the current account. Even in the current account, more attention is given to the visible trade because the service trade is underdeveloped. In some developing countries, tourism is one activity that draws the attention of policy makers to the service trade.

If a state has its own money supply and a fixed exchange rate system, a balance of payments deficit can be corrected through contraction of the money supply. The process takes a long time and creates unemployment. These disturbances may be reduced by using exchange rate adjustment (devaluation). After independence, Tanzania continued to be a member of the East African Currency Board [EACB]. Countries in the East African

currency area had a common currency which was managed jointly (Kratz, 1966). One country could not unilaterally decide to influence the money supply or exchange rate to correct a balance of payments deficit. The EACB was disbanded in 1966.

In 1966 Tanzania established the Bank of Tanzania [BOT] as its central bank and issued its own currency. Since then, with a fixed exchange rate system, Tanzania government could unilaterally influence money supply through government deficit financing, domestic lending rates, exchange rate adjustment, and foreign exchange reserve management to correct balance of payments deficit. The choice of the tools (approach) to be used depends on the assumptions the authorities perceive to apply. There are four approaches. First, elasticity approach assumptions lead to the choice of exchange rate adjustments if the Marshall-Lerner condition is met (Bickerdike, 1920; Lerner, 1944; Robinson, 1937 and Stern, 1973). Second, under the absorption approach to balance of payments, a mixture of exchange rate adjustment (monetary policy) and expenditure adjustment (fiscal policy) have to be applied simultaneously (Alexander, 1952 and Corden 1977). Devaluation makes local goods cheap to foreigners thus increasing exports. The increased exports reduce the trade deficit and raise the foreign exchange reserves which the exporters convert into local currency thus increasing the domestic money supply. Monetary authorities have to sterilize the increased money supply to avoid an increase in the demand for imports or domestic consumption of the goods needed for exports

which would neutralize the reduction of the trade deficit. In this sense exchange rate adjustment is a monetary policy. Under expenditure approach, devaluation makes local consumers switch their expenditure from imports which have become more expensive to domestic goods whose prices are not affected by devaluation thus reducing the trade deficit. The increased demand for domestic goods leads to expansion of output and increased income. The increased income may increase the demand for imports or goods meant for exports, developments which would neutralize the reduction in trade deficit. Fiscal authorities need to take counter measures to reduce the increased demand for imports or domestic goods meant for export resulting from increased income. It can be done by raising taxes or reducing government expenditure. Expenditure switching effect of devaluation therefore has fiscal policy implications. Third, assumptions under the monetary approach choose the moderation of money creating domestic credit expansion (Helpman, 1976; Johnson, 1977; King, 1979; Mundell, 1968; Polak & Argy, 1971). The last approach, which addresses itself to developing economies, is the structural approach. The suggested effective solution in this case is change in the structure and institutions of the economy and some trade controls (Prebisch, 1959, 1961; Singer, 1950; Lewis, 1952; Bruno, 1979 and Cline & Weintrab, 1981).

1.2 Structural Approach

Prebisch (1959, 1961) and Singer (1950) represent arguments for the proponents of the structural approach. They assert that, historically, distribution of technological progress has been uneven. There is concentration of high technology in developed countries [DCs] and low technology in less developed countries [LDCs]. Production of capital and manufactured goods tend to absorb higher technology than food and primary goods. Higher productivity brought by technical progress make production of all commodities more capital intensive. They also need less raw materials per unit produced. The result is greater increase in demand for capital goods compared to the increase of demand for raw materials. This brings higher demand for labor in the sector producing capital goods compared to the sector producing raw materials. Income increases more in the capital goods sector compared to the sector producing raw materials. Prebisch and Singer point out that capital and manufactured goods have higher income elasticity compared to income elasticity of food and primary goods. The higher income brought by increased productivity brings an added demand for capital and manufactured goods compared to the increase in demand for food and raw materials. Benefits of technological progress and increased productivity is therefore unevenly distributed in favor of the capital and manufactured goods sector. This sector gets more increase in employment and income. When the increased demand for capital and manufactured goods is high, prices of capital and

manufactured goods may rise. The sector that produces food and raw materials has less increase in employment and income. High production may lead to a fall in prices because of the lower income elasticity of food and manufactured goods. Market forces in world trade prescribe specialization of production of capital and manufactured goods by DCs and production of food and primary goods by LDCs. This fits the description of the current status of the world economy. However, newly industrializing countries are successfully getting into production of manufactured goods. Prices of capital and manufactured goods exported by DCs and imported by LDCs tend to increase while prices of food and raw materials exported by LDCs and imported by DCs tend to fall. Thus terms of trade tend to move in favor of DCs. The situation gets worse if DCs take measures to protect their food and raw material industries. Structuralists observe that the two different structures of the economies of DCs and LDCs need different solutions to their trade and balance of payments problems. They advocate that LDCs produce some of the capital, intermediate and manufactured goods at home instead of importing all, (import substitution).

If the prices of exports and imports are determined by the world market in convertible currency, devaluation of the local currency increases prices in local currency of exports and imports. In the case of food and raw materials, an increase in exports beyond some level may depress prices because of low income elasticity and results in worsening the terms of trade.

Higher export prices increase income in the export sector, thereby raising the demand for imports and expanding the trade deficit. Higher import prices increase the prices of both consumer imports and inputs for the import substitution industries. Devaluation is therefore inflationary. Faced with these problems Prebisch and Singer conclude that devaluation alone without some intervention cannot be the solution.

Structural approach policy recommendations aim at either diversifying the economies of developing countries by increasing the proportion of domestic manufactures in their exports and domestic consumption or changing the terms of trade in favor of primary commodities (United Nations, 1953). Some countries, Tanzania being one of them, have tried to change the structures and institutions of their economies. They have attempted to increase the production of capital and manufactured goods. Various measures of trade control also have been used. OPEC members have tried to move terms of trade in favor of their products. In carrying out the structural and institutional changes and imposing trade controls, some of the macroeconmic policy tools may be made less effective.

1.3 Tanzanian Economic Policy

Tanzania has taken steps to change the structure and institutions of its economy since 1967 (Green, Rwegasira and van Arkadie, 1980). The almost non-existence of the capital market limits the options of measures policy makers can take, to correct

a balance of payments disequilibrium, to those which deal with the current account and the management of the foreign reserves. Though the potential for tourism in the service trade is there, it has not been developed to command a substantial proportion of total foreign exchange earnings. Policy is therefore mainly focused on visible trade. Green et al. (1980) believe that the rare use of exchange rate adjustment as a tool of Tanzanian macroeconomic policy has been a deliberate choice. Mtei (1973b)[1], Green et al. (1980) and Nyirabu (1984)[2] observe that Tanzania is a price taker in both import and export markets. Exchange rate adjustment cannot influence external terms of trade. It can influence only internal terms of trade. Government sets producer prices of most export commodities. Since 1971 import duties and price controls have widely determined prices of imported goods. These tools are considered to be more flexible and precise than devaluation. Moreover they do not have the side-effects of devaluation. Devaluation is a tool used only if there are large imbalances or if there are special domestic problems that make it preferable to the other instruments. Nyirabu (1984) states:

> Devaluation of the currency should thus be viewed as part of the mix of policies designed to revive the economy and not a panacea for all economic ills. . . . How successfully devaluation is translated into expansion of exports and import substitutes depends, as I emphasized earlier, on the whole range of supportive measures.[p. 43]

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[1] E. I. M. Mtei was governor of Bank of Tanzania for the period 1966-74.

[2] C. M. Nyirabu was the governor of Bank of Tanzania for the period 1974-1989.

This suggests that according to Tanzanian policy makers not only is devaluation used cautiously but it also has to be supported by other measures.

1.4 Phases of Tanzanian Trade Policy

The Tanzanian economy has had three phases of trade policy. There has been a phase of almost free trade, followed by a phase of trade restrictions using the price mechanism, and lastly a phase of quantitative import restrictions. There has been a time when domestic prices of imports and quantitative import controls were effective at the same time. With the assumption that consumer responses to price fluctuations remained the same over the time, significant changes in elasticities can be attributed to changes in the import and exchange control regimes. Reviewing the import and exchange control policy in Tanzania may identify the dates of policy changes. Data analysis of the entire period can test the stability of regression parameters and find out whether policy changes were responsible for any significant changes in import price elasticities.

1.5 Agricultural Inputs

In Tanzania an increase in production of agricultural export crops in the 1960s was realized through expansion of farming areas. Since traditional methods of farming which needed no imported inputs were used, import restrictions had a negligible effect on export price elasticities. As areas and quality of land

approached their limits, better technology and agricultural inputs were needed to increase production. Farm machinery and fertilizers had to be used. These could only be procured through imports. Around that time, Tanzanian planners were expanding the manufacturing sector with import substitution industries. The objective was to diversify exports, reduce overdependence on exports of agricultural commodities in raw form, and increase the proportion of exports of manufactured goods and processed agricultural products. These needed importation of industrial capital goods, spare parts and other inputs. The proportion of manufactured and processed agricultural commodities to total exports has not reached a level to have much effect on export price elasticities. It will be shown below that industrial policy had a strong effect on import policy which may have influenced import price elasticity. The effects of trade restrictions on export price elasticities in Tanzania would therefore be indirect through quantitative restriction of imports of agricultural machinery and inputs.

1.6 Foreign Exchange Control in Tanzania

Foreign Exchange control in Tanzania has existed since the colonial times in the early 1920s. Tanganyika and Zanzibar[3] were part of the Sterling area. The effect of exchange control on balance of payments was negligible. Tanganyika and Zanzibar could

[3] Tanganyika and Zanzibar united on April 26th, 1964 to form the United Republic of Tanzania.

get most of their import supplies from within the Sterling area to the extent of making infinite elastic supply of imports valid. Mtei (1973a) notes, "Since very few people in Tanganyika and Zanzibar ever wanted to pay for or purchase anything from outside the sterling area, exchange control rules were not felt to be stringent" [p.46].

June 11, 1965 marked the departure from this regime. On that date Tanzania decided that there would be foreign exchange and payments restrictions between Tanzania and the rest of the world with the exception of Kenya and Uganda (International Monetary Fund [IMF], 1966). This was done concurrently by Kenya and Uganda allowing free exchange and payments between the three countries. This regime operated until March 18, 1971 (IMF, 1972). In examining this period, Annual Report on Exchange Restrictions of the IMF for these years document that over time the Open General Licence [OGL] regularly reviewed:

a. countries from which imports could be made or were restricted.

b. list of commodities that could be imported freely without need of specific licensing.

c. list of commodities that needed specific licensing.

d. list of commodities whose imports with or without licensing were confined to specific public organizations.

e. list of commodities whose imports were banned.

Throughout this period import licensing was exercised by the Import Controller in the Ministry of Trade. Foreign Exchange

control was directly administered by the Treasury up to April 16, 1966 when treasury delegated it to Bank of Tanzania (IMF, 1967). Security and health were the main reasons for banning imports during this period. According to the IMF annual reports the number of items from outside East Africa that needed specific licensing and could be quantitatively restricted increased between 1965 and 1971. Most of imports from Kenya and Uganda were unrestricted but required specific licensing. Though it is not stated specifically, various IMF and Tanzania government documents suggest that import control was mostly done through the price system where imposition of duties and taxes was expected to reduce imports rather than using quantitative restrictions. Transfer taxes also applied to some commodities imported from Kenya and Uganda. If this observation is correct, import price elasticities may be used to measure the response of general consumers to changes in domestic prices of imported goods. If import licensing imposed severe quantitative restriction at any time during this period, import price elasticities would have changed. At this time Tanzanian, Kenyan and Ugandan currencies were freely circulating between the three countries. Quantitative restrictions would have been very difficult to enforce. The nature of the borders is such that smuggling would have been rife and the effect of the controls would have been minimal.

1.7 Quantitative Trade Restrictions in Tanzania

On March 17th, 1971, foreign exchange control including prohibition of free circulation of Tanzanian currency was extended to Kenya and Uganda (IMF, 1972). From this date quantitative import restriction assumed an important role. Nyirabu (1978) states that this was facilitated by the introduction of the "Finance, Credit and Foreign Exchange Plan" during the 1971-1972 financial year, as "the basic tools of short to medium run macro-economic policy" [p. 50]. He describes the role of the annual foreign exchange plan in particular as, "to try to match the demand for foreign exchange likely to arise during the financial year with the supplies likely to be available" [p. 49]. Import control administration was moved from the Ministry of Trade to Bank of Tanzania effective from November 26, 1971 (IMF, 1972).

In reviewing the 1966-1976 economic development of Tanzania Bank of Tanzania (1976) states:

> Over the past ten years period the country's industrial policy has been geared to the expansion of existing import-substituting consumer goods industries. In 1974 emphasis was also placed on the development of basic industries and small scale rural industries and expansion of food processing industries for export. . . . The high rate of growth of imports is the combined result of several factors. Imports of items having a high priority in the developmental context such as capital goods, raw materials for industry, imports for agriculture and fuel oil have increased due both to volumes and price increases. Increases in import volumes are a direct consequence of the strategy of development particularly that in industrial sector.[p. 11]

In allocating foreign exchange and therefore setting import quotas Nyirabu (1974) states:

> we have to take into account the essentiality of the item, the extent to which domestic production of similar items can satisfy the demand, the quantities imported in the past, the stocks remaining from such importation, and finally the amount of foreign exchange now asked for in relation to the total amount of foreign exchange available for allocation. [p.51]

It is apparent from the above discussion that the Tanzanian financial year 1971-1972 is very significant in import and exchange control policy. Finance, Credit and Foreign Exchange Plan introduced a new policy. The steps taken to implement the new policy included the prohibition of circulation of Tanzanian currency outside the country and the transfer of import control administration to Bank of Tanzania. In considering allocation of foreign exchange thus import quotas, price is not mentioned. It is only mentioned when considering sources of supply. Since then price seems to have ceased to be the equilibrating mechanism between supply and demand of imports. This is likely to have a direct effect on price elasticity of demand for imports and an indirect effect on elasticities of supply of exports an issue of politically even greater importance.

1.8 Significance of the Study

This longitudinal study of the economy of Tanzania expresses all prices in domestic currency. It examines whether exchange rate adjustment as an appropriate tool for Tanzania is supported by the Marshall-Lerner condition assuming infinite price

elasticities of export demand and import supply. It also examines the effect of import and exchange control policy on the magnitudes of price elasticity of import demand. The study derives necessary and sufficient conditions for devaluation to be an effective tool.

1.9 Objective

The first objective of this study is to test the validity of exchange rate adjustment as an appropriate tool for improving trade balance of the Tanzanian economy. The second is to examine the stability of the price elasticities of imports with respect to changes in Tanzanian trade policy between the periods 1954-1971 and 1972-1981.

1.10 Statement of the Problem

Tests on economies of developing countries and on economies of developed countries of the inter-war period using Marshall-Lerner condition has tended to support the view that exchange rate adjustment is not an appropriate tool to solve problems of balance-of-payments. This contradicts orthodox economic theory, and has led to controversy between the International Monetary Fund and developing countries on the use of the economic tool.

1.11 Purpose of the Study

The purpose of this study is to examine the possibility of resolving the contradiction between classical theory and

empirical data on the effectiveness of devaluation as a tool for improving trade balance in a developing economy. Specifically the study will attempt to answer the following research questions:

1. What are the price elasticities of demand for imports and supply of exports in the Tanzanian economy over the period 1954-1986?

2. Did the import price elasticities remain stable when imports and exchange control policies changed between the periods 1954-1971 and 1972-1981.

3. Do the elasticities meet the Marshall-Lerner condition for the use of devaluation as a macroeconomic policy tool to improve balance of payments if the price elasticities of export demand and import supply are assumed to be infinite?

1.12 Hypotheses

To answer the above research questions the following hypotheses are tested:

Ho1: Import demand and export supply elasticities are zero.

Ho2: Price elasticities of import demand under the two import and exchange control regimes of 1954-1971 and 1971-1981 are the same.

Ho3: The magnitudes of price elasticities of supply of exports and demand for imports do not meet the Marshall-Lerner condition for devaluation to improve trade balance if price

elasticities of export demand and import supply are assumed to be infinite.

1.13 Summary

Division of world economy into the DCs with concentration of high technology and LDCs with a concentration of low technology is a historical reality. Law of comparative advantage prescribes specialization in production of capital and manufactured goods by DCs and production of food and primary goods by LDCs. Income elasticities of capital and manufactured goods differ from that of food and primary goods. As a result, technological progress distributes benefits of development in favor of DCs. Empirical studies have raised questions on the effectiveness of devaluation to improve trade balances of developing countries. Trade policy is suspected to be one of the causes of unexpected empirical findings. This chapter has shown that the history of import and exchange control policy in Tanzania has changed from almost free trade before 1966, to increasing restrictions through price mechanism between 1966 and 1971 and quantitative restrictions after 1971. This study will examine these two issues with respect to the economy of Tanzania during the period 1954-1986. The next chapter presents the literature review for the study.

CHAPTER 2

Literature Review

Chapter one introduced the ongoing debate on the effectiveness of exchange rate adjustment as a tool for improving trade balance in a developing economy. Some effects of trade policy on price elasticity of imports and exports were discussed. It described the history of import and exchange control policy in Tanzania. This chapter presents the literature review for the examination of devaluation as a tool to improve the trade balance of the economy of Tanzania.

2.2 Marshall-Lerner Conditions

Exchange rate adjustment is one of the economic tools for correcting a trade deficit. It has the advantage of having a measurable condition to determine the potential of its effectiveness. The Marshall-Lerner condition stipulates that when trade is balanced, the numerical sum of elasticities of demand for imports with respect to prices of imports in the domestic economy and elasticity of demand of domestic exports with respect to price of exports in the rest of the world economy should be greater than one (Lerner, 1944; Robinson, 1937; Stern, 1973). Elasticities found by some studies (Addler, 1945, 1946; Hinshaw, 1945; Chang, 1946a, 1946b, 1948) have tended to support the view that devaluation may not be effective in developing economies and the developed economies of the inter-war period. Systematic study

to determine the sensitivity of the magnitude of elasticities to differences in structures and trade policies of an economy has not been made. A longitudinal study of an economy which has undergone changes in its economic structure and trade policies or cross-sectional study of economies with different structures and trade policies would address the issue.

Williamson (1983) has shown that two cases of Marshall-Lerner condition can be identified depending on the type of economy. A small economy [case one] is one in which the elasticities of export demand and import supply are assumed to be infinite. An increase in exports of the domestic economy, in other words would not influence the price and demand of exports in the world market. Producers can sell all the quantity they produce at the going price. Similarly a change in domestic demand would have no effect on world prices. The second case [case two] is where the price elasticity of export supply is assumed to be infinite. This assumes unlimited resources to produce goods for export. Case two has received a lot of attention. Case one which has not received much attention seems to be more appropriate to developing countries. Case one assumes that price elasticities of demand for exports and supply of imports is infinite. Case two assumes that the elasticities of supply of exports and supply of imports are infinite. For exchange rate adjustment policy to be effective in case one when there is balanced trade the numerical sum of price elasticities of supply of exports and demand for

imports should be greater than zero. For case two the sum should be greater than one.

Studying the exports of Tanzania for the period 1956-1965 Faaland and Dahl (1970) state:

> We have made several abortive and perhaps pointless attempts to establish meaningful relationships determining exports of individual major products or groups of products as functions of demand conditions in receiving countries. . . . It seems quite clear that quantities of exports from Tanzania of many products are determined by supply conditions in Tanzania rather than by world demand. . . . On the other hand while demand factors in importing countries are no doubt playing a role in determining the state of world markets for such exports as Tanzania offers, Tanzania remains - with a possible partial exception of sisal - a very small supplier which can largely take the price as given and sell practically any amount it wishes to export at that price or only slightly below. [p.13]

For the period 1965-1980 Rashidi (1984) observes that in Tanzania government guarantees the purchase of all export crops at the government fixed prices. The observations of Faaland and Dahl (1970) and Rashidi (1984) fits with Williamson's (1983) case one assumptions.

With the original Marshall-Lerner assumptions Robinson (1947) looked at the effect of denominating all prices in domestic currency as opposed to denominating them in foreign currency. She also looked at the case of trade imbalance. Tanzania reports her trade statistics in local currency and has had a trade deficit since 1970. It will be interesting to combine Robinson's (1947) consideration of a trade deficit and use of local denomination with Williamson's (1983) modification in

Marshall-Lerner condition assumptions when studying the economy of Tanzania.

2.3 Effect of Quantitative Trade Restrictions on Response of consumers of imports to price changes

Writers (Cooper, 1971; Houthakker & Magee, 1969; Khan, 1974a and Rashidi, 1984) have mentioned the possibility of trade restrictions influencing the magnitude of import price elasticities. In an economy with export sector heavily dependent on imported inputs, import restrictions reduce quantity of exports. This reduces the magnitude of price elasticity of exports. Import restrictions may reduce quantity of imports. When domestic prices of imported goods are allowed to determine the allocation of imports, the result is a higher proportional price increase compared to when there are no restrictions thereby reducing the magnitude of import price elasticity.

2.4 Magnitude of Price Elasticities of Exports and Imports

Propositions about the magnitudes of the elasticities of demand for exports and imports started in the late 1930s. Machlup (1950) states that the first attempts of quantitative estimates from statistical research had been available since the mid-1940s. Among the first results were Addler (1945, 1946), Hinshaw (1945), and Chang (1946a, 1946b, 1948). The estimates used trade data and price indexes of the U.S.A., Britain and other developed countries for the period 1919-1939. Machlup (1950) notes that the

magnitudes of elasticities varied over a wide range and some were inconsistent. Some of them were much below unity. Using the Marshall-Lerner condition the magnitudes of elasticities led to the conclusion that devaluation would have adverse effects to the economies. Since then devaluation has been a controversial issue among researchers (Asheghian & Foote, 1988). The debates range from the assumptions of the Marshall-Lerner condition and the quality of the data used (Machlup, 1950) to the statistical methods used in the estimations (Orcutt, 1950). Others joined the debate (Morissett, 1953 and Polak, 1950). Later studies seem to have found higher magnitudes of elasticities Khan (1974a).

The findings that inter-war data for developed countries give low elasticities while post-war data give higher elasticities seem to support the arguments of structural approach. The structuralists argue that inter-war economies of developed countries could be equated to developing economies. The empirical studies on various economies and sectors of economies have brought no conclusive results so far (Cooper, 1971; Da Costa, 1965; Dutta, 1965a; Khan, 1974a; Lipumba, 1983 and Rashidi, 1984). Cooper (1971), Houthakker & Magee (1969), Khan (1974a) and Rashidi (1984) have indicated that trade policies in the form of import and exchange control may influence the magnitudes of the elasticities of supply of exports and demand of imports.

2.5 Estimation Methods

For some studies data covered post-war periods and used new statistical estimation techniques while other studies used the same estimation methods (Ball & Mavwah, 1962; Harberger, 1957; Junz & Rhomberg, 1965; Kreinin, 1961; and Scott, 1963). Preeg (1967) observes that the studies by Prais, 1962 and Preeg, 1963 indicate that discriminatory use of "classical" statistical methods and direct observations from published trade data can produce more reliable results than was formerly believed.

Developments in econometrics methods have improved tools for studying elasticities. Modern standard econometrics textbooks discuss ways of treating both contemporaneous and non-contemporaneous response relationships. The latter are discussed under distributed lag models. Various methods of handling multicollinearity which is one of the main problems in distributed lags models are also covered. Almon (1965), Schmidt (1974a, 1974b), and Mitchell and Speaker (1986) have demonstrated how coefficients of infinite lags with flexible shapes using ordinary least squares methods can be estimated. Tests of stability of linear model parameters can be done using prediction and dummy variable models of restricted ordinary least squares or switching regressions model.

2.6 Switching regressions models

For the deterministic models Quandt (1958, 1960), developed a maximum likelihood [ML] method of determining the

switching point. Chow (1960) developed an ML method for testing the equality of two sets of regression parameters [Chow test] when the switching point is known and the error terms in the two periods are homoscedastic. Toyoda and Ohtani (1986) extends the Chow test to cover the case when the error terms are not homoscedastic. Brown, Durbin and Evans (1975) discuss tests based on recursive residuals. The D-method developed by Goldfeld and Quandt (1972) is a more general formulation where deterministic switching is based on other variables. It can handle more than one switching points. Gallant and Fuller (1973), and Ferreira (1975) amongst others contributed to the development of the deterministic models.

In the case of stochastic models, Quandt (1972) designed a ML method of estimating the switching point and testing the significance of the change in regression parameters. Other studies that have covered stochastic models are Thomas (1969), Behboodian (1972), Goldfeld and Quandt (1973) Belsley (1973) and Cooley and Prescott (1973).

While the above deterministic and stochastic studies covered non-serially correlated error term cases Goldfeld and Quandt (1976a) extended the studies to cover serially correlated cases using the D-method for stochastic models and Quandt's method for deterministic models. Goldfeld and Quandt (1976b) consider estimation of structural changes in simultaneous equation models. Goldfeld and Quandt (1976) gives a good review on studies on switching regressions and their applications.

2.7 Summary of Literature Review

Balance of payments theory prescribes different macro-economic policy tools to improve balance of payments problems depending on the assumptions perceived to apply to the particular economy. Empirical studies do not give conclusive evidence of devaluation as an effective tool. Improvement in techniques of estimating elasticities have not resolved the controversy.

Next chapter will describe the data and methods that will be used to study the economy of Tanzania.

CHAPTER 3

Data and Methods

Literature review of chapter two showed the need of more investigation on the usefulness of devaluation to improve trade balance of developing countries. This chapter discusses methods that will be used to estimate the elasticities for the Tanzanian economy and testing their significance and the stability of price elasticity of demand for imports during the period the economy underwent policy changes. The two special cases of Marshall-Lerner conditions for devaluation to improve balance of payments are derived.

3.2 Exports

Tanzania's exports mainly consist of agricultural crops. This study considers seven of these crops broken down to eleven marketing grades. Breaking them into grades is needed to take into account the shift of emphasis by farmers from one grade to another in response to changes in differences in prices between grades. Though there are slight differences between different sources, data on prices of various grades of crops and quantities marketed are fairly reliable for the period 1970-1981. During this period the government set the prices the farmers were actually to receive for their crops. For the period 1964-1969 prices set were those which the Cooperative societies were to

receive. Farmers actually received less than these prices as the cooperative societies deducted some fees for services they rendered. The prices varied from one region of the country to another. The average national prices as reported by the Tanzania Background to the Budget/Economic Survey of various years are the ones used. In some cases data given by the Statistical Abstract are used. The difference between the two sources is not much as units preparing the two are within the same ministry.

The study assumes that farmers respond to real rather than nominal prices. The prices are deflated using the consumer price index with base year 1980. The national Consumer price index (NCPI) published by the Bank of Tanzania has been used for the period 1969-1981. No national consumer price index was compiled prior to this period. The Retail Price index of goods consumed by wage earners in Dar es Salaam with base period 1951 is used for the period 1952-1968. The two series are linked at year 1969. Since the NCPI is an index of urban dwellers in Tanzania, the difference between the two for the period involved is not much as there was not much difference between Dar es Salaam and other towns. However there is a genuine concern that there is a difference between consumer prices in towns and rural areas especially when consideration is given to the costs of housing and food faced by urban dwellers. If imputed values are used for these costs in rural areas the difference is reduced. Since the main objective of this study is to examine the response of producers to changes in prices, while the actual prices may

differ between towns and rural areas, the difference in percentage changes from year to year is expected to be small.

Mshomba (1987) and others indicate that some crops were sold in the black market especially in the border regions where either prices across the border were higher, or consumer goods not available in the country could be purchased across the border. This study assumes that this takes place in response to dissatisfaction of the level of producer prices. Similarly the efficiency of the marketing systems is reflected in the higher operating costs of the institutions resulting in lower prices paid to farmers.

Quantum and real producer price indexes are compiled using the Lespeyres formula. The period 1964-1971 has the base year 1966, and the period 1971-1981 has the base year 1976. Using 1971 as the link overall indexes with base year 1976 are compiled to be used for estimating the price elasticities of supply of exports.

3.2.2 Export elasticities estimation method

The response of farmers to changes in producer prices is reflected through change in quantities of the crops marketed. This change in quantity can be achieved by planting more of the crop, improving the husbandry of the already planted crop, or selling more of an accumulated stock of the crop. The use of marketed crop figures discounts crop accumulation as this would usually be done by the marketing bodies rather than the farmer.

There is a gestation period between planting and bearing of the first fruit. The gestation period varies between various Tanzanian crops. Acland (1973) states that the gestation periods are two to four years for coffee, one and a half to four years for sisal, two to three years for tea, and three years for cashew nuts. Cotton, tobacco and pyrethrum are annual crops. For the perennial crops, once they start bearing fruit they continue for a long time in some cases even up to more than twenty years. During this time the crop husbandry effect adds to the planting effect whose decision was made much earlier. The crop husbandry effect has a much shorter gestation period. Clearing of undergrowth and pruning in the cases of cashew nut and coffee respectively can have an effect the following fruit bearing season. The effect of mulching, use of manure and fertilizers, pruning in the case of tea, and pest and disease control have longer gestation periods and their results last for more than one fruit bearing season.

The above discussion points to the fact that responses to changes in prices can be spread over a period of from the same year when prices are announced in advance to several years from the date the prices take effect. This led to the decision of using the distributed lag model. Given that the maximum gestation period from planting to the first fruit is that of coffee and sisal which is four years, a maximum lag of five years has been assumed for the estimation equation. The polynomial inverse lag [PIL] of Mitchell and Speaker (1986) [MS] is used. This method

has the advantage of the data deciding on the degree of the polynomial and it accommodates various shapes of the lags. Though the authors used it for an infinite lag case they suggest that it can also be used for finite lags.

The estimating equation is:

$$X_t = A \prod_{i=0}^{5} P_{(t-i)}^{w_i} e_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1).$$

where:

X_t = quantum index of crops marketed in year t.

$P_{(t-i)}$ = real producer price index for year (t-i).

w_i = real producer price elasticity of supply of exports at time t for price at time (t-i).

e_t = error term.

A log transformation of this equation gives:

$$LnX_t = \ln A + \Sigma w_i \ln P_{(t-i)} + e_t' \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2).$$

Since correlation between the various lags is expected, the data are transformed to take care of multicollinearity. The PIL transformation gives:

$$w_i = \sum_{j=2}^{n} \frac{a_j}{(i+1)^j}, \quad i = 0, 1, \ldots\ldots\ldots 5 \quad \ldots\ldots\ldots\ldots (3)$$

and

$$LnX_t = \ln A + \sum_{j=2}^{n} a_j Z_{jt} + e_t' \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

where $$Z_{jt} = \sum_{i=0}^{5} \frac{\ln P_{(t-i)}}{(i+1)^j}, \quad j = 2, 3, \ldots . n \quad \ldots\ldots (5)$$

Equation (4) is used to estimate a_j s. When OLS was used to estimate equation (4) the Durbin-Watson d-value did not rule out the presence of autocorrelation. The Autoreg procedure of SAS package was used to correct for the autocorrelation as suggested by MS. Dropping the first X_t of equation (4) during the estimation gave the best results. The w_i s are derived using equation (3). The standard errors of the w_i s and their sum are calculated using the covariance matrix of the a_j s estimates.

3.2.3 Test statistics

A t-test is applied to each of the w_i s and the sum over all the lags with the null hypotheses H_{o1} : $w_i = 0$ and H_{o2} : $\Sigma w_i = 0$ respectively. A t-value exceeding the critical value leads us to reject the null hypotheses. The w_i s are expected to have positive values because farmers are expected to produce more when prices are increased and produce less when prices are decreased. The alternative hypotheses then are: H_{11} : $w_i > 0$ and H_{12} : $\Sigma w_i > 0$ respectively. The sum of coefficients reflects the long-run response covering the period. However applying this method Mitchell and Speaker (1986) got opposite signs for some lags whose true values were zero.

3.3 Imports

Detailed data on Tanzania's imports are available in Annual Trade Report [ATR] published by the Customs Department. This

gives quantities imported and the CIF values of trade items up to six digits of the International Standard Trade Classification [SITC]. The quantities and values are as declared by the importers. The customs officers are required to check the accuracy of the information. Since the quantity and value declaration is used for the assessment of customs duties, understatement of either value or both can be expected. To obtain the unit value a consumer pays for an item one needs to add to the CIF unit value, the taxes, and wholesale and retail trade margins. In Tanzania most of the taxes on imports are collected by the customs department. Information is available in the ATR. Wholesale and retail trade margins data are not available. This study uses the CIF plus taxes information. Since this study considers proportional changes of quantities and prices rather than the actual prices, the bias introduced because of using this information is expected to be negligible. To derive relative prices the CIF plus tax unit values are deflated using the NCPI.

First, introduction of quantitative import restriction assumes that non-government consumers of imports are not responsive to changes in prices of imports. This study intends to find the response of non-government consumers of imports to the price changes in the absence of quantitative import restriction and in the presence of the restrictions. This will determine the effectiveness of quantitative import restrictions on making non-government consumers of imported goods more responsive to price changes. Second, it is the government which takes action to

correct trade balance. If the government realizes the need, it can reduce imports of goods for government consumption without the need of devaluation. Devaluation is mainly meant to make non-government consumers of imports to reduce their imports by making the imports more expensive. To capture these two aspects, this study includes only commercial goods omitting goods imported for government use.

The quantum and unit value indices were compiled using 72 SITC six digit items. The choice was constrained by the requirement that the physical appearance and use of the items be about the same for the entire period of study. All groups except group nine of the SITC were covered. Group eight was represented by one item, khanga[1].

Lespeyres formula is used in compiling the quantum and price indexes. The base periods were 1956 for the period 1954-1962, 1966 for the period 1962-1971 and 1976 for the period 1971-1981. The linking at 1962 and 1971 facilitated the calculation of overall indexes with base year 1976.

The quantum index of 1978 is an outlier (see figure 4.3-4.6). There were above normal imports of sewing machines, batteries for motor vehicles, and dry cells. Imports for batteries for motor vehicles fluctuated widely during the period. The high imports of sewing machines and dry cells could not be explained. The index was included in the regression estimation.

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[1] Khanga is printed cotton cloth used by African women of all walks of life both in rural and urban areas in Tanzania.

The gross domestic product at market prices figures at 1980 prices were extracted from the International Financial Statistics (IFS) of the International Monetary Fund for the period 1964-1981. GDP at market prices were extracted from the Statistical Yearbook of the United Nations Statistical Office for the period 1954-1964. The 1964-1981 GDP deflator from IFS was linked to the retail price index of goods consumed by wage earners in Dar es Salaam for period 1951-1964 to get the GDP deflator for period 1951-1963.

3.3.2 Import elasticities estimation method: Nominal unit values

This study assumes the consumer's decision to buy an imported good depends on his/her level of income and the price of the good. This relationship is represented by the regression equation of quantum index of imports on real gross domestic product lagged by one year and distributed lag of nominal unit value index of imports with two lags. The lags take account of delays in importation procedures which result in a time lag between ordering and arrival of imports. Two years has been assumed to be the maximum length of the lag. The time lag is shorter when there are no foreign exchange and import controls. A multiplicative model is used, which is log-transformed to enable the use of ordinary least squares. Autoregression procedure was used to correct for autocorrelation.

The regression equation is:

$$M_t = BY_{(t-i)}^{b_y} \prod_{i=0}^{q} U_{t-i}^{b_i} e_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (6)$$

where:

M_t = quantum index of imports.

$Y_{(t-1)}$ = gross domestic product in year (t-1).

b_y = income elasticity of demand of imports.

$U_{(t-i)}$ = unit value index at time (t-i).

b_i = price elasticity of demand of imports.

B = the constant of regression.

q = the maximum lag number.

e_t = the error term.

Log transformation gives:

$$LnM_t = LnB + b_y \ln Y_{(t-1)} + \sum_{i=i}^{2} b_i \ln U_{(t-i)} + Lne_t \quad \ldots\ldots (7)$$

Equation (7) is used to estimate the elasticities for the period 1954-1981[2].

3.3.3 Test statistics

The null hypotheses to be tested are:

1. H_{o1}: bi = 0, with the alternative hypothesis H_{11}: $b_i > 0$.

2. H_{o2}: $\Sigma b_i = 0$, with the alternative hypotheses H_{12}: > 0.

---

[2] A dummy variable of zero or one multiplied to any variable in equation (7) implies a multiplication of the variable by e to the power of zero or one respectively in equation (6).

The second null hypothesis is for testing long-run elasticities of two and three years.

To examine the effect of import and exchange control policy changes during the period three methods may be used.

a. Out of sample (Prediction) method: Equation (7) is used to estimate the elasticities for period 1954-1971 giving an unrestricted residual sum of squares SSE. The elasticities are again estimated using data for period 1954-1981, giving a restricted residual sum of squares SSE_R. The restriction here is that the estimated elasticities remain the same for the prediction of each of the additional time periods. An F-test has the F-statistic:

$$F = \frac{(SSE_R - SSE)/g}{SSE/(n-k)} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (8)$$

where g = number additional observations beyond 1971.

n = number of observations during period 1954-1971.

k = number of parameters (bs) to be estimated including the constant.

This test statistic tests the validity of using the k regression estimates using data for period 1954-1971 to predict the observations of period 1972-1981. An F-value (or its reciprocal if it is less than one) exceeding the critical value leads to rejection of the null hypothesis Ho: it is valid to use the regression estimates.

b. The dummy variable regression method: If there exists two

different sets of parameters to describe the data for the two time periods i.e.

for period 1954-1971:

$$Q_{1t} = A_1 + b_{1y} \ln Y_{(t-1)} + \sum_{i=0}^{2} b_{1i} P_{(t-i)} e_1 \quad \ldots\ldots\ldots \quad (9a)$$

for period 1972-1981

$$Q_{2t} = A_2 + b_{2y} \ln Y_{(t-1)} + \sum_{i=0}^{2} b_{2i} P_{(t-i)} + e_2 \quad \ldots\ldots\ldots\ldots \quad (9b)$$

Using dummy variables and combining the two equations:

$$Q_t = A_1 + \delta_2 D_{2t} + \Sigma\, b_1 \ln P_{(t-i)} + \Sigma\, \tau_2 (D_2 \ln P_{(t-i)}) \quad \ldots\ldots \quad (10)$$

where for the lags involved,

$\delta_2 = A_2 - A_1$

$\tau_2 = b_2 - b_1$

D = 1 for period 1954-1971

D = 0 for period 1972-1981

δ_2 represents the difference between intercepts of the given lag between the two periods and τ_2 represents the difference between slopes of the given lags between the two periods. The F-test statistic can then be used to test the null hypotheses Ho: $\delta=0$ and Ho: $\tau=0$. Test statistic (8) is used:

$$F = \frac{(SSE_R - SSE)/g}{SSE/(n-k)} \qquad \text{where,}$$

SSE_R is the restricted residual sum of squares. This is the residual sum of squares obtained by estimating equation (9a) using data for period 1954-1981. This has the restriction that $\delta_2 = 0$ and $\tau_2 = 0$ for the relevant variables. SSE is the unrestricted residual sum of squares obtained by estimating equation (10) using data for the period 1954-1981. This assumes that δs and τs have non-zero values thus $A_2 = A_1 + \delta_2$ and $b_2 = b_1 + \tau_2$.

n = number of observations during the period 1954-1981.

g = number of restrictions i.e. δs and τs restricted to zero.

k = number of parameters estimated in the unrestricted form.

An F-value greater than the critical value leads to rejection of the null hypothesis that $\delta_2 = 0$ and $\tau_2 = 0$. This method enables the testing of any number of parameters. It also can test changes in intercept and slope singly or both taken together for each variable or group of variables.

c. Chow test method: When the error terms of the two periods are homoscedastic, equation (7) is estimated using data for period 1954-1981 to give the restricted residual sum of squares SSE_R. It is estimated again using data for periods 1954-1971 and 1971-1981 separately giving the residual sums of squares SSE_1 and SSE_2 respectively. The unrestricted residual sum of squares is the sum $SSE = SSE_1 + SSE_2$. An F-test is used to test the null hypothesis that all parameters are the same between the periods 1954-1971 and 1971-1981. Test statistic (8) is used:

$$F = \frac{(SSE_R - SSE)/g}{SSE/(n-k)}$$

where g = number of restrictions i.e. number of parameters estimated in each of the two periods separately.

n = number of observations during the period 1954-1981.

k = sum of number of parameters estimated in each period.

An F value (or its reciprocal if it is less than one) greater than the critical value leads to rejection of the null hypothesis that Ho: all the parameters are the same in the two periods.

If the homoscedasticity of the variances is in question the alternative is to use the two stage test proposed by Toyoda and Ohtani (1986) [TO]. A preliminary stage is to test the homoscedasticity of the error terms between the two periods. This is done by using an F-test with the statistic:

$$F = (SSE_2/(n_2-k)/(SSE_1/(n_1-k) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (11)$$

where:

SSE_1 and SSE_2 are as defined above and n_1 and n_2 are the number of observations in periods one and two respectively and k is the number of parameters estimated in each of the two periods. An F value greater than the critical value leads to the rejection of the null hypothesis that the error terms in the two periods are homoscedastic. In this case the second stage will be to adopt TO's method of testing the equality of the parameters between the two periods. If the null hypothesis is not rejected, the Chow test is used.

Of the three methods of testing the stability of the coefficients, the dummy variable method is the most powerful. It is flexible in the number of coefficients that can be tested. It can do all that the other two methods do. This study will use this method.

3.3.4 Import elasticities estimation method: Relative unit values

Following Khan (1974) a consumer can be assumed to compare the prices of imports to prices of local goods in deciding to buy imported goods. In this case prices of imports need to be divided by prices of local goods to reflect the relative relationship. In Tanzania there is no separate price index for local goods. The NCPI however has a very high weight of local goods namely the food group. All unit values are therefore divided by the NCPI to represent the relative unit values. The implication is that the elasticities derived measure the response of the consumer to changes in import prices above the changes of the general local price levels which have import prices as a component.

Modifying equations (6) and (7) accordingly the estimating equations for this case are:

$$M_t = BY_{(t-1)}^{b_y} \prod_{i=0}^{q} R_{(t-i)}^{b_i} e_t \qquad \text{.....} \qquad (6a)$$

where R is the index of relative unit values. All other terms are as defined in section 3.3.2.

Log transformation gives:

$$\ln M_t = \ln B + b_y \ln Y_{t-1} + \sum_{i=0}^{q} b_i \ln R_{t-i} + \ln e_t \quad \ldots\ldots\ldots \quad (7a)$$

Equation (7a) is used to estimate the elasticities.

3.3.5 Test statistics

To test the effect of changes in trade and exchange control policies the test statistics described under section 3.3.3 may be used.

3.4 Derivation of Two Special Cases of Marshall Lerner Conditions

Williamson (1983) showed that Marshall-Lerner condition can be reduced to two special cases. Case one assumes infinitely elastic price elasticities of foreign demand for domestic exports and foreign supply of domestic imports. He suggests that this assumption is justified in the case of developing countries. Observations of Faaland and Dahl (1970) and Rashidi (1984) suggest that it is justified in the case of Tanzania. The government in Tanzania guarantees the purchase of all crops produced at the prices it sets. Developing countries have small economies whose export supplies and import demand cannot influence world prices. Case two assumes infinitely elastic price elasticities of export supplies and import supplies. This assumption applies to large economies which can supply the world economy a big proportion of its demand because they export mainly

manufactured goods a large proportion of which is consumed locally.

Using Williamson's notation:[3]

Let TB = trade balance.

M = quantity of imports, $\hat{M} = \frac{\Delta M}{M}$.

X = quantity of exports, $\hat{X} = \frac{\Delta X}{X}$.

P_x = domestic price of exports, $\hat{P}_x = \frac{\Delta P_x}{Px}$.

P_x^* = world price of exports, $\hat{P}_x^* = \frac{\Delta P_x^*}{P_x^*}$.

ε_x = price elasticity of supply of exports $= \frac{\hat{X}}{\hat{P}_x}$.

μ_x = price elasticity of foreign demand for domestic exports

$= -\frac{\hat{X}}{\hat{P}_x^*}$.

P_m = domestic price of imports, $\hat{P}_m = \frac{\Delta P_m}{P_m}$.

P_m^* = world price of imports, $\hat{P}_m^* = \frac{\Delta P_m^*}{P_m^*}$.

ε_m = price elasticity of foreign supply of imports $= \frac{\hat{M}}{\hat{P}_m^*}$.

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[3]. For the derivation of the results in this section, refer to appendix A.1 at the end of this chapter.

μ_m = price elasticity of domestic demand for imports = $-\frac{\hat{M}}{\hat{P}_m}$.

e = exchange rate i.e. $\frac{P_x}{P_x^*} = \frac{P_m}{P_m^*}$ [4].

$\hat{e} = \frac{\Delta e}{e}$

Trade balance can be expressed as:

$TB = XP_x^* - MP_m^*$ in foreign currency, or

$TB = XP_x - MP_m$ in domestic currency.

Following the algebraic derivations in the appendix (A1) to this chapter, the two special cases of Marshall-Lerner conditions are derived in the following sections.

Expressed in foreign currency,

$$d(TB) = XP_x^* \hat{e}\varepsilon_x \frac{(\mu_x - 1)}{(\varepsilon_x + \mu_x)} + MP_m^* \hat{e}\mu_m \frac{(\varepsilon_m + 1)}{(\varepsilon_m + \mu_m)}$$

$$= XP_x^* \hat{e}\left[\varepsilon_x \frac{(\mu_x - 1)}{(\varepsilon_x + \mu_x)} + \frac{MP_m^*}{XP_x^*}\mu_m \frac{(\varepsilon_m + 1)}{(\varepsilon_m + \mu_m)}\right]$$

and expressed in local currency,

$$d(TB) = XP_x \hat{e}\mu_x \frac{(\varepsilon_x + 1)}{\varepsilon_x + \mu_x)} - MP_m \hat{e}\varepsilon_m \frac{(1 - \mu_m)}{(\varepsilon_m + \mu_m)}$$

$$= XP_x \hat{e}\left[\mu_x \frac{(\varepsilon_x + 1)}{(\varepsilon_x + \mu_x)} - \frac{MP_m}{XP_x}\varepsilon_m \frac{(1 - \mu_m)}{(\varepsilon_m + \mu_m)}\right].$$

---

[4] Throughout this study exchange rate refers to real exchange rate. The Marshall-Lerner conditions are derived using the Purchasing Power Parity definition of exchange rate.

3.4.2 Balanced trade

In whichever currency the trade is expressed, when it is balanced i.e. $XP_x = MP_m$ and $XP_x^* = MP_m^*$:

a. for assumptions under case one, the necessary and sufficient condition for trade to improve when there is devaluation is:

$$\varepsilon_x + \mu_m > 0 \qquad \text{(Williamson, 1983).}$$

Sufficient but not necessary conditions are either

$$\varepsilon_x > 0 \qquad \text{for} \qquad \mu_m = 0$$

or

$$\mu_m > 0 \qquad \text{for} \qquad \varepsilon_x = 0.$$

b. Under assumptions of case two, the necessary and sufficient condition for trade to improve when there is devaluation is:

$$\mu_x + \mu_m > 1 \qquad \text{(Marshall-Lerner).}$$

Sufficient but not necessary conditions are either

$$\mu_x > 1 \qquad \text{for} \qquad \mu_m = 0$$

or

$$\mu_m > 1 \qquad \text{for} \qquad \varepsilon_x = 0.$$

3.4.3 Trade imbalance expressed in foreign currency

If trade expressed in foreign currency is not balanced i.e. $XP_x^* \neq MP_m^*$:

a. under assumptions of case one, the necessary and sufficient condition for trade to improve when there is devaluation is:

$$\varepsilon_x + \mu_m \frac{MP_m^*}{XP_x^*} > 0.$$

Sufficient but not necessary conditions are either

$$\varepsilon_x > 0 \qquad \text{for} \quad \mu_m = 0$$

or

$$\mu_m \frac{MP_m^*}{XP_x^*} > 0 \implies \mu_m > 0 \qquad \text{for} \quad \varepsilon_x = 0.$$

b. under assumptions of case two, the necessary and sufficient condition for trade to improve when there is devaluation is:

$$\mu_x + \mu_m \frac{MP_m^*}{XP_x^*} > 1.$$

sufficient but not necessary conditions are either

$$\mu_x > 1 \quad \text{for} \quad \mu_m = 0$$

or $$\mu_m \frac{MP_m^*}{XP_x^*} > 1 \implies \mu_m > \frac{XP_x^*}{MP_m^*} \quad \text{for } \varepsilon_x = 0.$$

3.4.4 Trade imbalance expressed in local currency

If trade expressed in domestic currency is not balanced i.e. $XP_x \neq MP_m$:

a. under assumptions of case one, the necessary and sufficient condition for trade to improve when there is devaluation is:

$$\varepsilon_x + \mu_m \frac{MP_m}{XP_x} > \frac{MP_m}{XP_x} - 1.$$

Sufficient but not necessary conditions are either

$$\varepsilon_x > \frac{MP_m}{XP_x} - 1 \qquad \text{for} \quad \mu_m = 0$$

or

$$\mu_m > 1 - \frac{XP_x}{MP_m} \qquad \text{for} \quad \varepsilon_x = 0.$$

When ε_x and μ_m have been estimated sufficient conditions for trade balance to improve if there is a trade deficit under case one are:

either $$\varepsilon_x + 1 - \frac{MP_m}{XP_x} > 0 \qquad \text{for } \mu_m = 0$$

or

$$\mu_m + \frac{XP_x}{MP_m} - 1 > 0 \qquad \text{for } \varepsilon_x = 0.$$

The test statistics are:

$$\varepsilon_x + 1 - \frac{MP_m}{XP_x} > s_x * \underline{t}(v_x) \qquad \text{for } \mu_m = 0$$

or

$$\mu_m + \frac{XP_x}{MP_m} - 1 > s_m * \underline{t}(v_m) \qquad \text{for } \varepsilon_x = 0.$$

where s_x and s_m are the standard errors of ε_x and μ_m respectively, and v_x, v_m are their degrees of freedom. The equations translate to:

$$\frac{MP_m}{XP_x} < \varepsilon_x + 1 - s_x * \underline{t}(v_x) \qquad \text{for } \mu_m = 0$$

or

$$\frac{XP_x}{MP_m} > s_m * \underline{t}(v_m) + 1 - \mu_m$$

i.e. $$\frac{MP_m}{XP_x} < (s_m * \underline{t}(v_m) + 1 - \mu_m)^{-1} \quad \text{for } \varepsilon_x = 0.$$

b. Under assumptions of case two, the necessary and sufficient condition for trade to improve when there is devaluation is:

$$\mu_x + \mu_m \frac{MP_m}{XP_x} > \frac{MP_m}{XP_x}.$$

Sufficient but not necessary conditions are either

$$\mu_x > \frac{MP_m}{XP_x} \quad \text{for } \mu_m = 0$$

or

$$\mu_m \frac{MP_m}{MP_x} > \frac{MP_m}{XP_x} \Longrightarrow \mu_m > 1 \quad \text{for } \mu_x = 0.$$

These results show that the effectiveness of devaluation on balance of trade if there is trade imbalance depends on the ratio of value of imports to value of exports. Under case one conditions for devaluation to improve balance of payments are less restrictive on the magnitude of the elasticities than case two when the trade is not balanced. Following the observations of Faaland and Dahl (1970), Rashidi (1984) and Williamson (1983), this study takes case one assumptions for the Tanzanian economy and tests the appropriateness of devaluation as a macroeconomic policy tool. The study will estimate price elasticities of domestic supply of exports and domestic demand for imports. Mshomba (1987) estimated elasticities of some of the major cash crops. This study concentrates on the aggregates. The importance

of the individual grades of crops is taken into account through the compilation of the quantum and price indices.

3.5 Summary

This chapter has described methods that have been used to estimate the price elasticities of supply of export crops and demand of imports for Tanzania. Statistical tests that can be used to test the significance of the elasticities and the stability of the price elasticity of demand for imports over the two periods (1954-1971 and 1972-1981) have been presented. The conditions for exchange rate adjustment to have a positive effect on trade balance for the two special cases of Marshall-Lerner condition have been derived.

Chapter four will present the econometric results of the study.

Appendix to Chapter 3

A.1 Derivation of the modified Marshall-Lerner condition

Following Williamson (1983), the Marshall-Lerner condition can be reduced to two special cases depending on the assumptions on the magnitudes of the price elasticities of supply and demand of exports and imports of the domestic economy being examined. Case one assumes that price elasticities of foreign demand for domestic exports and foreign supply of imports are infinitely elastic. Case two assumes that price elasticities of supply of domestic exports and foreign supply domestic imports are infinitely elastic.

Case one is likely to be appropriate to developing countries. The exports of individual economies are too small to influence the world price of the goods. They face a flat demand curve. Case two is more appropriate to developed countries who export manufactured goods, a greater proportion of which is consumed locally. An increase in demand of these goods in the world market can easily be met by increasing production in a big country. The increase in demand is too small to affect the price of the goods in the domestic economy. The economy faces a flat supply curve.

Using Williamson's notation the implication of these assumptions are examined. The case of an economy with a trade deficit is more interesting to developing countries most of which have trade deficits. Prices are denominated in both local and

convertible foreign currencies. Denominating prices in local currency is more useful for local policy makers. Statistics on trade are reported in local currencies. Converting them into convertible currency is cumbersome when exchange rate realignment takes place frequently.

Let:

TB = trade balance.

X = quantity of exports.

$\hat{X}$ = proportional change in exports i.e. $\frac{\Delta X}{X}$

P_x = domestic price of exports.

$\hat{P}_x$ = proportional change in P_x i.e. $\frac{\Delta P_x}{P_x}$.

P_x^* = world price of exports.

$\hat{P}_x^*$ = proportional change in P_x^* i.e. $\frac{\Delta P_x^*}{P_x^*}$.

M = quantity of imports.

$\hat{M}$ = proportional change in M i.e. $\frac{\Delta M}{M}$

P_m = domestic price of imports.

$\hat{P}_m$ = proportional change in P_m i.e. $\frac{\Delta P_m}{P_m}$.

P_m^* = world price of imports.

$\hat{P}_m^*$ = proportional change in P_m^* i.e. $\frac{\Delta P_m^*}{P_m^*}$.

ε_x = price elasticity of supply of exports i.e. $\frac{\hat{X}}{\hat{P}_x}$.

μ_x = price elasticity of demand for domestic exports

i.e. $-\frac{\hat{X}}{\hat{P}_x^*}$.

ε_m = price elasticity of supply of imports i.e. $\frac{\hat{M}}{\hat{P}_m^*}$.

μ_m = price elasticity of demand for imports i.e. $\frac{\hat{M}}{\hat{P}_m}$.

e = exchange rate i.e. $\frac{P_x}{P_x^*} = \frac{P_m}{P_m^*}$.

$\hat{e}$ = proportional change in exchange rate i.e. $\frac{\Delta e}{e}$.

From the definitions:

$P_x = eP_x^*$.

$dP_x = P_x^* de + edP_x^*$.

$$\frac{dP_x}{eP_x^*} = \frac{P_x^* de}{eP_x^*} + \frac{edP_x^*}{eP_x^*} .$$

$$\frac{dP_x}{P_x} = \frac{de}{e} + \frac{dP_x^*}{P_x^*} .$$

$$\hat{P}_x = \hat{e} + \hat{P}_x^*$$

$$\hat{P}_x^* = -\frac{\hat{X}}{\mu_x} = -\frac{\varepsilon_x \hat{P}_x}{\mu_x} = -\frac{\varepsilon_x}{\mu_x}(\hat{e} + \hat{P}_x^*) .$$

$$\hat{P}_x^* \mu_m = - \varepsilon_x \hat{e} - \varepsilon_x P_x^* .$$

$$\hat{P}_x^* (\varepsilon_x + \mu_x) = - \varepsilon_x \hat{e}.$$

$$\hat{P}_x^* = - \frac{\varepsilon_x \hat{e}}{\varepsilon_x + \mu_x} .$$

$$\hat{P}_x = \hat{e} + \hat{P}_x^* .$$

$$\hat{P}_x = \hat{e} - \frac{\varepsilon_x \hat{e}}{\varepsilon_x + \mu_x} .$$

$$\hat{P}_x = \frac{(\varepsilon_x + \mu_x - \varepsilon_x)\hat{e}}{\varepsilon_x + \mu_x} .$$

$$\hat{P}_x = \frac{\mu_x \hat{e}}{\varepsilon_x + \mu_m} .$$

Similarly:

$$\hat{P}_m^* = - \frac{\mu_m \hat{e}}{\varepsilon_m + \mu_m} ; \quad \text{and} \quad \hat{P}_m = \frac{\varepsilon_m \hat{e}}{\varepsilon_m + \mu_m} .$$

Trade balance in foreign currency can be expressed as:

$$TB = P_x^* X - P_m^* M.$$

$$d(TB) = P_x^* dX + X dP_x^* - P_m^* dM - M dP_m^* .$$

Substituting

$$dX = X\hat{P}_x \varepsilon_x ; \qquad dP_x^* = P_x^* \hat{P}_x^* ;$$

$$dM = - M\mu_m \hat{P}_m \quad \text{and} \quad dP_m = P_m^* \hat{P}_m^* ,$$

$$d(TB) = P_x^* X\hat{P}_x \varepsilon_x + XP_x^* \hat{P}_x^* + P_m^* M\mu_m \hat{P}_m - MP_m^* \hat{P}_m^* .$$

$$= XP_x^* (\hat{P}_x^* + \hat{P}_x \varepsilon_x) - MP_m^* (\hat{P}_m^* - \mu_m \hat{P}_m)$$

$$= XP_x^* \left[- \frac{\varepsilon_x \hat{e}}{\varepsilon_x + \mu_x} + \frac{\mu_x \hat{e} \varepsilon_x}{\varepsilon_x + \mu_x} \right] - MP_m^* \left[- \frac{\mu_m \hat{e}}{\varepsilon_m + \mu_m} - \frac{\mu_m \varepsilon_m \hat{e}}{\varepsilon_m + \mu_m} \right].$$

$$= XP_x^* \varepsilon_x \hat{e} \frac{(\mu_x - 1)}{\varepsilon_x + \mu_x} + MP_m^* \mu_m \hat{e} \frac{(\varepsilon_m + 1)}{\varepsilon_x + \mu_m}$$

When trade is balanced:

$XP_x^* = MP_m^*$

$$d(TB) = XP_x^* \hat{e} \left[\varepsilon_x \frac{(\mu_x - 1)}{\varepsilon_x + \mu_x} + \mu_m \frac{(\varepsilon_m + 1)}{\varepsilon_m + \mu_m} \right].$$

Devaluation and improvement in trade balance implies:

$d(TB) > 0$ and $\hat{e} > 0$.

Since $X > 0$ and $P_x^* > 0$,

then the necessary and sufficient condition for devaluation to improve trade balance is:

$$\varepsilon_x \frac{(\mu_x - 1)}{\varepsilon_x + \mu_x} + \mu_m \frac{(\varepsilon_m + 1)}{\varepsilon_m + \mu_m} > 0.$$

Under assumptions of case one:

$$\underset{\mu_x,\ \varepsilon_m \longrightarrow \infty}{\text{Lt.}} \quad \varepsilon_x \frac{(\mu_x - 1)}{\varepsilon_x + \mu_x} + \mu_m \frac{(\varepsilon_m + 1)}{\varepsilon_m + \mu_m} > 0.$$

$$\Longrightarrow \quad \varepsilon_x + \mu_m > 0 \text{ as shown by Williamson (1983).}$$

Under assumptions of case two:

$$\underset{\varepsilon_x,\ \varepsilon_m \longrightarrow \infty}{\text{Lt.}} \quad \varepsilon_x \frac{(\mu_x - 1)}{\varepsilon_x + \mu_x} + \mu_m \frac{(\varepsilon_m + 1)}{\varepsilon_m + \mu_m} > 0.$$

$$\Longrightarrow \quad \mu_x - 1 + \mu_m > 0,$$

i.e. $\mu_x + \mu_m > 0$, the well known Marshall-Lerner condition.

If trade is not balanced:

$XP_x^* \neq MP_m^*$.

$$d(TB) = XP_x^* \hat{e} \left[\varepsilon_x \frac{(\mu_x - 1)}{\varepsilon_x + \mu_x} + \mu_m \frac{MP_m^*}{XP_x^*} \frac{(\varepsilon_m + 1)}{(\varepsilon_m + \mu_m)} \right].$$

The necessary and sufficient condition for devaluation to improve trade balance is:

$$\varepsilon_x \frac{(\mu_x - 1)}{\varepsilon_x + \mu_x} + \mu_m \frac{MP_m^*}{XP_x^*} \frac{(\varepsilon_m + 1)}{(\varepsilon_m + \mu_m)} > 0.$$

Under assumptions of case one this leads to:

$$\varepsilon_x + \frac{MP_m^*}{XP_x^*} \mu_m > 0.$$

Sufficient but not necessary conditions are:

either $\varepsilon_x > 0$ for $\mu_m = 0$,

or $\dfrac{MP_m^*}{XP_x^*}\mu_m > 0$ i.e. $\mu_m > 0$ for $\varepsilon_x = 0$.

Under assumptions of case two it leads to:

$$\mu_x - 1 + \frac{MP_m^*}{XP_x^*}\mu_m > 0,$$

i.e. $$\mu_x + \frac{MP_m^*}{XP_x^*}\mu_m > 1.$$

Sufficient but not necessary conditions are:

either $\mu_x > 1$ for $\mu_m = 0$,

or $\dfrac{MP_m^*}{XP_x^*}\mu_m > 1$ i.e. $\mu_m > \dfrac{XP_x^*}{MP_m^*}$ for $\mu_x = 0$.

If prices are denominated in local currencies:

$$TB = P_x X - P_m M.$$

$$d(TB) = X dP_x + P_x dX - M dP_m - P_m dM.$$

$$= XP_x \hat{P}_x + P_x \varepsilon_x X\hat{P}_x - MP_m \hat{P}_m + P_m \mu_m M\hat{P}_m .$$

$$= XP_x (\hat{P}_x + \varepsilon_x \hat{P}_x) - MP_m (\hat{P}_m - \mu_m \hat{P}_m)$$

Substitute

$$\hat{P}_x = \frac{\mu_x \hat{e}}{\varepsilon_x + \mu_x}; \quad \text{and} \quad \hat{P}_m = \frac{\varepsilon_m \hat{e}}{\varepsilon_m + \mu_m}$$

$$d(TB) = XP_x \left[\frac{\mu_x \hat{e}}{\varepsilon_x + \mu_x} + \frac{\varepsilon_x \mu_x \hat{e}}{\varepsilon_x + \mu_x} \right] - MP_m \left[\frac{\varepsilon_m \hat{e}}{\varepsilon_m + \mu_m} - \frac{\mu_m \varepsilon_m \hat{e}}{\varepsilon_m + \mu_m} \right].$$

$$= XP_x \mu_x \hat{e} \frac{(1 + \varepsilon_x)}{\varepsilon_x + \mu_x} - MP_m \varepsilon_m \hat{e} \frac{(1 - \mu_m)}{\varepsilon_m + \mu_m},$$

which is equivalent to Robinson's (1947) p. 142 footnote 1.

If trade is balanced:

$XP_x = MP_m$.

$$d(TB) = XP_x \hat{e} \left[\mu_x \frac{(1 + \varepsilon_x)}{\varepsilon_x + \mu_x} - \varepsilon_m \frac{(1 - \mu_m)}{\varepsilon_m + \mu_m} \right].$$

The necessary and sufficient condition for trade balance to improve when there is devaluation is:

$$\mu_x \frac{(1 + \varepsilon_x)}{\varepsilon_x + \mu_x} - \varepsilon_m \frac{(1 - \mu_m)}{\varepsilon_m + \mu_m} > 0.$$

Under assumptions of case one this leads to:

$1 + \varepsilon_x - 1 + \mu_m > 0$,

i.e. $\varepsilon_x + \mu_m > 0$ the same condition as Williamson's (1983).

Under assumptions of case two it leads to:

$\mu_x - 1 + \mu_m > 0$,

i.e. $\mu_x + \mu_m > 0$, the Marshall-Lerner condition.

If trade is not balanced:

$XP_x \neq MP_m$.

$$d(TB) = XP_x \hat{e} \left[\mu_x \frac{(1 + \varepsilon_x)}{\varepsilon_x + \mu_x} - \varepsilon_m \frac{MP_m}{XP_x} \frac{(1 - \mu_m)}{(\varepsilon_m + \mu_m)} \right].$$

The necessary and sufficient condition for devaluation to improve trade balance is:

$$\mu_x \frac{(1 + \varepsilon_x)}{\varepsilon_x + \mu_x} - \varepsilon_m \frac{MP_m}{XP_x} \frac{(1 - \mu_m)}{(\varepsilon_m + \mu_m)} > 0.$$

Under assumptions of case one it leads to:

$$1 + \varepsilon_x - \frac{MP_m}{XP_x}(1 - \mu_m) > 0 \quad \Longrightarrow \quad \frac{(1 + \varepsilon_x)}{(1 - \mu_m)} > \frac{MP_m}{XP_x} \quad \text{for } \mu_m < 1.$$

$$\text{or } 1 + \varepsilon_x + (\mu_m - 1) \frac{MP_m}{XP_x} > 0.$$

Sufficient but not necessary conditions for devaluation to improve trade balance are:

$$1 + \varepsilon_x > \frac{MP_m}{XP_x} \qquad \text{for} \quad \mu_m = 0,$$

$$\text{or} \quad \frac{1}{1 - \mu_m} > \frac{MP_m}{XP_x} \qquad \text{for} \quad \varepsilon_x = 0 \text{ and } \mu_m < 1,$$

$$\text{or} \quad 1 - (1 - \mu_m)\frac{MP_m}{XP_x} > 0 \text{ for } \varepsilon_x = 0.$$

In both cases higher deficits would require higher elasticities for devaluation to be effective. This makes economic sense.

Under the assumptions of case two, the necessary and sufficient condition is:

$$XP_x \hat{e} \mu_x - MP_m \hat{e}(1 - \mu_m) > 0.$$

$$XP_x \hat{e} \left[\mu_x - \frac{MP_m}{XP_x} (1 - \mu_m) \right] > 0.$$

This is equivalent to Robinson's (1947) p. 143 footnote 1. It implies:

$$\mu_x - \frac{MP_m}{XP_x} + \mu_m \frac{MP_m}{XP_x} > 0.$$

$$\text{i.e.} \quad \mu_x + (\mu_m - 1)\frac{MP_m}{XP_x} > 0.$$

$$\text{or} \quad \mu_x + \mu_m \frac{MP_m}{XP_x} > \frac{MP_m}{XP_x}.$$

Sufficient but not necessary conditions are:

$$\mu_x > \frac{MP_m}{XP_x} \qquad \text{for} \quad \mu_m = 0,$$

$$\text{or} \quad \mu_m > 1 \qquad \text{for} \quad \mu_x = 0.$$

The conditions require that for devaluation to be effective the elasticities must be greater than unity.

CHAPTER 4

Econometric Results

Chapter three described the methods that were used to estimate the price elasticities of supply of exports and demand for imports. It also described the test statistics that may be used to test the significance of the elasticities and the stability of the price elasticity of imports between the periods 1954-1971 and 1972-1981. This chapter presents the econometric results of the study.

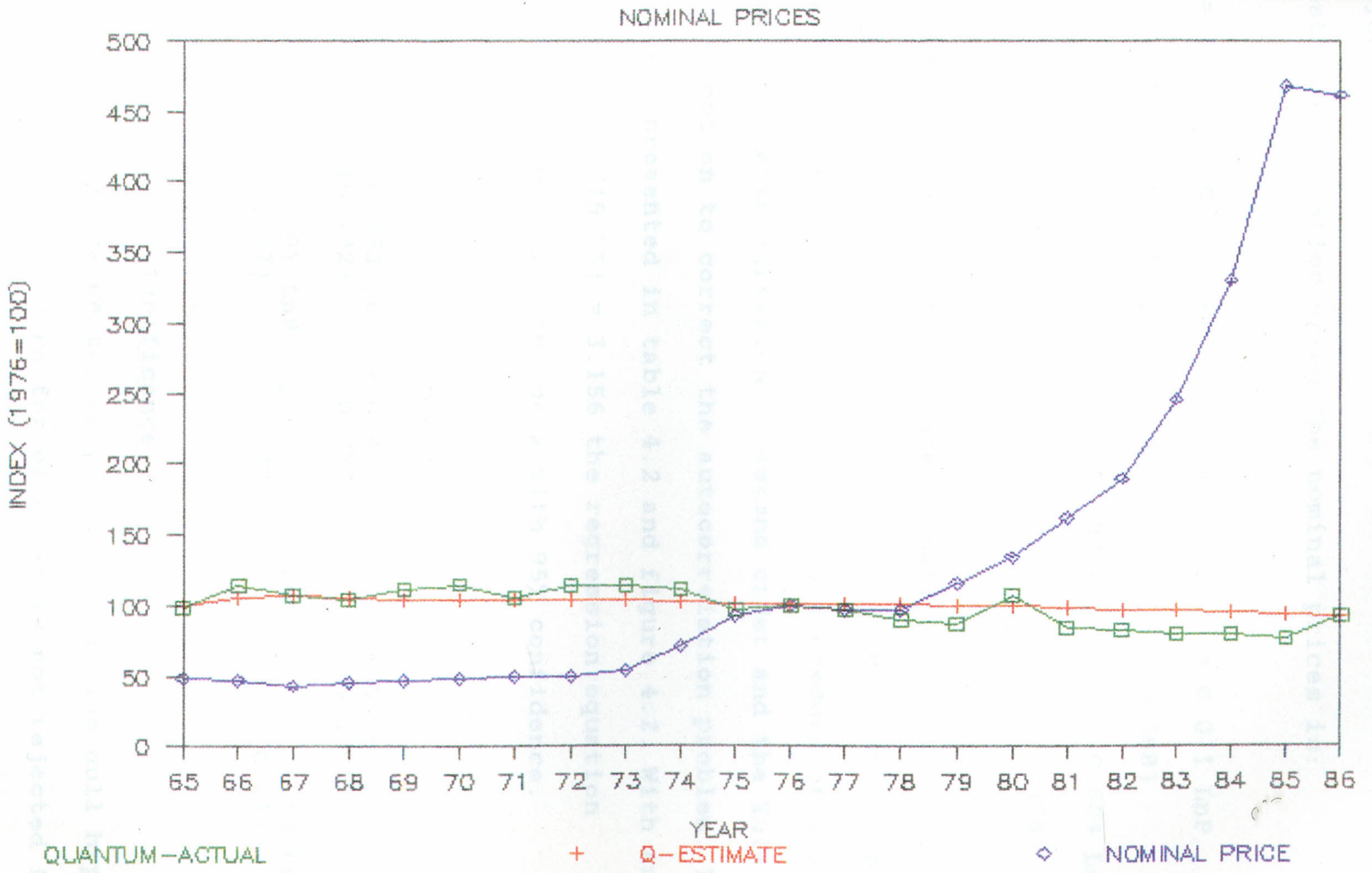
4.2 Export Elasticities

Annual data for the period 1964-1986 were used as described under section 3.2.1 to estimate equation (2) as described under section 3.2.2. The notation introduced in section 3.2.2 is retained.

4.2.2 Estimated equation

Efforts of estimating the equation using nominal prices and the polynomial inverse lag with the autoregression procedure of order four to correct for autocorrelation produced results showing that it is only the intercept which is significant. The regression equation, illustrated on figure 4.1., explains the variation significantly at 95% confidence level as it has an

FIG 4.1 TANZANIA EXPORT INDEXES



F(13,8) value of 7.274. However none of the price elasticities are significant.

The estimated equation using the nominal prices is:

$$\begin{aligned} LnQ_t = {} & 4.84 - 0.028\ LnP_t - 0.031\ LnP_{(t-1)} + 0.011\ LnP_{(t-2)} \\ & (0.368)\quad (0.406)\qquad (0.458)\qquad (0.588) \\ & + 0.003\ LnP_{(t-3)} - 0.002\ LnP_{(t-4)} - 0.004\ LnP_{(t-5)}. \\ & (0.445)\qquad (0.207)\qquad (0.398) \end{aligned}$$

Table 4.1 shows the estimated equation if real prices are used. The Durbin-Watson statistic does not rule out the presence of positive autocorrelation. The Autoreg procedure of SAS package was used with autoregression of second order and the Yule-Walker iteration option to correct the autocorrelation problem. The results are presented in table 4.2 and figure 4.2. With analysis of variance of F(6,15) = 3.156 the regression equation satisfactorily explains the data with 95% confidence.

The implied equation from table 4.2 is:

$$\begin{aligned} LnQ_t = {} & 1.566 - 0.223\ LnP_t + 0.826\ LnP_{(t-1)} + 0.060\ LnP_{(t-2)} \\ & (0.794)\quad (0.192)\qquad (0.237)\qquad (0.020) \\ & - 0.001\ LnP_{(t-3)} + 0.005\ LnP_{(t-4)} + 0.013\ LnP_{(t-5)}. \\ & (0.007)\qquad (0.008)\qquad (0.011) \end{aligned}$$

4.2.3 Tests of significance

The critical value $t_{(0.05,13)}$ is 1.753. The null hypothesis Ho: the coefficient is zero for each lag is not rejected for

Table 4.1

Regression of quantity of exports on real price of exports 1964-1986

Method: PIL

Dependent Variable: LnQ_t

Independent Variable	Coeff.	Std. Err	T-ratio
Const.	1.435	0.555	2.584
LnP_t	-0.095	0.209	-0.452
$LnP_{(t-1)}$	0.729	0.241	3.026
$LnP_{(t-2)}$	0.059	0.019	2.996
$LnP_{(t-3)}$	0.001	0.006	0.233
$LnP_{(t-4)}$	0.004	0.006	0.717
$LnP_{(t-5)}$	0.010	0.009	1.106

SSE	0.1163	DFE	17	F(4,17)	9.504
MSE	0.007	Root MSE	0.083		
Reg RSQ	0.691	Total RSQ	0.691	DurbWat	1.290

Table 4.2

Regression of quantity of exports on real price of exports 1964-1986

Method: PIL-AR(2)

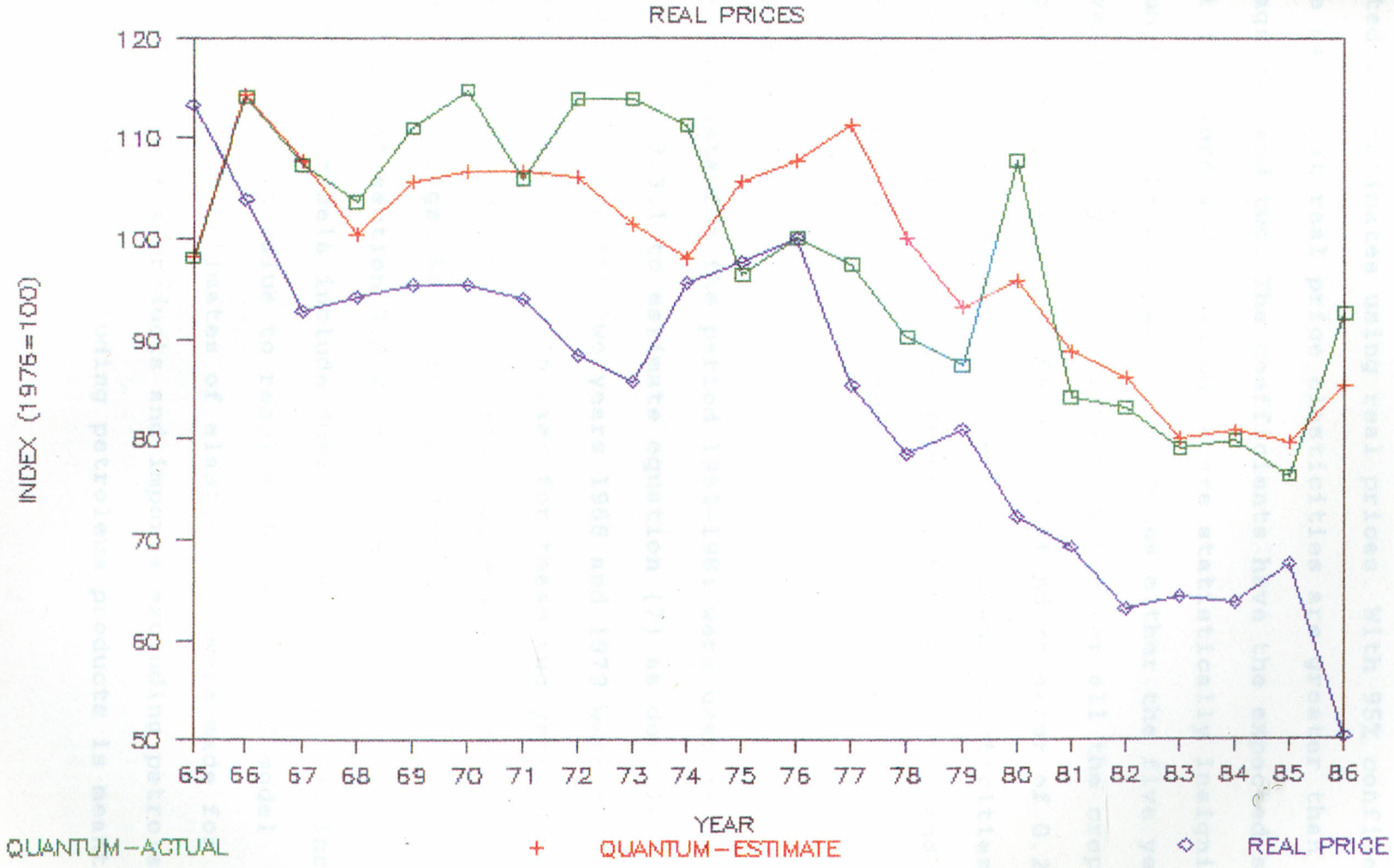
Dependent Variable: LnQ_t

Independent Variable	Coeff.	Std. Err	T-ratio
Const.	1.566	0.794	1.973
LnP_t	-0.223	0.192	-1.163
$LnP_{(t-1)}$	0.826	0.237	3.484
$LnP_{(t-2)}$	0.060	0.020	3.041
$LnP_{(t-3)}$	-0.001	0.007	0.098
$LnP_{(t-4)}$	0.005	0.008	0.64
$LnP_{(t-5)}$	0.013	0.011	1.176
Sum	-0.68	0.247	2.753

Yule-Walker Estimates:

SSE	0.1001	DFE	15
MSE	0.0067	Root MSE	0.082
Reg RSQ	0.558	Total RSQ	0.734 F(8,13) = 3.156

FIG 4.2 TANZANIA EXPORT CROP INDEXES



estimates using nominal prices. However the hypothesis is not accepted for estimates using real prices. With 95% confidence it can be said that real price elasticities are greater than zero for lags one and two. The coefficients have the expected sign except lags zero and three which are statistically insignificant. The sum of all the lags which indicates either the five year interval elasticity or the total response for all the crops having different lags is 0.68 with a standard error of 0.247 and t(15) value of 2.753. Each of the significant elasticities and the sum fall within the range found by Mshomba (1987) and Rashidi (1984) for the individual crops.

4.3 Imports

Annual data for the period 1954-1981 were used as described under section 3.3.1 to estimate equation (7) as described under section 3.3.2. Data for two years 1968 and 1979 were not available for this study. Indexes for these two years were estimated to avoid losing too many degrees of freedom especially when using two lags. Estimation used twenty-eight observations. The notation of section 3.3.2 is retained.

The basic models include dummy variables for real income and second lag of unit value to resolve the problem of model misspecification. Estimates of elasticities were made for imports including petroleum products and imports excluding petroleum. Estimates on imports excluding petroleum products is meant to

remove the influence of above average changes of prices of these products in the 1970s and early 1980s.

4.3.2 Estimated equations: Nominal unit values

Table 4.3 and figure 4.3 present the regression results of quantum index of imports on real GDP and the index of nominal unit values of all imports. The implied equations are:

Period 1954-1971

$$LnM_t = \underset{(0.750)}{-0.109} + \underset{(0.081)}{0.422}\ LnY_{(t-1)} - \underset{(0.282)}{0.118}\ LnU_t - \underset{(0.343)}{0.395}\ LnU_{(t-1)} + \underset{(0.274)}{0.691}\ LnU_{(t-2)}.$$

Period 1972-1981

$$LnM_t = \underset{(5.946)}{-18.347} + \underset{(0.681)}{2.676}\ LnY_{(t-1)} - \underset{(0.282)}{0.118}\ LnU_t - \underset{(0.343)}{0.395}\ LnU_{(t-1)} - \underset{(0.377)}{0.526}\ LnU_{(t-2)}.$$

Income elasticities have the expected signs and are very significant at 95% confidence in both the two periods. Income elasticity increased significantly between the two periods. Among the individual year elasticities, the contemporaneous and first lag elasticities of unit value have the expected signs but they are not significant at 95% confidence. The second lag coefficient is significant at 95% confidence and has the opposite sign in period 1954-1971 but it is not significant in period 1972-1981 and has the expected sign. It decreased significantly between the two periods implying a significant increase in elasticity.

Table 4.3

Regression of quantity of imports on real GDP and nominal unit value of imports 1954-1981

Method: AR(2)

Dependent Variable: LnM_t

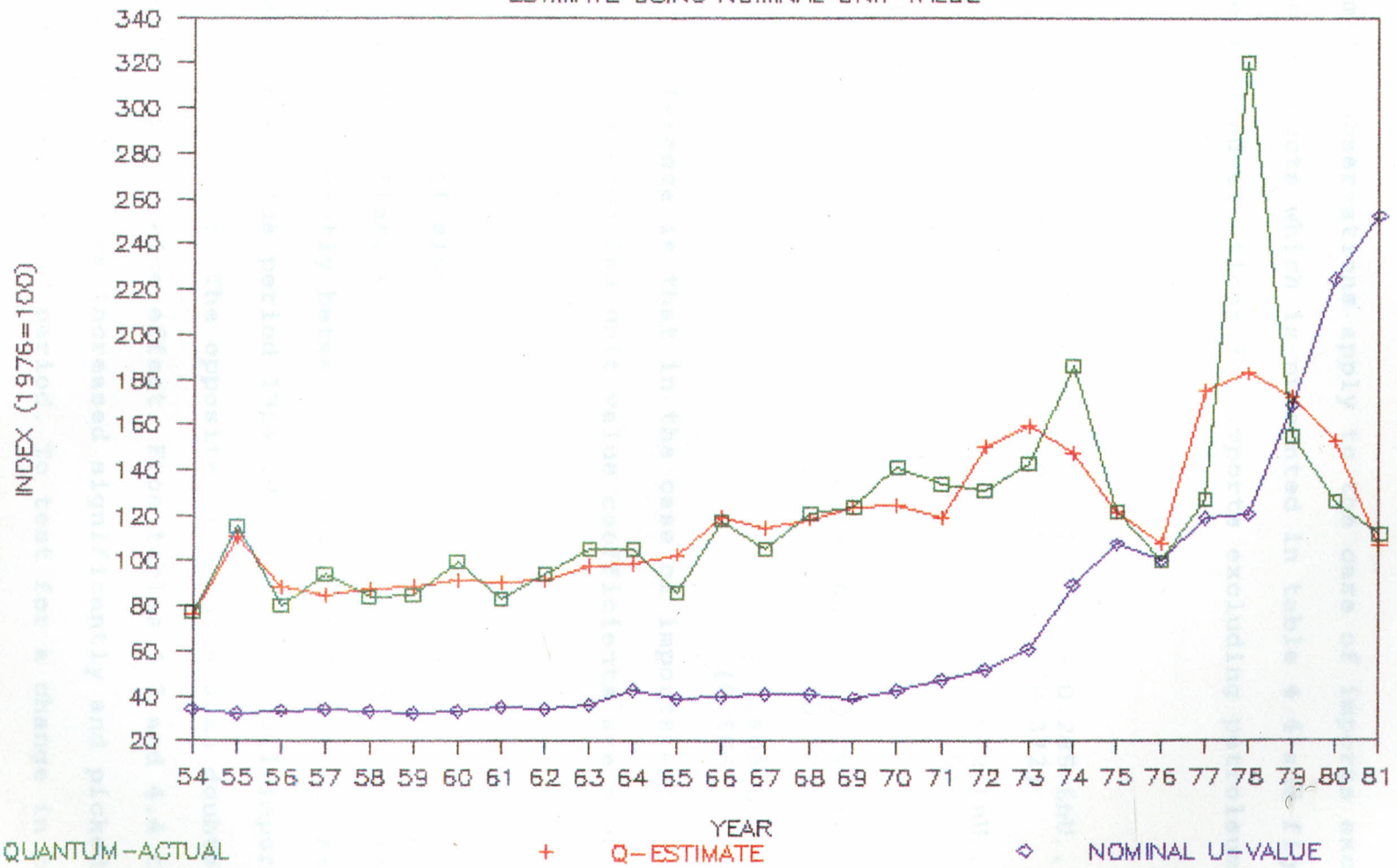
Independent Variable	Coeff.	Std. Err	T-value	Appr. Prob.
Const.	-18.347	5.946	-3.085	0.006
D	18.238	6.030	3.024	0.007
$LnY_{(t-1)}$	2.676	0.681	3.930	0.001
LnU_t	-0.118	0.282	-0.418	0.681
$LnU_{(t-1)}$	-0.395	0.343	-1.152	0.265
$LnU_{(t-2)}$	-0.526	0.377	-1.397	0.179
$D*LnY_{(t-1)}$	-2.254	0.668	-3.373	0.003
$D*LnU_{(t-2)}$	1.217	0.344	3.536	0.002
Interval (2 years)	-0.513	0.238	-2.155	
Autoreg (rho_1)	0.662	0.197	3.361	
Autoreg (rho_2)	0.548	0.197	2.781	

Yule-Walker Estimates:

SSE	0.4380	DFE	18	
MSE	0.024	Root MSE	0.156	
Reg RSQ	0.928	Total RSQ	0.806	F(9,18) = 25.778

FIG 4.3 TANZANIA: ALL IMPORTS—INDEXES

ESTIMATE USING NOMINAL UNIT VALUE



For period 1972-1981 all unit value elasticities have expected signs.

Similar observations apply to the case of imports excluding petroleum products which is presented in table 4.4 and figure 4.4. The implied equations for imports excluding petroleum products are:

Period 1954-1971

$$LnM_t = \underset{(0.948)}{0.496} + \underset{(0.073)}{0.316}\ LnY_{(t-1)} - \underset{(0.300)}{0.049}\ LnU_t - \underset{(0.372)}{0.285}\ LnU_{(t-1)} + \underset{(0.275)}{0.622}\ LnU_{(t-2)}.$$

Period 1972-1981

$$LnM_t = \underset{(6.269)}{-35.806} + \underset{(0.742)}{4.728}\ LnY_{(t-1)} - \underset{(0.300)}{0.049}\ LnU_t - \underset{(0.372)}{0.285}\ LnU_{(t-1)} - \underset{(0.506)}{1.603}\ LnU_{(t-2)}.$$

The main difference is that in the case of imports excluding petroleum the second lag unit value coefficients are significant in both the periods.

4.3.3 Tests of significance

As noted earlier, the second lag unit value coefficient decreased significantly between the two periods but it has the opposite sign for the period 1954-1971 for both, all imports and non-petroleum imports. The opposite sign shows some doubts that it reflects a pure price effect. From tables 4.3 and 4.4 the second lag elasticities increased significantly and picked the right sign in the second period. To test for a change in price

Table 4.4

Regression of quantity of non-petroleum imports on real GDP and nominal unit value of imports 1954-1981

Method: AR(2)

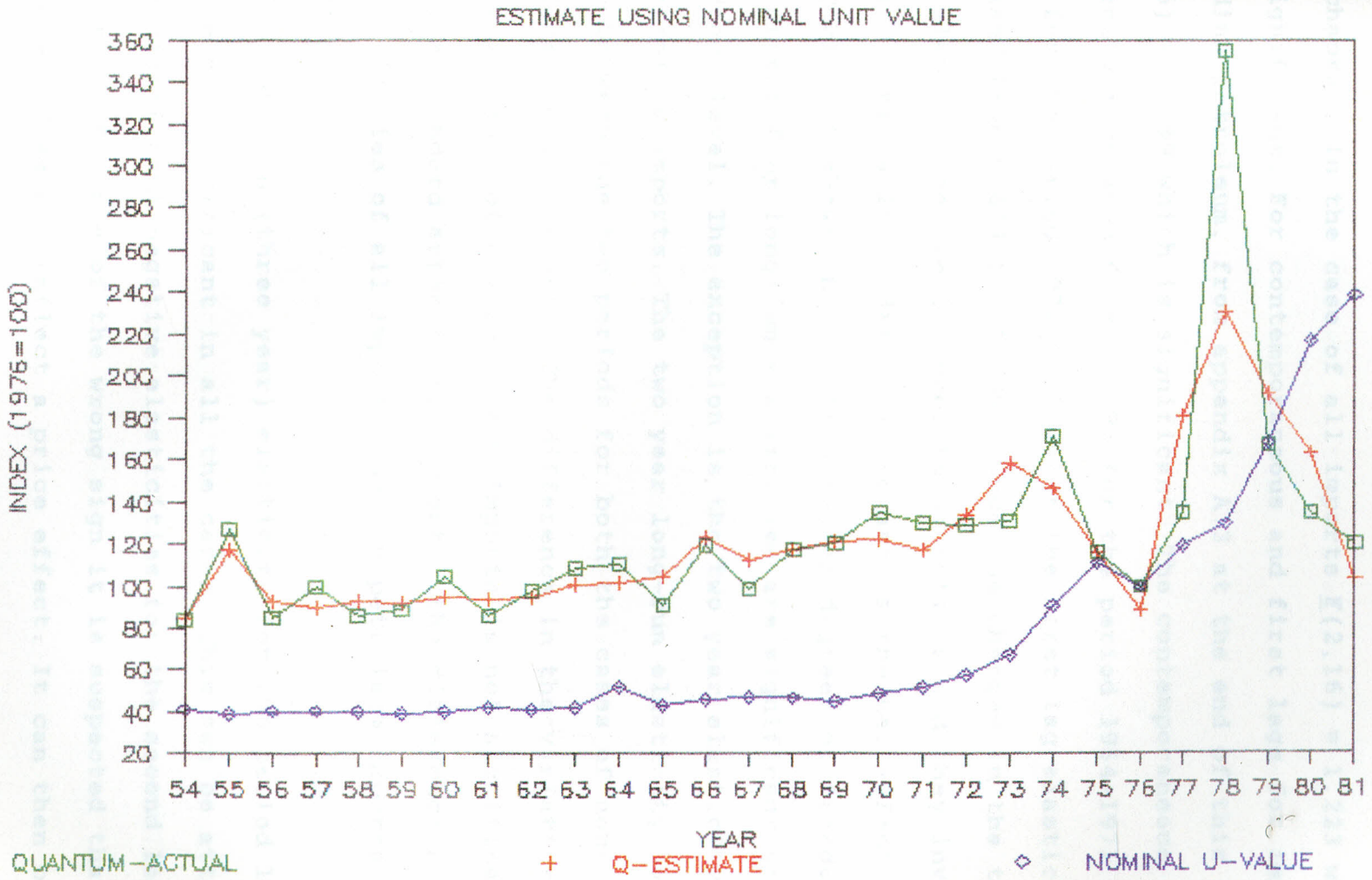
Dependent Variable: LnM_t

Independent Variable	Coeff.	Std. Err	T-value	Appr. Prob.
Const.	-35.806	6.269	-5.712	0.000
D	36.302	6.315	5.748	0.000
$LnY_{(t-1)}$	4.728	0.742	6.375	0.000
LnU_t	-0.048	0.300	-0.163	0.872
$LnU_{(t-1)}$	-0.285	0.372	-0.766	0.454
$LnU_{(t-2)}$	-1.603	0.506	-3.168	0.005
$D*LnY_{(t-1)}$	-4.412	0.742	-5.945	0.000
$D*LnU_{(t-2)}$	2.225	0.452	4.920	0.000
Interval (2 years)	-0.334	0.290	1.152	
Autoreg (rho_1)	0.644	0.222	2.896	

Yule-Walker Estimates:

SSE	0.3731	DFE	18
MSE	0.021	Root MSE	0.144
Reg RSQ	0.931	Total RSQ	0.836 F(9,18) = 26.986

FIG 4.4 NON-PETROLEUM IMPORTS INDEXES



elasticities for contemporaneous and first lags between the two periods, using information given in appendix A.2 at the end of this chapter, in the case of all imports $F(2,16) = 1.223$ which is not significant. For contemporaneous and first lags for imports excluding petroleum, from appendix A.3 at the end of this chapter $F(2,16) = 3.849$ which is significant. The contemporaneous elasticity increased from -0.588 for the period 1954-1971 to 1.241 for the period 1972-1981 while the first lag elasticity decreased from 0.613 to -1.796. Since the changes in the two point elasticities are in opposite directions and they involve changes in signs it is difficult to assess the net effect.

Table 4.5 shows that, with nineteen degrees of freedom, three of the four long-run elasticities are significant at 95% confidence level. The exception is the two year elasticity for non-petroleum imports. The two year long-run elasticity does not change between the two periods for both the cases of non-petroleum and all imports. The difference in the variation of all imports and that of non-petroleum imports is not significant. Using the standard error of all imports, the difference between the elasticities of all imports and non-petroleum imports is not significant.

The long-run (three year) elasticity for the period 1954-1971 are not significant in all the cases. This can be attributed to the significant negative elasticities for the second lag for this period. Because of the wrong sign it is suspected that this coefficient does not reflect a price effect. It can then be

Table 4.5

Long-run nominal unit value elasticities

	Elasticity	Std. error	T-ratio
Two year: for period 1954-81			
All imports	0.513	0.238	2.155
Non-petroleum imports	0.334	0.290	1.152
Three year: for period 1972-1981			
All imports	1.039	0.270	3.848
Non-petroleum imports	1.937	0.344	5.631

assumed that the full response to price changes takes place in two years for the period 1954-1971 and three years for the period 1972-1981. Though there is not a common variance to enable the comparison of the elasticities of the two periods, using the variance of either period shows that the difference is significant at 95% confidence.

For the period 1972-1981, the difference in the long run (three year) elasticities between all imports and non-petroleum imports is significant at 95% confidence level.

4.3.4 Estimated equations: Relative unit value

If relative unit values are used, from table 4.6, the estimated equations for all imports are:

Period 1954-1971

$$LnM_t = \underset{(2.318)}{1.997} + \underset{(0.077)}{0.438}\ LnY_{(t-1)} - \underset{(0.510)}{0.415}\ LnU_t - \underset{(0.425)}{0.791}\ LnU_{(t-1)} + \underset{(0.362)}{0.841}\ LnU_{(t-2)}.$$

Period 1972-1981

$$LnM_t = \underset{(2.746)}{7.503} + \underset{(0.077)}{0.438}\ LnY_{(t-1)} - \underset{(0.510)}{0.415}\ LnU_t - \underset{(0.425)}{0.791}\ LnU_{(t-1)} - \underset{(0.482)}{0.322}\ LnU_{(t-2)}.$$

These results are illustrated in figure 4.5. Income elasticity is significant but unlike the nominal unit value case the income elasticity does not change significantly between the two periods. Second lag unit value elasticity changes significantly at 95% confidence and changes from opposite sign to the right sign. At 95% confidence it is significant in the first period but it is not significant in the second period. The contemporaneous unit value elasticity is not significant in the two periods. First lag elasticity is significant at 95% confidence level.

From table 4.7, illustrated by figure 4.6, the estimated equations for imports excluding petroleum are:

Period 1954-1971

$$LnM_t = \underset{(4.050)}{0.028} + \underset{(0.130)}{0.372}\ LnY_{(t-1)} + \underset{(0.639)}{0.068}\ LnU_t - \underset{(0.411)}{0.670}\ LnU_{(t-1)} + \underset{(0.399)}{0.819}\ LnU_{(t-2)}.$$

Table 4.6

Regression of quantity of imports on real GDP and relative unit value of imports 1954-1981

Method: AR(2)

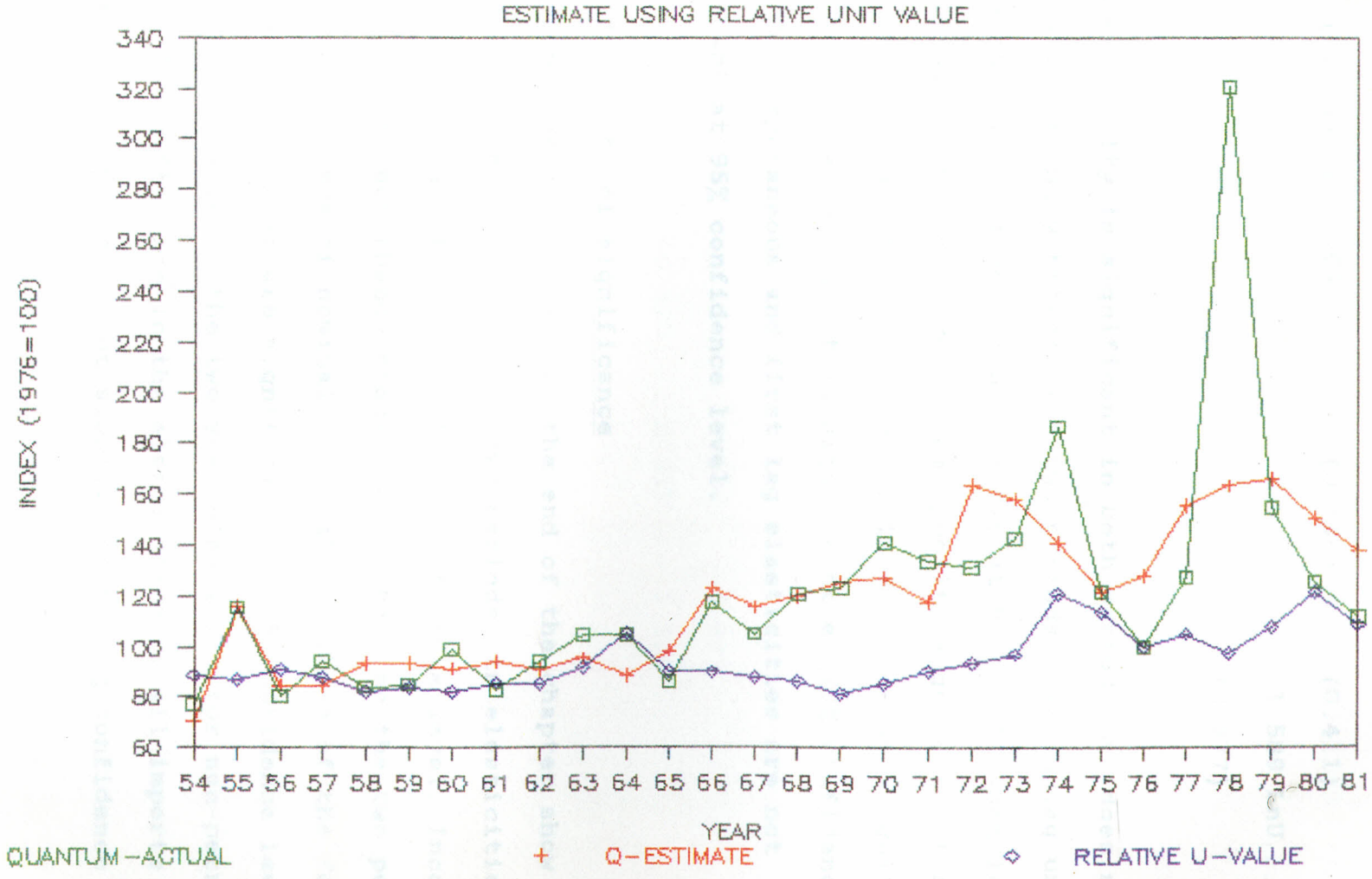
Dependent Variable: LnM_t

Independent Variable	Coeff.	Std. Err	T-value	Appr. Prob.
Const.	7.503	2.745	2.733	0.013
D	-5.506	2.452	-2.246	0.037
$LnY_{(t-1)}$	0.438	0.077	5.658	0.000
LnU_t	-0.415	0.510	-0.815	0.425
$LnU_{(t-1)}$	-0.791	0.425	-1.850	0.079
$LnU_{(t-2)}$	-0.322	0.482	-0.667	0.513
$D*LnU_{(t-2)}$	1.162	0.537	2.164	0.043
Interval (2 years)	-1.206	0.487	-2.476	
Autoreg (rho_2)	0.587	0.186	3.162	

Yule-Walker Estimates:

SSE	0.5721	DFE	19		
MSE	0.030	Root MSE	0.174		
Reg RSQ	0.876	Total RSQ	0.756	F(8,19)	22.371

FIG 4.5 TANZANIA: ALL IMPORTS—INDEXES



Period 1972-1981

$$LnM_t = 11.362 + 0.372\ LnY_{(t-1)} + 0.064\ LnU_t - 0.670\ LnU_{(t-1)} - 1.589\ LnU_{(t-2)}.$$

(5.994) (0.130) (0.639) (0.411) (0.977)

Income elasticity is significant in both periods but does not change significantly between the two periods. Second lag unit value elasticity changes significantly at 95% confidence level changing signs in the process from opposite sign to right sign in the second period. At 95% confidence level it is not significant in the second period but it is significant at 90% confidence level. Contemporaneous and first lag elasticities are not significant at 95% confidence level.

4.3.5.Tests of significance

Appendixes A.4 and A.5 at the end of the chapter show no significant changes between the two periods, in elasticities of contemporaneous and first lag at 95% confidence level. Income elasticity does not change significantly between the two periods.

As in the case of nominal unit values, three of the four long-run elasticities are significant at 95% confidence level. The exception again is the two year elasticity for non-petroleum imports. The difference in the elasticities of all imports and non-petroleum imports is not significant at 95% confidence level.

Table 4.7

Regression of quantity of non-petroleum imports on real GDP and relative unit value of imports 1954-1981

Method: AR(2)

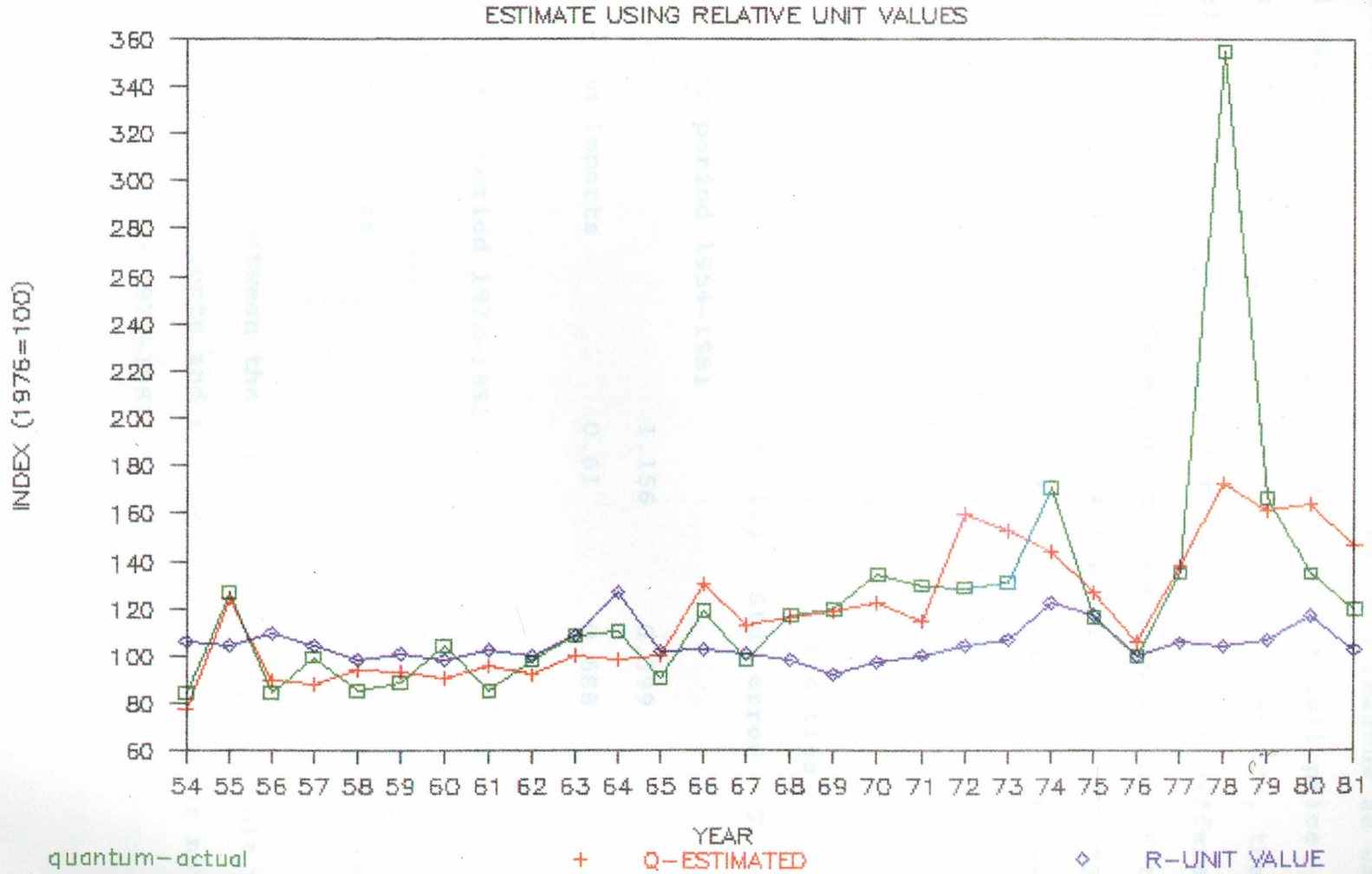
Dependent Variable: LnM_t

Independent Variable	Coeff.	Std. Err	T-value	Appr. Prob.
Const.	11.362	5.994	1.896	0.073
D	-11.335	4.886	-2.320	0.032
$LnY_{(t-1)}$	0.372	0.130	2.859	0.010
LnU_t	0.064	0.639	0.100	0.922
$LnU_{(t-1)}$	-0.670	0.411	-1.629	0.120
$LnU_{(t-2)}$	-1.589	0.977	-1.626	0.120
$D*U_{(t-2)}$	2.409	1.048	2.298	0.033
Interval (2 years)	-0.61	0.688	-0.887	
Autoreg (rho_2)	0.329	0.217	1.520	

Yule-Walker Estimates:

SSE	0.7586	DFE	19		
MSE	0.040	Root MSE	0.200		
Reg RSQ	0.735	Total RSQ	0.668	F(8,19)	6.587

FIG 4.6 NON—PETROLEUM IMPORT INDEXES



Similarly, the long-run three year elasticities are not significant for period 1954-1971 for the same reasons as was in nominal values. Making similar assumptions for full price response and comparing the differences between periods, the elasticities for all imports are not different. The difference in elasticities for non-petroleum imports are significant if the variation of 1954-1971 is assumed. If the variation of 1972-1981 is assumed, the elasticities are not significantly different. The long-run elasticities are presented in table 4.8.

Table 4.8

Long-run relative unit values elasticities

	Elasticity	Std. error	T-ratio
Two year: for period 1954-1981			
All imports	1.156	0.399	2.897
Non-petroleum imports	0.61	0.688	0.887
Three year: for period 1972-1981			
All imports	1.528	0.599	2.551
Non-petroleum imports	2.199	1.207	1.821

The difference between the long-run (three year) unit value elasticities of all imports and non-petroleum imports is not significant for period 1972-1981.

4.4 Marshall Lerner Conditions Test for the Economy of Tanzania

Econometric results have shown that point unit value elasticities are not significant. However long-run (two year) elasticities are significant in the case of all imports for both nominal and relative unit values. There was no significant change in the two year interval elasticity between the two periods. Second lag unit value elasticity started to pick price influence only in the second period. It did not assume significance in the case of all imports but it started assuming significance in the case of imports excluding petroleum if nominal unit values are used. Given the delays in processing of applications for imports it can be assumed that the long-run (two year) elasticities reflect the consumers' response to price changes for the period 1954-1971. For the period 1972-1981 the three year elasticities apply.

Tables 4.5 and 4.8 show that at 95% confidence level the long-run (two year) elasticities are significant in the case of all imports valuated in both nominal and relative unit values. In the case of imports excluding petroleum products they are not significant. The three year elasticities which apply to period 1972-1981 are significant in all the cases without exception. For testing Marshall-Lerner conditions all imports are used. The use of nominal or relative values depends on how all the other variables in the Marshall Lerner equations have been valuated. They have to be consistent. For exports, real prices were used where nominal producer prices were deflated by NCPI. Since it is

also the real exchange rates that are used, this study uses relative unit value elasticities. A decision has to be made whether to use the two year or the three year long-run elasticity. The two year elasticity applies to conditions of period 1954-1971. The three year elasticity applies to conditions of period 1972-1981. Period two is characterized by the presence of quantitative restrictions. Both elasticities will be used to give an idea of the effectiveness of devaluation for the conditions characterizing the two periods. For two year elasticity, the elasticity is 1.156 with a standard error of 0.399. For three year, the elasticity is 1.528 with a standard error of 0.599.

Exports had insignificant contemporaneous elasticity and significant elasticities for two lags and the sum. Since long-run elasticities are used for imports, the sum of the export elasticities, which is 0.68 is used. This implies an assessment of the impact after a period of five years. However, most of the response is concentrated in the first three years. The standard error is 0.247.

Since the export supply and import demand elasticities are significant, sufficient conditions for trade balance to improve if there is a trade deficit under case one are:
Assuming price elasticity of import demand is zero,

$$\frac{MP_m}{XP_x} < \varepsilon_x + 1 - s_x * \underline{t} \quad (13)$$

$$\frac{MP_m}{XP_x} < 0.68 + 1 - 0.247 * 1.771$$

i.e. $$\frac{MP_m}{XP_x} < 1.243$$

Assuming price elasticity of export supply is zero,

Using the two year unit value elasticity of imports:

or $$\frac{MP_m}{XP_x} > \{s_m * \underline{t}(19) + 1 - \mu_m\}^{-1}$$

i.e. $$\frac{MP_m}{XP_x} > (0.399 * 1.729 + 1 - 1.156)^{-1}$$

i.e. $$\frac{MP_m}{XP_x} < 1.873.$$

Using three year unit value elasticity of imports:

$$\frac{MP_m}{XP_x} > (0.599 * 1.729 + 1 - 1.528)^{-1}$$

i.e. $$\frac{MP_m}{XP_x} < 1.97.$$

It can be observed that the condition on the magnitude of the ratio of the value of imports to the value of exports does not differ much between using the two year and three year long-run elasticities.

Earlier the necessary condition for devaluation to be effective was derived as:

$$\varepsilon_x + \mu_m \frac{MP_m}{XP_x} > \frac{MP_m}{XP_x} - 1$$

i.e.
$$\varepsilon_x + \mu_m \frac{MP^m}{XP_x} - \frac{MP_m}{XP_x} + 1 > 0$$

The student t statistic test:

$$\underline{t}(v) = \frac{1}{s}\left[\varepsilon_x + \mu_m \frac{MP_m}{XP_x} - \frac{MP_m}{XP_x} + 1\right]$$

can be used where:

v is the degrees of freedom and s is the standard error of $\left(\varepsilon_x + \mu_m \frac{MP_m}{XP_x}\right)$. In this study the degrees of freedom for ε_x and μ_m are not the same. The more conservative number could be used. In view of the significant income elasticity there is likely to be high correlation between ε_x and μ_m. To solve this problem of simultaneity, equations linking exports, imports, and income need to be jointly solved. This study did not tackle this problem. For this reason this study does not test for the necessary condition.

4.5 Discussion

From the findings of section 4.2 export crop producers do increase production when real producer prices increase. Section 4.3 showed that Tanzanian consumers reduce the consumption of

imports when nominal or relative prices of imports increase. However section 4.3 also showed that consumers increase consumption of imports when their real income increases. Devaluation increases the real producer prices and prices of imports. According to this study the direct effect of devaluation is to increase exports and reduce imports. The higher incomes from increased exports have a secondary effect of increasing imports. The study did not examine the net effect of these forces.

Between the periods 1954-1971 and 1972-1981 the significant changes were the increase of income elasticity if nominal unit values are used. It does not change if relative unit values are used. There was also a change from a non-price influence of the second lag of unit value to a price influence. This seems to be in line with changes in the trade and foreign exchange policies. Allocation of import quotas during the second period depended very much on the availability of foreign exchange which is a proportion of GDP. The policy change did not change the short-run unit value elasticity or first lag of unit value elasticity. The change in policy did not change the response of consumers to changes in prices of all imports. However the new policy spread the price effect to the second lag of unit value. This is likely to be the result of delays in processing of import applications, a procedure introduced by the new policy. The study could not explain the influence represented by the significant coefficient of the second lag of unit value especially during the period

1954-1971. Its sign discounts it from being a price effect. Level of stocks of imports could be one explanation. No statistics on levels of stock of imported goods were available for this study.

Test of sufficient Marshall-Lerner conditions show that given the estimated elasticities, with 95% confidence, devaluation would be effective when the ratio of value of imports to value of exports is less than 1.2 assuming elasticity of imports is zero or less than 1.9 assuming elasticity of exports is zero. The figures for 90% confidence are 1.5 and 2.7 respectively (in the case of two year elasticity) or 1.5 and 3.7 respectively (in the case of three year elasticity). These are conservative values as elasticities of exports and imports are positive. If Tanzania is to depend on the response to devaluation of exporters only (represented by farmers), then for devaluation to be effective this ratio should be less than 1.2. This does not take into account the secondary effect of increase of imports that would result from increased income from higher prices and increased production of exports. As appendix A.9 (after chapter five) shows that, in Tanzania's foreign trade the ratio of imports to exports for all imports has ranged between 1.148 and 2.422 for the period 1970-1981 when there was trade deficit. With 95% confidence, devaluation would have been effective for the years 1970-1973 and 1976-1977 only. For the other years higher elasticities would have been needed to make devaluation effective. If Tanzania is to depend on the response of consumers of imports to devaluation this ratio has to be less than 1.9.

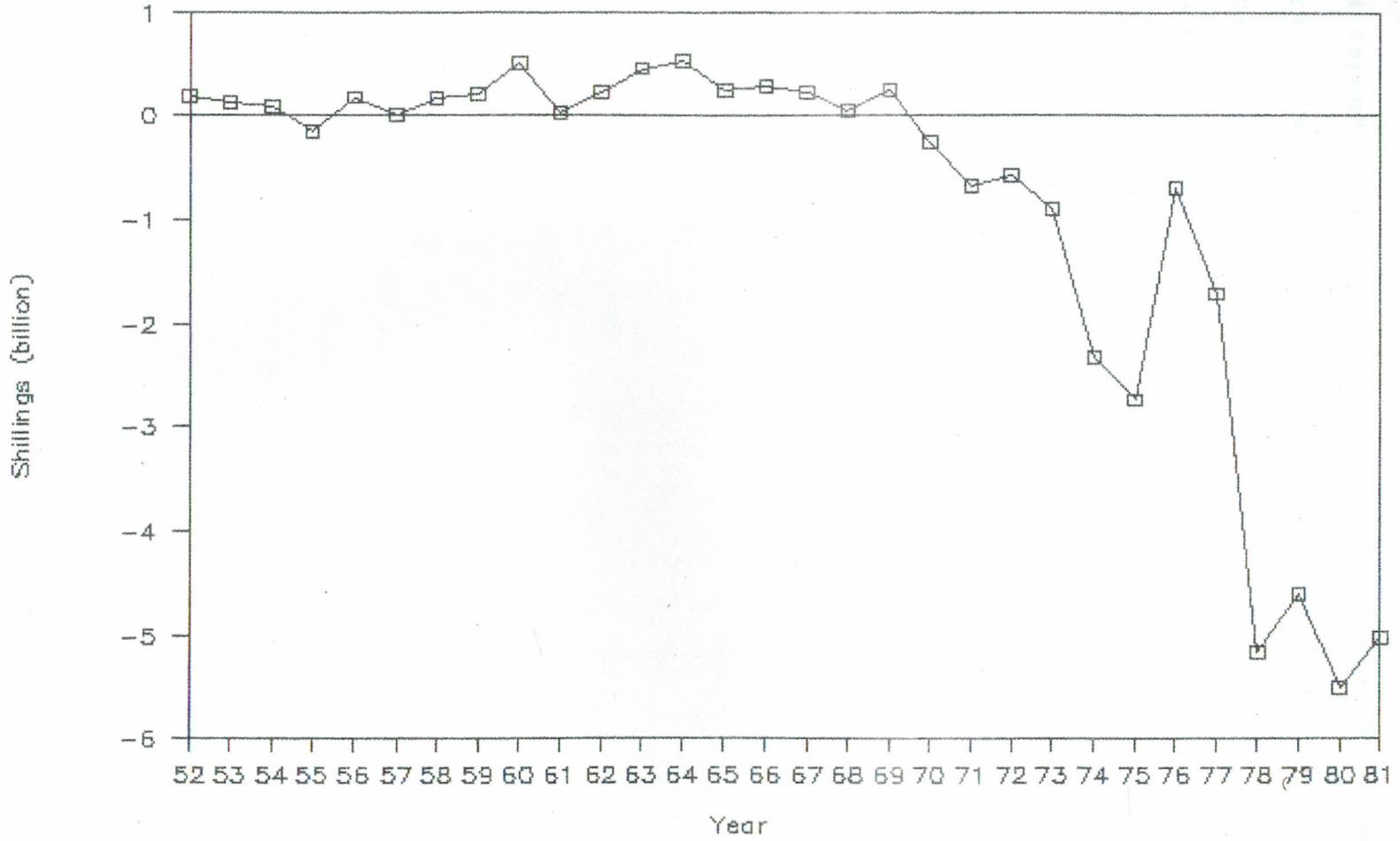
Devaluation would have been effective for the whole period except the years 1978 and 1980. This does not take into account the contribution of some of the imports to production for exports such as farm inputs, farm machinery, spare parts for manufacturers and so on.

During the period of study there were devaluations of 7.9% on December 22, 1971; 10% on February 17, 1973; 15% on October 25, 1975; and 10% on January 20, 1979. As figure 4.7 illustrates, from the data in appendix A.9 (after chapter five), it can be observed that in all the cases there was a temporary drop in trade deficit during the following one or two years after devaluation. Since the study found positive elasticities for both exports and imports the observations do not contradict the findings of the study.

4.6 Summary

This chapter has shown that Tanzanian producers respond to changes in real producer prices and consumers of imports respond to changes in prices of imports. There is no evidence to show that change in trade and foreign exchange policy affected all import price elasticities. The Marshall-Lerner sufficient conditions test shows that the estimated export supply and import demand price elasticities imply that Tanzanian farmers' response to devaluation would make it effective if the ratio of value of imports to value of exports is less than 1.2 The response of Tanzanian consumers of imports would make it effective if the

FIG 4.7 TANZANIA: TRADE BALANCE



ratio is less than 1.9. From historical data devaluation should have been effective for the years 1970-1973 and 1976-1977 if Tanzania depended on exporters' response. If she depended on consumers of imports, devaluation would have been effective for all years except 1978 and 1980.

The next chapter gives the summary, conclusions, problems for further study and recommendations of the study.

Appendix to Chapter 4

A.2 Test for significance of a change in at least one coefficient of nominal unit value between the periods 1954-1971 and 1972-1981 (all imports)

Method: AR(2)

Dependent Variable: LnM_t

Independent Variable	Coeff.	Std. Err	T-value	Appr. Prob.
Const.	-20.804	5.939	-3.503	0.003
D	20.627	6.019	3.427	0.004
$LnY_{(t-1)}$	2.961	0.679	4.364	0.001
LnU_t	-0.528	0.317	-1.664	0.116
$LnU_{(t-1)}$	0.255	0.396	0.644	0.529
$LnU_{(t-2)}$	-0.879	0.387	-2.273	0.037
$D*LnY_{(t-1)}$	-2.592	0.703	-3.688	0.002
$D*LnU_t$	0.796	0.800	0.995	0.335
$D*LnU_{(t-1)}$	-1.109	0.607	-1.829	0.086
$D*LnU_{(t-2)}$	1.804	0.511	3.532	0.003

Yule-Walker Estimates:

SSE	0.3799	DFE	16		
MSE	0.024	Root MSE	0.154		
Reg RSQ	0.933	Total RSQ	0.832	F(11,16)	20.255

$$F = \frac{(SSE_R - SSE)/2}{SSE/16} = \frac{(0.4380 - 0.3799)/2}{0.3799/16} = 1.223.$$

Critical $F_{(0.05,2,16)} = 3.63$.

A.3 Test for significance of a change in at least one coefficient of nominal unit value between the periods 1954-1971 and 1972-1981 (non-petroleum imports)

Method: AR(2)

Dependent Variable: LnM_t

Independent Variable	Coeff.	Std. Err	T-value	Appr. Prob.
Const.	-47.546	7.503	-6.337	0.000
$LnY_{(t-1)}$	47.282	7.590	6.230	0.000
LnU_t	-1.241	0.454	-2.735	0.015
$LnU_{(t-1)}$	1.796	0.744	2.414	0.028
$LnU_{(t-2)}$	-3.141	0.749	-4.195	0.001
$D*LnY_{(t-1)}$	-5.911	0.891	-6.633	0.000
$D*LnU_t$	1.799	0.750	2.400	0.029
$D*LnU_{(t-1)}$	-2.409	0.808	-2.982	0.009
$D*U_{(t-2)}$	3.930	0.795	4.944	0.000

Yule-Walker Estimates:

SSE	0.2519	DFE	16	
MSE	0.016	Root MSE	0.125	
Reg RSQ	0.946	Total RSQ	0.890	F(11,16) = 25.481

Test on change in price coefficients:

$$F(2,16) = \frac{(0.3731 - 0.2519)/2}{0.2519/16} = 3.849.$$

Critical F(.05,2,16) = 3.63.

A.4 Test of significance for a change in at least one coefficient of relative unit value of imports 1954-1981 (all imports)

Method: AR(2)

Dependent Variable: LnM_t

Independent Variable	Coeff.	Std. Err	T-value	Appr. Prob.
Const.	10.635	3.707	2.869	0.011
D	-10.345	4.482	-2.308	0.034
$LnY_{(t-1)}$	0.423	0.077	5.502	0.000
LnU_t	-1.345	0.816	-1.648	0.118
$LnU_{(t-1)}$	-0.426	0.792	-0.538	0.598
$LnU_{(t-2)}$	-0.394	0.578	-0.682	0.504
$D*LnU_t$	1.432	1.012	1.415	0.175
$D*LnU_{(t-1)}$	-0.474	0.928	-0.511	0.616
$D*LnU_{(t-2)}$	1.225	0.706	1.778	0.093

Yule-Walker Estimates:

SSE	0.5102	DFE	17		
MSE	0.030	Root MSE	0.173		
Reg RSQ	0.892	Total RSQ	0.782	F(10,17)	14.041

$$F = \frac{(SSE_R - SSE)/2}{SSE/17} = \frac{(0.5721 - 0.5102)/2}{0.5102/17} = 1.031$$

Critical $F_{(0.05,2,17)} = 3.52$

A.5 Test of significance for a change in at least one coefficient of relative unit value of imports 1954-1981 (non-petroleum imports)

Method: AR(2)

Dependent Variable: LnM_t

Independent Variable	Coeff.	Std. Err	T-value	Appr. Prob.
Const.	17.091	8.095	2.111	0.050
D	-17.848	8.483	-2.104	0.051
$LnY_{(t-1)}$	0.354	0.111	3.195	0.005
LnU_t	-0.828	1.222	-0.678	0.507
$LnU_{(t-1)}$	-1.487	1.188	-1.253	0.227
$LnU_{(t-2)}$	-1.057	1.067	-0.991	0.336
$D*LnU_t$	1.172	1.402	0.836	0.415
$D*U_{(t-1)}$	0.787	1.286	0.612	0.549
$D*U_{(t-2)}$	1.835	1.156	1.586	0.131

Yule-Walker Estimates:

SSE	0.7007	DFE	17		
MSE	0.041	Root MSE	0.203		
Reg RSQ	0.814	Total RSQ	0.693	F(8,17)	9.300

$$F = \frac{0.7007/17}{(0.7586 - 0.7007)/2} = 1.424$$

Critical F(.05,17,2) = 19.45

CHAPTER 5

Summary, Conclusions and Recommendations

Chapter four presented the econometric results and the conclusions. This chapter summarizes the study and gives implications, recommendations and problems for further study.

5.2 Special Characteristics of the Study

The purpose of this study was to examine the possibility of resolving the contradiction between classical theory and empirical data on the effectiveness of devaluation as a tool for improving trade balance in a developing economy. The study proceeded as follows: First, price elasticities were estimated for export supply and import demand for the economy of Tanzania. Second, there was an investigation of whether the import demand elasticities remained stable between the periods 1954-1971 and 1972-1981 (periods characterized by different trade and foreign exchange policies). Third, there was a test to determine whether the elasticities meet case one of Marshall-Lerner condition.

The special characteristics of the study include the modification of Marshall-Lerner condition assumption. The study considers the prices producers of export goods receive for their products and prices the consumers of commercial imports pay for commercial imported goods they consume. It assumes that export

demand and import supply price elasticities are infinite. A trade deficit is assumed to exist. All prices are denominated in local currency.

5.3 Methods

Estimating both export supply and import demand price elasticities, used the distributed lag models. The polynomial inverse lag was used to solve the problem of multicollinearity in the case of estimating export elasticities. Autoregressive procedure was used in both cases to solve the problem of autocorrelation. The dummy variable method tested the stability of import demand price elasticities. Marshall-Lerner condition test tested the effectiveness of devaluation to improve balance of trade.

5.4 Findings

The study found that the sum of the six point price elasticities of export supply and two of the point elasticities were significant at 95% confidence level. The first and second lag price elasticities were the most significant. Point price elasticities for import demand were insignificant in almost all cases. The only case when it was significant at 95% confidence is the first lag relative unit value elasticity for all imports. Long-run (two year) elasticities were significant at 95% confidence level in the case of all imports. They were not significant for non-petroleum imports. Long-run three year

elasticities for period 1972-1981 were all significant. No significant change was found in either point or long-run (two year) price elasticity of import demand between the periods 1954-1971 and 1972-1981. Comparing the full price responses for the two periods, there was a significant change if nominal unit values are used. If relative unit values are used the difference in elasticities of all imports are not significant. The results of comparing elasticities of non-petroleum imports are mixed. Income elasticity of demand for imports was significant in all cases and increased significantly between the two periods if nominal unit values are used. If relative unit values are used the change is not significant.

If a trade deficit is assumed the study found that effectiveness of devaluation to improve balance of trade depends on not only magnitude of price elasticities of export supply and import demand but depends on ratio of value of imports to value of exports as well. Given the estimated elasticities the Marshall-Lerner sufficient conditions indicated that devaluation would have been effective in Tanzania for the years 1970-1973 and 1976-1977 if she were to depend on response of exporters to a devaluation. The size of the trade deficit for the other years would have needed higher elasticities to make devaluation effective. The response of consumers of imports on the other hand would have made devaluation effective for all the years except 1978 and 1980.

5.5 Conclusions and Implications for Further Study

Estimates of price elasticities of export supply and import demand are significant enough to make devaluation effective if the trade deficit is small. If trade deficit is too high, devaluation alone may not be sufficient to improve the trade balance. However, the study did not take into account the secondary effects of devaluation on imports which comes through the increased income resulting from higher prices and production of exports. The higher income tends to increase imports. The increase in imports would suppress the effect of higher prices of imports. The interaction of price elasticity of export supply and import demand expressed in the necessary Marshall-Lerner condition was not examined. The interaction effect may relax the trade deficit conditions derived under conditions of sufficiency. These two aspects need to be examined to assess the full effectiveness of devaluation to improve balance of trade.

Finally the study considered only major agricultural export crops and commercial imports components of visible trade. Expansion of the study to cover other exports and import purchases for government consumption would extend the findings of the this study. Government purchased imports formed a substantial proportion of total imports especially during the period 1966-1975 when it ranged between 10% and 26%. Other components of the balance of payments, namely, the capital account and the service sector may need to be considered. The almost non-existence of a capital market in Tanzania may justify giving the capital account

a low profile. There is not much capital mobility. There is a high potential of the tourism industry in Tanzania. Once tourism is developed to make a fair contribution to Tanzania's foreign exchange earnings, the service sector will need to be considered.

5.6 Recommendations

As this study was being carried out major changes in Tanzania's trade policy were taking place. While effects of these changes were captured in the case of export crops whose data were available up to 1986, the effects on imports could not be captured because data were available only up to 1981. The major changes started to be effected from 1982. However, trade liberalization takes the policy back to where it was in the 1960s. This makes the results of the study relevant for current conditions of Tanzania's trade policy.

The major result of this study is the finding that the price mechanism does have an influence on exporters and consumers of imports. The major recommendation following from the study is that policy should be geared towards using the price mechanism as much as possible. For example, tariffs should be preferred to quantitative trade restrictions. The use of the price mechanism would do away with the imports control administrative machinery with its bureaucracy and costs. According to the list of senior staff of Bank of Tanzania in the bank's 1984 Economic and

Operations Report 25% work with import licensing, and exchange control departments sharing equally between the departments.

In the case of exports, prices of export crops should reflect the prices in the world market. Whatever deductions are made on these prices should be considered as a tax on farmers. Such taxes should be compared to taxes paid by others. However, this can only be done with the removal of subsidies on farm inputs or considering it as income. Their removal would make farmers take into account the actual costs of producing their crops when selling them outside the official marketing channels. Subsidies could then be limited to educational and agricultural extension purposes where the objective is to make the farmer aware of advantages of using the inputs during the introductory phases.

Monetary aggregates such as money supply and domestic credit can be adjusted to support the stability of the exchange rate and the domestic prices. If there is a significant trade deficit despite these measures, devaluation can then be used to correct it.

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