MACROECONOMIC IMPACTS ON INDONESIAN AGRICULTURAL EXPORTS

By

KAMAN NAINGGOLAN

Sarjana in Agricultural Product
Technology
Institut Pertanian Bogor
Bogor, Indonesia
1976

Master of Science
Institut Pertanian Bogor
Bogor, Indonesia
1979

Submitted to the Faculty of the
Graduate College of the
Oklahoma State University
in partial fulfillment of
the requirements for
the Degree of
DOCTOR OF PHILOSOPHY
December, 1987

MACROECONOMIC IMPACTS ON INDONESIAN

AGRICULTURAL EXPORTS

THESIS APPROVED:

Luther G. Tweeten
Thesis Adviser

David M. Henneberry

Joseph M. Jadlow

Dean F. Schreiner

Norman N. Durham
Dean of the Graduate College

ACKNOWLEDGEMENTS

I am deeply indebted to Dr. Luther G. Tweeten for his guidance, assistance, and encouragement in the preparation of this thesis. I am also grateful to the members of my advisory committee: Dr. Dean Schreiner, Dr. David Henneberry, and Dr. Joseph Jadlow Jr. for their invaluable criticism, suggestions, and recommendations in the preparation of the final draft.

I am grateful to the Government of Indonesia for awarding me the financial support. Special thanks are extended to Roberta Gottfried, then the Fellowships Manager, and Patricia Whitehead, the Fellowships Secretary of Winrock International for their encouragement and administrative support during my study. Dr. Gary Vocke of ERS deserves special thanks for sending me interest rate data for Indonesia and Singapore. To Dr. Dale Grosvenor of Iowa State University and Dr. Randall Hoffmann I owe a great debt for their long distance support and encouragement during my doctoral program at Oklahoma State University.

My father, Mareas Nainggolan and my mother, Kornelia boru Samosir have always been the source of support, encouragement, and endless prayer. I am truly grateful to them. My doctoral work would have been impossible without the encouragement, patience, and understanding of my beloved wife Lucy. My son Hugo has been the greatest source of inspiration. To them I dedicate this thesis. Finally, I thank to Jesus Lord who gives me the strength and ability to complete this thesis.

TABLE OF CONTENTS

Chapter Page

LIST OF TABLES

CHAPTER I

INTRODUCTION

Problem Situation

Indonesia is a net exporter of agricultural commodities. During the 1975-1979 period the average annual growth of net agricultural exports by nominal value was 29 percent. However, in the 1980-1983 period, net agricultural exports declined by 11 percent annually. In 1975, the agricultural component of total export earnings of Indonesia was 20 percent. Excluding export earnings from oil, the share was 79 percent. The latter share declined to 66 percent in 1981, to 28 percent in 1984, and to 25 percent in 1985 (Glassburner, 1985; Muir,1986).

Traditionally, rubber has been the most important Indonesian agricultural export commodity by value. In 1982 rubber production was down 4 percent from 1981, and lower prices caused export value to fall nearly 30 percent to $600 million. Nevertheless, rubber retained its position as Indonesia's largest agricultural earner of foreign exchange, accounting for 26 percent of total agricultural export receipts.

Coffee ranked third in commodity export earnings after rubber and wood (logs, sawn timber). Coffee export value was $427.3 million in 1983, above 1982's $341.7 million and well below 1980's record $658 million. Other important agricultural export commodities include: shrimp, tea, spices, rattan, tobacco, cocoa beans, fish, palm oil, and seeds. Europe, the United States, and Japan are major markets for Indonesian agricultural exports. US agricultural imports from Indonesia totaled $ 482 million in 1982, 26 percent below 1981 (ERS). USDA (1985) ranked Indonesia as the fourth agricultural commodities supplier to the U.S. in 1984 after Brazil, Canada, and Mexico.

With the dramatic fall of oil price, the growth of foreign exchange in the future must depend increasingly on non-oil export earnings. Agricultural exports remain of the greatest importance, having averaged 74 percent of non-oil exports since the first oil shock in 1974 (Glassburner). Low cost labor, soil, and climate have strongly influenced comparative advantage in agricultural exports but government policies have also influenced exports.

The policies of the Indonesian government have been instrumental in making sustained growth of agricultural export earnings possible. Most forms of overt export taxation were eliminated in the early 1970's, and the multiple exchange rate system of the 1960's, which discriminated strongly against non-oil primary exports, was almost completely eliminated by 1970.

On November 15 1978, a major devaluation, known as 'KENOP 15', was undertaken as a means of establishing 'exchange rate protection' for non-oil exports. The rupiah was devalued from Rp 415 to Rp 625 per US $ (34 percent rupiah depreciation, or 51 percent dollar appreciation). In response to the balance of trade deficit in 1983, the government announced another large devaluation to Rp 994 per US $ (37 percent rupiah depreciation or 59 percent dollar appreciation). It has since depreciated to the level of Rp 1133 per US $ in May 1986 (Indikator Ekonomi). Recently, the government further announced rupiah devaluation from Rp. 1200 to Rp. 1600 per US $ (25 percent rupiah depreciation or 33 percent dollar appreciation).

The performance of the agriculture sector is affected by macroeconomic policies through its effects on inflation, the real exchange rate, and incentives to export and import. The effects of macroeconomic policies on the informal sector, defined as that small sector of the economy which operates with limited capital, simple technology and having no organized links with other sectors (ILO, 1972), along with the agriculture sector have been noted by McKinnon. He has argued that the informal sector in general, and agriculture in particular, have been held back in many developing countries by policies that have contributed to capital market fragmentation, by inflation, administered interest rates, exchange rate overvaluation, and protectionism. Timmer, Falcon, and Pearson argue in a similar fashion for greater focus on "macroprices", i.e., the inflation rate, interest rates, wage rates, the exchange rate, and the intersectoral terms of trade.

Certain policies such as expansionary monetary policy depreciate nominal exchange rate and result in lower real exchange rates if nominal exchange rate changes offset differences in inflation rates among countries. A lower real exchange rate decreases the cost to foreign consumers of Indonesian products, improving agricultural exporters competitive position. On the other hand, contractionary monetary policy results in lower inflation. If lower inflation raises real interest rates and hence real exchange rates, the competitiveness of agricultural exports is retarded. Other factors including the increase in world demand for export products, export price fluctuations and policies of Indonesia's trading partners also affect export performance.

Schuh in 1974 argued that the exchange rate would have an impact on the agricultural sector of the economy. Following Schuh, many attempts have been made to link macroeconomic policies with the agriculture sector. In developing countries, however, the attempts to incorporate the effect of monetary factors into empirical models of agricultural activity have been few. Such a study is important for Indonesia to understand the linkage between macroeconomic policy and the agricultural sector, especially agricultural exports.

Objectives

The general objective of this study is to specify and estimate the linkages between macroeconomic policy and agricultural exports in Indonesia. Specific objectives are to:

1. Determine the interrelationships between the macroeconomic sector and agriculture through (a) exchange rates, (b) interest rates, and (c) inflation linkages;
2. Estimate the effect of changes in the Indonesian monetary policies on agricultural exports through (a) to (c) above;
3. Simulate the impact of different levels of money supply growth and foreign income on real exchange rate, real interest rate, inflation, real income, and agricultural exports.

Hypothesis

Considering these objectives, hypothesis to be examined are:

1. An increase in the money supply has no impact on the real exchange rate;
2. Changes in the real exchange rate do not change agricultural exports;
3. An increase in government deficit has no influence on the real interest rate;
4. An increase in foreign income does not affect net agricultural exports.

Overview of Research Procedure

To investigate the linkages between macroeconomic sector and agriculture sector, an econometric model will be constructed. Quarterly time series data from 1975/1 to 1985/4 will be used to estimate coefficients for the model. The data will be collected from the International Financial Statistics (IFS) published by the International Monetary Fund and other complementary sources. Variables will be included based on theory, previous empirical studies, and availability of data. The Ordinary Least Square (OLS) procedure will be used to estimate coefficients in the models. The estimated parameters will be used for simulation and policy analysis under certain assumption regarding the state of the economy.

Outline of Thesis

The remainder of this study is divided into five chapters. The literature review will be presented in Chapter II. The theoretical relationship and econometric model to be used in this study will be developed in Chapter III. Chapter IV discusses the data, analysis, and results of the econometric models.

Chapter V reports simulation experiments. The baseline and simulation predictions will be generated and compared. The baseline predictions will be based on the assumption that all the exogenous variables grow at their historical trends. Forecasts will be for years 1986, 1987, and 1988. The simulation predictions are similar to those of baseline predictions except that some exogenous variables are altered to measure how the economy will adjust to these changes. Finally, Chapter VI will contain the summary and conclusions of the study.

CHAPTER II

REVIEW OF LITERATURE

Macroeconomic policy interacts with agriculture through its effect on inflation, the real exchange rate, the real interest rate, and incentives to export and import (see Schuh 1974, 1984). The consequences of macroeconomic policy can reinforce or neutralize the policies directed solely at agriculture. Timmer (1986) emphasized the linkages between macroeconomic policy and food sector in Indonesia and found that the foreign exchange rate is the most important macro price affecting agricultural production and the health of rural economy. Similarly, Dorosch (1986) conducted a study linking macroeconomic policy to the food sector through changes in the inflation and the exchange rate in Indonesia. He found that inflation and exchange rate policy had widespread effects on the food sector. This chapter presents theoretical and empirical reviews of past studies regarding the effect of exchange rate, interest rate, inflation, and money supply on farm exports.

Exchange Rates and Agricultural Exports

Schuh was among the first to highlight the effects of exchange rates on U.S. agriculture. He argued that the exchange rate was overvalued during the 1960s and 1980s and undervalued in the 1970s. The consequence of overvaluation of U.S. dollar is, other things being equal, undervaluation of agricultural resources in relation to their world opportunity costs and to shift the demand for U.S. farm exports downward. This lowers the price in the domestic market. Domestic supply quantity falls as resources are transferred out of the agriculture sector. The price of product in terms of foreign currency rises, reducing the quantity demanded. Exports decline as foreign demand decreases. Consequently, gross agricultural sector income and foreign exchange earnings are reduced.

The magnitude of the reduction in foreign exchange earnings as well as the reduction in gross sector income depend on the magnitude of overvaluation and the respective elasticities of demand and supply for the products. Schuh emphasized that the exchange rate has been ignored in explaining the farm problem in the U.S, and need to be considered to understand the performance of the agriculture sector.

Vellianitis-Fidas (1975) reported econometric studies that measure the effect of exchange rate changes on U.S. agricultural exports. The results indicated that the exchange rate changes were not significant explanatory variables for U.S. farm exports because agricultural export supplies are inelastic. Her econometric models were criticized by Schuh (1975) and Chambers and Just (1979) as too simple to capture a complex reality; and her empirical investigation has no underlying theoretical structure.

Kost (1976) presented the theoretical framework to assess the trade impact of changes in exchange rate on commodity production, consumption, trade levels, and prices for two trading partners. The theoretical model was used to analyze the possible effects of a devaluation on the agriculture sector of the two economies.

His approach was based on the export supply and import demand curves. Export supply was assumed to be a function of the market price in the exporting country, while import demand was assumed to be a function of the market price in the importing country. If an exporter devalues its currency, the change in exchange rate will shift the import demand upward. The elasticity of the export supply curve determines the impact of a shift in the import demand curve. The more elastic the export supply, the larger the quantity effect and the smaller the price effect.

Similarly, the elasticity of the import demand curve determines the magnitude of imports. The more elastic the import demand curve the larger the quantity effect and the smaller the price effect. Kost contends that because farm products are highly inelastic, it is very likely that the effect on agricultural prices will be larger than the effect on quantity. Thus a devaluation would be inflationary in the agriculture sector. Kost (p.104) concluded:" In summary, we can only expect a small impact on agricultural trade as a result of a change in exchange rates".

The theoretical framework described by Kost fails to incorporate cross price effects between the traded agricultural commodity and all other goods for which prices are not constant in deriving the excess demand function. Chambers and Just (1979) argued that excess demand and excess supply equations must include all prices and income, since neo-classical demand and supply functions are the results of utility and profit maximization. Their econometric model treated all prices, the exchange rate, and income as demand shifters and treated all prices and the exchange rate as supply shifters. Their study implies that there is no a priori reason to expect the price or quantity change to be less in percentage terms than the change in the exchange rate. From the above studies it is important to note the magnitude of the elasticity of farm exports with respect to the exchange rate, a parameter crucial in analyzing the impact of money supply on the farm exports through the exchange rate.

Cooper (1971) analyzed the effects of devaluation in 19 less developed countries (LDCs) that occurred in the late

1950s and early 1960s. He found that import prices rose quickly in the three or four months following the devaluation and the absolute volume of imports generally declined within the first year. He also observed that there was a tendency for export taxes to be initiated or increased, particularly on primary commodities. These were intended to tax away some of the gains that would otherwise accrue to export producers following the devaluation. Cooper found that devaluations tended to be followed by a depression of economic activity.

Kincaid (1984), estimating import demand and export supply equations, analyzed the effectiveness of the exchange rate adjustment of November 1978 in promoting non-oil exports and restraining import in Indonesia. Foreign price of imports was treated as exogenous by the small country assumption. It was assumed that imports were demand determined. Demand for imports was specified as follows:

$$\log IM^d = a_0 + a_1 \log RI - a_2 \log RP + a_3(\log L^e - a_4 \log RI) \qquad 2.1$$

where IM^d is demand quantity for real imports, RI is domestic income, RP is the relative price of foreign to domestic goods, L^e is excess supply of liquidity, and a_1, a_2, a_3, and $a_4 > 0$ are parameters.

To account for importer's behavior when they are off their long-run demand curve, Kincaid introduced a partial-adjustment mechanism which relates the change in imports at time t to the difference between import demand in that period and actual imports in the previous period:

$$\log IM_t - \log IM_{t-1} = k\ (\log IM_t^d - \log IM_{t-1}) \qquad 2.2$$

where $0<k<1$ is the coefficient of adjustment. Substituting equation 2.1 into equation 2.2 and solving for import in period t results in

$$\log IM_t = ka_0 + k\ (a_1 - a_3a_4)\ \log RI - k\ a_2 \log RP$$
$$+ka_3 \log L^* + (1-k) \log IM_{t-1} \qquad 2.3$$

where the coefficients of real income, relative prices, and liquidity represent short-run elasticities. The coefficient of real income is indeterminate because higher real income increases money demand, and thereby reduces pressure on import demand. Real imports were obtained by deflating imports by a foreign price deflator calculated as a weighted average of trading partner's export prices.

Since Indonesia has a small export share in the world market, exporters are assumed to be price takers. Export supply was specified as

$$\log X^s = c_0 + c_1 \log RPD + c_2 \log RGDP \qquad 2.4$$

where X^s is export supply, RPD is relative price measured as the ratio of the weighted average of Indonesia's major export commodities to its domestic consumer price index (CPI), RGDP is real gross domestic product which serves as a proxy for the country's productive capacity, and c_0, c_1, and c_2 are parameters with $c_1, c_2 > 0$.

A partial adjustment mechanism was introduced to accommodate a lag in supply response:

$$\log X_t - \log X_{t-1} = j\,(\log X_t^* - \log X_{t-1}) \qquad 2.5$$

where $0<j<1$ is the coefficient of adjustment for export supply. Substituting equation 2.4 into equation 2.5 and solving for exports in period t yields

$$\log X_t = jc_0 + jc_1 \log RPD + jc_2 \log RGDP + (1-j)\log X_{t-1}. \qquad 2.6$$

Results of the study showed that the relative price elasticities for the import demand equation were small both in the short-run and in the long-run. But, these elasticities were significantly different from zero, indicating that relative prices had an impact on import demand even in the short-run. The supply price elasticity for export was estimated at 0.61 in the short-run and about 6 in the long-run.

Kincaid's study does not relate the exchange rate to export supply and import demand directly. Furthermore, the linkage between macroeconomic variables and the exchange rate was not specified. The issue of whether the exchange rate should be treated as an exogenous or endogenous variable is critical in agricultural trade modeling. In many LDCs, the generalized floating exchange rate has been widely adopted which implies that the exchange rate can no longer be considered as a policy variable but must be considered as an endogenous variable. If the exchange rate is treated as an exogenous variable, the causal linkage between the money supply and the exchange rate can not be calculated.

The model that simultaneously determines commodity prices, domestic inflation, and the exchange rate was developed by Chambers and Just (1982). In their model, the nominal exchange rate, measured as special drawing rights per dollar, was treated as an endogenous variable and was assumed to be a function of the nominal discount rate, the general price level, and a lag function of the balance on current account. The latter was used to capture the effects of other important non-monetary factors that affect the level of the exchange rate.

After estimating a model of the agricultural sector and its links to monetary variables, they simulated the effects on prices and trade from a reduction in the level of money supply. Based on these simulations, they concluded that monetary policy has a quite dramatic impact on the exchange rate which in turn seriously affects the competitive position of U.S. exports in international trade. In their study, the only monetary link is the U.S. money supply as a determinant of the exchange rate which in turn is a determinant of agricultural exports. Real interest rate and inflation rate links were ignored.

Batten and Belongia (1984) argued for distinguishing between nominal and real exchange rates in trade modeling. In their study, they isolated the marginal impact of exchange rates on trade, holding the impact of the other forces that affect export flows constant. The agricultural export equation was assumed to be a function of the level of foreign real economic activity, the price of U.S. exports relative to those of other countries, and the real exchange rate. They used a double-log specification to estimate the following equation for the period 1971/1-1984/1:

$$\log(AGX)_t = \underset{(0.54)}{0.73} + \underset{(10.93)}{1.32}\log(GNPF)_t - \underset{(5.43)}{0.30}$$

$$Sum\{b_i \log(USAGP/USCPI)_{t-i}\} - \underset{(4.49)}{0.71} Sum\{c_j \log(RTWER)_{t-j}\}$$

$R^2=0.94$, $SE=0.058$, $DW=1.51$

where

AGX =the volume of U.S. agricultural exports (in 1972 dollars),

GNPF =the trade-weighted index of foreign real GNP,

USAGP=the price index of U.S. agricultural exports,

USCPI=the U.S. consumer price index, and

RTWER=the real trade-weighted index of the foreign exchange rate of the U.S. dollar.

The above result indicates that the real exchange rate has a significant effect on agricultural exports.

Studies of noncoffee exports in Colombia has been documented by Edwards (1985). The results generally showed that the domestic relative price of noncoffee exports (RER) and the level of world economic activity have been important in determining export volumes. Edwards developed and estimated the following model for the noncoffee export in Colombia using quarterly data for 1970-1981 period:

$$\log X_t = a_0 + a_1 \log PX_t + a_2 \log YW_t + a_3 \log Y_t + u_t$$

where

X_t=long-run volume of noncoffee exports,

PX_t=domestic relative price of exports, measured as effective nominal rate of the peso to the U.S. dollars times the U.S. wholesale price index divided by the Colombia CPI (PX can be interpreted as a measure of RER),

YW_t=world real level of economic activity (U.S. real GNP was used as a proxy),

Y_t=domestic real level of economic activity, defined as domestic real GNP, and

u_t=disturbance .

The results indicated that the RER had a significant effect on the behavior of noncoffee exports. The real level of economic activity in the rest of the world also was strongly related to noncoffee exports.

In a recent study, Barclay and Tweeten (1986) developed a general equilibrium econometric model relating U.S. macroeconomic policies to U.S. net farm exports using data from 1970 to 1984. Export supply was assumed to be a function of price of agricultural products, real exchange rate, and foreign income. A partial adjustment mechanism was introduced into the model. The exchange rate equation was assumed to be a function of real rate of interest, difference between foreign and domestic interest rates, and balance of payments. The lagged dependent variable was also included as a regressor.

Estimated coefficients and simulation results showed a positive relationship between the deficit and the real interest rate. This result supports a previous finding by Tweeten (1985). The real exchange rate was also found to be significantly affected by the real interest rate. An increase in the real interest rate increases the real value of the U.S. dollar. Simulation experiments indicated that a decrease in the real interest rate reduces the real exchange rate. Finally they found that the net exports increased as a result of the decrease in the real exchange rate.

The foregoing discussion suggests that most farm export models have focused on the impact of exchange rates on farm exports whereby the exchange rate has been assumed to be an exogenous variable. The linkages between macroeconomic policies and real interest and inflation rates have not been incorporated into most models. As mentioned in Chapter I, this study attempts to analyze the impacts of macroeconomic policy on farm exports through exchange rates, interest rates, and inflation linkages. The rest of this chapter will discuss the determinants of exchange rates, interest rates, and inflation linkages to farm exports.

The Monetary Approach of Exchange Rate Determination

The monetary approach to exchange rate is based upon two assumptions: (1) demand for money is a stable function of a limited numbers of aggregate economic variables, and (2) in the absence of tariff, transport costs and restrictions upon trade, the law of one price will hold in international markets. In the monetary approach, the law of one price appears in the form of the purchasing- power- parity condition (PPP), in which the exchange rate equates the prices of traded goods in alternative currencies:

$$E=P/P^{*} \qquad 2.7$$

where P and P* represent the domestic and foreign currency prices of traded goods, and E is the domestic currency prices of foreign exchange (variables with asterisks refer to the foreign country). This definition implies that the exchange rate appreciation and depreciation refer to a fall and a rise in the E respectively.

The next step is to link the exchange rate to the monetary sector which requires money market equilibrium conditions of countries:

$$MS=P.L() \qquad 2.8$$

$$MS^*=P^*.L^*() \qquad 2.9$$

where MS and MS* denote the domestic and foreign nominal money supply, L and L* denote the domestic and foreign real demand for money. Solving P and P* in equation 2.8 and 2.9 and substitute in equation 2.7 yields equation 2.10:

$$E=(MS/MS^*).(L^*/L). \qquad 2.10$$

Equation 2.10 expresses the principal determinants of exchange rates. These are the nominal quantities of monies and the real money demands. The rate of change (denoted by ^) in the equilibrium exchange rate can then be expressed as:

$$\hat{E} = (\hat{MS}-\hat{MS}^*) +(\hat{L}^*-\hat{L}). \qquad 2.11$$

The first term in 2.11 represents the effects of nominal money supply changes on the exchange rate. In a floating exchange rate system, the country with higher money supply growth will experience a depreciating nominal exchange rate, other things equal. This term captures the effect of differences in long-run inflation rates between countries and their reflection in exchange rates. The second term in 2.11 captures the effects of changes in real money demand. Other things equal, the country that experiences a relative increase in real money demand will have an appreciation in the exchange rate.

The factors that influence the real money demand include interest rate, expected inflation, and real income growth. Given that the real demand for money, under the monetary approach, is a stable function, equation 2.11 can be written in functional form to have the following directional relationships:

$$E=f(MS,y,i,MS^*,y^*,i^*). \qquad 2.12$$

The partial derivative signs can be explained intuitively by the money markets. An increase in the money stock of any currency creates an excess supply of money, which lowers the value of that currency ($\partial E/\partial MS >0$, $\partial E/\partial MS^* <0$). If income elasticity of money demand (domestic or foreign) is positive, an increase in the income of any country creates an excess demand for money, which appreciates the value of the country's currency ($\partial E/\partial Y <0$, $\partial E/\partial Y^*>0$).

Finally, if the interest rate elasticity of money demand ($E_{d,i}$; $E^*_{d,i}$) is negative, an increase in interest rate of any country depresses demand for money and creates an excess supply of money, which depreciates the value of the country's currency ($\partial E/\partial i > 0$), $\partial E/\partial i^* < 0$).

The monetary approach has produced several variations, as exemplified by Frenkel (1976), Bilson (1978), Dornbusch (1976), Frankel (1979), and Hooper-Morton (1982). Frenkel constructed a model of the mark-dollar exchange rate during the German hyperinflation which was tested with monthly data for the period February 1920 to November 1923. The demand for German money, measured in real units (M^d/P), is assumed simply to be a function of the expected rate of German inflation (π^*) on the assumption that the effects of these expectations swamped the effects of changes in either real income or the real rate of interest during the time period under consideration:

$$M^d/P = g(\pi^*). \qquad 2.13$$

The U.S. price level was assumed to be fixed and normalized to equal 1, and the assumption of PPP was invoked to equate the exchange rate (E, in marks per dollar) with the German price level (P), or

$$E = P. \qquad 2.14$$

In equilibrium, nominal money demand equates nominal money supply (MS) and yields the exchange rate equation

$$E = MS/g(\pi^*). \qquad 2.15$$

By assumption, the expected rate of inflation equals the expected rate of currency depreciation, which in turn was assumed to be reflected by the forward discount on the mark (π^*_{-1}). A double log version of the exchange rate equation was then estimated as

$$\log E = -5.135 + 0.975 \log MS + 0.591 \log \pi$$
$$(0.731) \quad (0.050) \qquad (0.073)$$

$R^2=0.994$, D.W=1.91

with standard errors shown in parenthesis. Support for the model is apparent from the goodness of fit, the signs and significance of the coefficients, and the fact that the coefficient on logMS does not differ significantly from unity indicating that the exchange rate exhibits homogeneity of degree 1 in the relative money supply as suggested by theory.

Bilson (1978) presented a variant that combines the assumption of PPP with money market equilibrium hypothesis. The demand for money was assumed to be the Cagan functional form

$$M/P = ke^{-wi}y^n \qquad 2.16$$

where M= the stock of money demanded,

P= the price level,

i= the interest rate,

y= the level of real income; and k,w, and n are parameters. The PPP condition allows Bilson to write the exchange rate equation as

$$E=(MS/MS^*).(y^*/y)^{-n}.k^*/k.e^{w(i-i^*)}. \qquad 2.17$$

To specify the shift factor k/k^* a trend equation was introduced as follows

$$\log(k/k^*)=k_0+k_1.t \qquad 2.18$$

where k_0 is a constant, and k_1 is the rate of growth in the relative money demand. The partial adjustment mechanism was then employed to take into account the actual exchange rate adjustment towards the equilibrium rate according to equation 2.19

$$\log(E_t)-\log(E_{t-1}) = d(\log E_t{}^*-\log E_{t-1}) \qquad 2.19$$

where d denotes the partial adjustment coefficient and $E_t{}^*$ denotes the equilibrium exchange rates defined in 2.17. Substituting equation 2.17 and 2.18 into 2.19 and adding an error term yields equation 2.20, the final estimating equation:

$$\log(E^{*)}= d.k_0+d.\log MS-d.\log MS^*+d.w.(i-i^*)$$
$$-d.n\log(y)+d.n\log(y^*)+d.k_1.t+(1-d)E_{t-1}+u . \qquad 2.20$$

The model was tested using monthly data for the Federal Republic of Germany and the United Kingdom from April 1970 to May 1977. Based on the results of the study Bilson concluded that the actual behavior of the DM/pound rate during the sample period was consistent with the prediction of the monetary approach.

A similar analysis was done by Clements and Frenkel (1980). In their work, the monetary approach was applied to examine the dollar/pound exchange rate for the 1920s. They argued that the equilibrium exchange rate is influenced by both real and monetary factors which operate through their influence on the relative demands and supplies of monies. One of the important channels through which real factors affect the exchange rate is the relative price of traded to non-traded goods.

Their model follows the Frenkel-Bilson model. The price level was assumed to be a linear homogeneous (Cobb-Douglas) function of the prices of non-traded goods P_N and traded goods P_T :

$$P=P_N^{B}P_T^{1-B} \qquad 2.21$$

$$P^*=P_N^{*B*}P_T^{*1-B*}. \qquad 2.22$$

From 2.21 and 2.22 the ratio of traded goods prices P_T/P_T^* can be written as

$$P_T/P_T^*=(P_T/P_N)^{B}/(P_T^*/P_N^*)^{B*}(P/P^*). \qquad 2.23$$

Equation 2.23 links the relative price of traded goods to the ratio of the price levels through terms which summarize the price structure in the two economies. Assuming that PPP applies to traded goods, the parity is expressed as

$$E=P_T/P_T^*. \qquad 2.24$$

Further, they assumed that the demand for money is in Cagan form:

$$M/P=L(y,i)=ke^{-wi}y^n \qquad 2.25$$

$$M^*/P^*=L^*(y^*,i^*)=k^*e^{-w^*i^*}y^{*n^*}. \qquad 2.26$$

By substitution, and assuming that domestic and foreign parameters are the same (i.e. that $n=n^*$, $k=k^*$, $w=w^*$, $B=B^*$) the exchange rate equation becomes

$$\log E=c+B\log(P_T/P_N)/(P_T^*/P_N^*)\ +\log(MS/MS^*)+n\log(y^*/y)$$
$$+w(i-i^*). \qquad 2.27$$

Equation 2.27 implies that a rise in the relative domestic price of traded goods results in a depreciation of the currency, i.e. rise in E. The elasticity of the exchange rate with respect to the relative price should approximate the relative share of spending on non-traded goods (B). Equation 2.27 was used for empirical estimation. The model was applied to analyze the dollar/pound monthly exchange rate over the period from February 1921 to May 1925 during which exchange rates were flexible. They used wholesale price indices as a proxy for the prices of traded goods, and wages as a proxy for non-traded goods.

An equation like 2.27 was estimated without imposing any of the restrictions of equality between domestic and foreign parameters. They found the following OLS estimate (with standard errors in parenthesis)

$$\underset{(1.396)}{\log E=-4.297}\ \underset{(0.099)}{+0.415}\log (P_T/P_N)/(P_T^*/P_N^*)\ \underset{(0.182)}{+1.050}\log MS$$

$$\underset{(0.143)}{-0.044}\log MS^*\ \underset{(0.066)}{+0.188}\log(y/y^*)\underset{(0.350)}{+0.363}(i-i^*)$$

$R^2=0.96$; s.e=0.015; D.W=1.55.

The coefficient of relative prices above implies that the relative share of expenditures on non-traded goods is about 0.42. The elasticity of the exchange rate with respect to the domestic money supply is 1.05 which is consistent with homogeneity postulate.

Dornbusch (1976) emphasized the linkage between expected exchange rate changes and interest rate differential, focusing on how a monetary expansion affects the time paths of the exchange rate, the domestic price level, and the domestic interest rate. The Dornbusch model assumes that prices are sticky, at least in the short run. As a consequence of the sticky-price assumption, changes in the nominal interest rate reflect changes in the tightness of monetary policy. When the domestic interest rate rises relative to the foreign rate, it is because of contraction in the domestic money supply relative to domestic money demand without a matching fall in prices. Higher interest rate at home than abroad attracts a capital inflow which causes the domestic currency to appreciate. The result is a negative relationship between the exchange rate and the nominal interest differential. This theory is a realistic description when variation in the inflation differential is small.

Frankel (1979) combined the Dornbusch model with the Frenkel-Bilson model. The model incorporates the expected long-run inflation at home and abroad. PPP was assumed to hold in the long run. The exchange rate equation was then formulated and tested as

$$\log E=\log(MS/MS^*)-a_1\log(y/y^*)+a_2(i-i^*)+a_3(\pi-\pi^*)+u \quad . \qquad 2.28$$

The model was tested on the mark/dollar exchange rate using monthly data between July 1974 and February 1978. He found that the coefficient on the expected long-run inflation differential was significantly greater than zero. Moreover, the coefficient of the relative money supply was significantly positive and equal to 1 which conforms with theory. The principal theoretical difference between the Frenkel-Bilson model and the Dornbusch-Frankel model is that the latter allows for short-run deviations from PPP caused by sticky domestic prices. Prices adjust only gradually in response to excess demand, which depends on the terms of trade (TOT), and to secular inflation differential.

Another version of the exchange rate determination was developed by Hooper-Morton (1982). Their model is basically a modification of Dornbusch-Frankel model. The Hooper-Morton model allows for changes in the long-run real exchange rate. These long-run real exchange rate changes are assumed to be correlated with unanticipated shocks to domestic trade balance.[1] The exchange rate equation was derived as:

$$LogE=a_0+a_1\log(MS/MS^*)-a_2\log(y/y^*)+a_3(i-i^*)+a_4(\pi-\pi^*)$$
$$+a_5TB+a_6TB^*+u \qquad 2.29$$

where TB and TB* represent the cumulative U.S. and foreign trade balances, and u is a disturbance term. They found that the trade balance variable significantly affected the exchange rate.

Each of these models supports the conclusion that monetary expansion leads to currency depreciation in the short-run, and none of the models adds significantly to our insights about the effects of fiscal policy on exchange rates. Some authors (Batten and Belongia, 1984; Henneberry, Henneberry, and Tweeten ; Belongia and Stone, 1985) argued that in investigating the effect of exchange rate changes on farm exports one should look at the movement of exchange rates after adjusting for the effects of inflation

[1]Hooper and Morton used the trade balance as a proxy for current account since current account data are available only on a quarterly basis.

differential. The real exchange rate (RER) can be defined (Dutton and Grennes, 1985) as:

$$RER=E.(P^*/P)$$

where E is the nominal exchange rate; P and P^* are the price indices for the domestic and foreign countries. Since RER is determined by nominal exchange rates and the relative price ratio between domestic and foreign countries, the monetary model of exchange rate determination can be applied for the RER determination with the inclusion of the relative price ratio.

However, some authors contend that fiscal variables also affects the RER (Valdes, 1986; Belongia and Stone, 1985; Tweeten, 1985). One of fiscal variables that is thought to affect the RER is government spending. A government deficit affects the RER through its effects on real interest rates. The conventional view suggests that, other things being equal, higher deficits raise real interest rates and lower deficits reduce them. If the real interest rates rise relative to foreign real rates, other things being equal, the RER of the home country should rise. On the other hand, if the domestic real interest rate falls relative to foreign real rates, the real exchange rate of the domestic currency should decline. The presumption is that a positive real rate differential attracts foreign capital, while a negative differential makes investment abroad more attractive. Some studies in Argentina, Chile, Colombia, and Peru indicated a negative relationship between government expenditure and RER (Valdes, 1986). A similar result was found by Barclay and Tweeten (1986). In contrast, Batten and Belongia (1986) found that RER was not significantly affected by federal government deficit/surplus in the U.S. It should be noted however, that none of these models included monetary factors in the RER determination.

The above review suggests that all of the structural exchange rate models discussed above can be expressed in general form as equation 2.29 (the Hooper-Morton model). All models emphasize first-degree homogeneity of exchange rate with respect to relative money supply, or $a_1=1$. The Frenkel-Bilson or flexible-price monetary model imposes PPP hypothesis to hold, implying that RER is constant over time or zero degree homogeneity of RER with respect to money supply.

The Dornbusch-Frankel or sticky-price monetary model also hypothesizes values for the coefficients on the short-term interest differential; $a_3<0$ and $a_4>0$. The derivation of these coefficient restrictions is explained in Frankel (1979).

The Hooper-Morton model imposes the same constraints as the Dornbush-Frankel model, but it allows unanticipated shocks in the trade balance to affect the PPP. This implies that the RER is not constant over time. The model assumes $a_5<0$.

Evidence in Indonesia (Dorosch, 1986) indicated that there was deviations from PPP, implying that RER was not constant. In such a case, the Frenkel-Bilson model is not appropriate. The Hooper-Morton model, combined with government deficit as a separate regressor would seem more appropriate in modeling RER in Indonesia.

Interest Rates and Agriculture Export

The real interest rate is an important factor affecting profitability in the agricultural sector. High real interest rates reduce real wealth, and transfer wealth from debtor to creditors. Since in majority farmers are net borrowers, they are disadvantaged by high real interest rates.

The determinants of real interest rate include monetary and fiscal policy. According to macroeconomic theory, a country that pursues a contractionary monetary policy drives up real interest rates if an increase in inflation rates does not offset an increase in nominal interest rate. This is clear from the Fisher equation:

$$i=r + INF \text{ , or } r=i-INF$$

where i and r are nominal and real interest rates, and INF is inflation rate.

Similarly, government deficits, if financed by borrowing or increasing tax rates (can be interpreted as contractionary monetary policy), will raise nominal interest rate. However, if deficits are financed by issuing high-powered money the net impact is ambiguous.

High real interest rates raise real interest expense, and hence production costs (direct effect). Furthermore, high real interest rates attract investment from abroad, creating higher demand for domestic currency relative to supply and driving up the value of local currency in international exchange (indirect effect). High value of currency will reduce farm exports as explained in the previous section. The net impact is lower farm income generated from exports.

Empirical studies have estimated the impact of macroeconomic variables on interest rates. Tweeten (1985) used deficit-investment ratio and inflation rate as regressors to explain variability in the nominal interest rates. The results showed that higher deficit-investment ratio implies higher nominal interest rate. He also found that the coefficient of inflation rate is positive and less than 1, implying that nominal interest rates rise by more in percentage terms than inflation rates. Thus, real interest rates increased.

In their general equilibrium model, Barclay and Tweeten (1986) specified real interest rate as a function of RER, net capital outflow, gross private domestic investment, federal government budget (surplus), and supply of high powered-money (M_1-B). The resulted equation had a poor explanatory power, but all estimated coefficients' signs conformed with economic theory. Devados (1985) related the real interest rate in the general economy to real interest rate in agricultural sector in U.S. using a distributed-lag model. He found that the coefficient for the current interest rate in the general economy had the expected sign and was statistically significant at 1 percent level.

Inflation and Agriculture Export

In previous sections the interconnections among macroeconomic policies, exchange rates, interest rates, and farm exports have been discussed. These relationships are linked by inflation rates. Inflation, a continuing increase in the overall level of prices for a country's goods and services, may be measured by consumer or wholesale price indices. Inflation studies in LDCs have been based on two approaches, monetarist and structuralist .

The monetarist approach was first develcped and tested by Harberger (1963). Harberger specified the following equation:[2]

---

[2]Harberger's equation can be derived from the demand for money (equation 2.16) by writing $P=MS.e^{w_1}y^{-n}$. Fxpressing the equation in logs and differentiating with respect to time, we obtain the basic form of the Harberger model. Harberger substitutes A for i and adds MS_{-1} in his model.

$$PR = a_0 + a_1 MSR + a_2 MSR_{-1} - a_3 YR + a_4 AR \qquad 2.30$$

where PR = rate of change in aggregate price index,

MSR= money supply growth,

YR = real output growth ,and

AR = a proxy for change in the cost of holding money.

According to equation 2.30, changes in the money supply result in changes in prices, given the rate of growth of output. Harberger employed equation 2.30 to study inflation in Chile using quarterly data for the 1940-1958 period. He found that a one percent increase in the quantity of money caused a rise of about one percent in the price level, other things equal.

Empirical studies in Brazil and India (Colaco, 1969) and Latin American countries (Vogel, 1974; Sheehey, 1980) showed that there is an almost one-to-one correspondence between the growth of the money supply and the inflation rate. Grenville (1981) presented evidence that the growth of money supply was associated with inflation in Indonesia. However, no quantitative model was constructed.

The success of the naive monetarist model in explaining the rate of inflation in many LDCs has led to a crude form of monetarism where policy prescriptions are based primarily on the control of the money supply. Government expenditures in LDCs tend to be financed not by higher taxes or bond sales to the public but by money creation (Bautista, 1980).

The second or structuralist approach to inflation holds that an excess supply of money leads to an excess demand for goods and services. The excess demand for goods and services will be eliminated partially by price increases and, at least in the short run, partially by increases in the supply. The agriculture sector, however, does not respond to changes in the money supply while the manufacturing sector responds by increasing output. Output expansion in the industrial sector increases employment, and hence the demand for food from the agricultural sector. Since increases in demand are not matched by increases in supply, food prices increase. Higher food prices lead to higher wages, resulting in higher industrial prices.

Structuralist models use equation 2.30 as a basic framework but add to it variables such as the relative price of food, import prices, and/or wages. The significance of the coefficients of these variables is interpreted as evidence for the validity of the structuralist models of inflation . Structuralists argue that if these variables are significant, then the simple relationship between the money supply and prices is not valid, and other cost-push elements such as import prices have an independent effect on inflation. Moreover, output in equation 2.30 is not exogenously determined because it also responds to money supply changes, and simultaneity bias emerges.

Numerous empirical studies have followed the structuralist view. Cooper (1971) and Glytsos (1977) expressed the change in the general price level as:

$$PR=b_0 + b_1MSR + b_2YR + b_3MIR \qquad 2.31$$

where MIR is change in import price, with b_1, $b_3 > 0$ and $b_2 < 0$.

Blejer and Halevi (1980) used change in the foreign price of imports , the rate of effective devaluation, and excess demand in the goods market in specifying the domestic rate of inflation in Israel. Excess demand (approximated by the difference between the rate of increase of the money supply and the rate of growth of real income) captured the excess liquidity created by the government fiscal deficit as well as changes in the demand for money caused by income growth. They found that coefficients of the excess demand and foreign price change variables were not significant. The coefficient of effective exchange rate, however, was significant with lags of one and of two periods but was not significant in the current period.

In a similar study in 22 LDCs by Bautista (1982), the excess demand and changes in effective exchange rates were found to be significant. In his study of devaluation in 19 LDCs during the period 1959-1966, Cooper (1971) found that increases in wholesale and consumer prices have been far less than the devaluation -- on average by 32 and 42 percent, respectively, of the devaluation. Connoly and Taylor (1976) observed that devaluations in 5 LDCs during 1962-1970 period resulted in faster increases in wholesale and consumer prices in the year following devaluation but at much lower rate than export and import prices.

The prediction and policy implications of the naive monetarist and the structuralist models are different. Within the monetarist framework, recent models have eliminated some of the differences between the two models. These neo-monetarist models, by distinguishing between expected and unexpected changes in the money supply, relax the assumption of exogenous output growth. A study in Latin American countries indicated a positive relationship between the unexpected money supply and output (Hanson, 1980).

Aksoy (1982) analyzed inflation in Turkey using monetarist and structuralist models. In the first step, the naive monetarist model similar to the Harberger model was developed and estimated with and without the import price variable . The cost of holding money (AR) was defined as changes in expected price level which was generated adaptively by using past prices. The results showed that the coefficient of the current money supply was close to 1. The income coefficient was close to -1 which is in accordance with the monetarist theory. Import price was found to have direct effects on the inflation rate.

In the second step, a simple neo-monetarist model was constructed and tested assuming output was an endogenous variable. At this stage, the first structuralist element was introduced to the monetarist model. Changes in price and output levels were then estimated simultaneously by using three stage least squares (3-SLS). He found that the results were different significantly from those of naive version. The neo-monetarist model indicated that unexpected monetary expansions resulted in higher output growth.

Finally the neo-monetarist framework was extended to test the differential output and price response of agricultural and non-agricultural sectors. The results generally support the structuralist view. Both sectors showed output response to unexpected changes in the money supply, but the agricultural sector responded with a one year lag. He also found that the impact of output growth on the price increases was differed between sectors. Agricultural output growth showed no impact on the prices of this sector because of government intervention to maintain prices.

The foregoing review has discussed some approaches to the study of inflation in LDCs. Some variables that affect inflation rates have been identified. These include growth of money supply, real output, and cost of holding money.

However, some other studies have shown that import prices and effective exchange rates have also affected inflation rates. In this study, the monetary framework combining the RER and import price as separate regressors will be adopted.

Conclusions

The review presented in this chapter documents previous studies regarding the linkages between macroeconomic policies and farm exports through the exchange rates, interest rates, and inflation rates. Some controversies with regard to the impact of exchange rates on farm exports have been identified. Different authors presented different methodology with different sets of data, and ended up with different estimates and policy recommendations. Recent studies, however, generally used the RER as one of the important determinants in explaining farm export behavior.

Unlike earlier studies, more recent studies such as those of Belongia and Stone and Barclay and Tweeten have considered RER as endogenous variables. These studies, however, have emphasized the government deficit and none of them have included monetary factors in explaining variation in the RER as suggested by theory.

Like real exchange rate, interest rate and inflation rate are also influenced by macroeconomic policies. A country that pursues an expansionary monetary policy to stimulate the growth of the economy will put upward pressure on the general price level and downward pressure on the real interest rate and nominal exchange rate. The real exchange rate will then be affected which eventually influences farm exports. The monetary theory of inflation has been extensively employed to study inflation in most LDCs but may be usefully augmented by fiscal policy variables.

CHAPTER III

MODEL SPECIFICATION

The previous chapter presented an overview of the literature regarding the linkages between macroeconomic policies and agricultural exports. The linkages through the exchange rate, interest rates, and inflation rates also were discussed.

This chapter incorporates conceptual frameworks described earlier into an econometrically estimable model to test the hypotheses advanced in Chapter I. The first section will formulate the export model of Indonesia's agricultural products. The RER determination will be presented in the second section. The third section will model the real interest rate determination. The inflation rate model will be developed in the final section.

The Export Model

The export model will be developed for three export commodities of Indonesia : rubber, coffee, and palm oil. For these commodities, exporters are assumed to be price takers on the world market because Indonesia has a small share in the world trade. The foreign demand for exports is assumed to be perfectly elastic.

The export quantity reflects the equilibrium condition between two markets : the foreign demand for and the supply of Indonesia's agricultural exports. The foreign demand for Indonesia's exports is assumed to be a function of (1) the real income of foreign (importing) countries, (2) the price of Indonesia's agricultural exports, and (3) the real exchange rate between Indonesia and its trading partners. Other things equal, the higher the level of foreign real income, the larger is foreign demand for Indonesia's agricultural exports. On the other hand, the higher the price of Indonesia's exports, other things equal, the smaller is the demand quantity for Indonesia's agricultural exports. The higher the RER , the lower is the demand for Indonesia's agricultural exports.

On the supply market, the supply of Indonesia's agricultural exports is assumed to be a function of the real domestic price of Indonesia's agricultural exports and exogenous factors affecting production such as technology and weather. An increase in the real price of agricultural exports, other things equal, increases the supply of exports. In equilibrium, the foreign demand for agricultural exports equals the supply. A reduced form is used to generate the export equation for each commodity:

$$\ln X_{kt}=a_0+a_1\ln RP_{kt}+a_3\ln GNP_t^*+a_4\ln RER_t+D_i+T+u_t \qquad 3.1$$

where X_{kt} = long-run quantity of export of commodity k in thousand tons ,

RP_{kt}= real price of commodity , defined as commodity price divided by wholesale price index for agricultural exports (1980=100),

GNP^*_t= weighted average of real income of Indonesia's major trading partner in billion US$ (1980=100),

RER_t= real trade-weighted exchange rate of Indonesia's trading partner measured as unit of foreign currency per rupiah (1980=100). This definition implies that the RER appreciation and depreciation refer to a rise and a fall in the RER respectively,

D_i = dummy variables to measure seasonal variability among quarters, with D_1=first quarter, D_2=second quarter, and D_3=third quarter,

T = time trend as a measure of technology changes and weather.

u_t = disturbance, and t refers to time period.

It is assumed that the actual quantity exported does not adjust instantaneously to changes in its determinants. The dependent variable, therefore, is expressed as a distributed lag function of the price and the exchange rate variables. The response to the foreign real income is assumed to be instantaneous. Incorporating the lags in equation 3.1, the export equation (with L denotes ln) becomes:

$$LX_{kt}=a_0+a_1LGNP_t^*+Sum(b_jLRP_{kt-j})+Sum(c_jLRER_{kt-j})+D_i+T+u_t. \quad 3.2$$

RP_t and GNP_t^* are assumed to be exogenous in the model. RER_t is an endogenous variable, and RER_{kt-j} and RP_{kt-j} are predetermined variables. The short-run elasticities of exports with respect to world real level of economic activity, real price, and the RER are derived directly from a_1, b_0, and c_0 respectively. The long-run elasticities can be calculated by combining the short-run elasticity with the lag coefficients for each independent variable. Other forms for expected real price and real exchange rate will also be used:

$RP^*=Sum(a_jRP_{t-j})$, and

$RER^*=Sum(b_jRER_{t-j})$,

where RP^* and RER^* are the expected real price and real exchange rate respectively, and the values of a_j and b_j are selected based on the highest adjusted R^2 of regression.

The inclusion of the RER as a separate regressor is based on Orcutt's argument that the market reacts more quickly to exchange rate changes than to price changes. Furthermore, exchange rate changes are usually larger than price fluctuations in the short run (Chambers and Just, 1979). This approach allows for estimation of changes in exports that arise directly from either exchange rate movement or from real price movement in the exporting country.

Because equation 3.2 is a reduced form, coefficient of RP may be positive or negative depending on whether supply or demand response is greatest. As world real level of economic activity improves, demand for agricultural commodities increases. This would increase the export quantity from an exporting country. The theoretical relationship between the RER and exports has been discussed in Chapter II. The higher (appreciate) the RER, the lower is the export volume. Thus, all coefficients in equation 3.2, except the coefficient of the RER, are expected to be positive.

The RER is calculated as follow:

$$RER=Sum[w_i.E_i.CPI_i/CPI^*] \qquad 3.3$$

where w_i is the relevant weight which sums to unity, and is based on Indonesia's import shares by seven major trading partner constructed by Warr (1984). The countries and their respected weights are Japan 0.45, USA 0.21, Germany 0.11, Singapore 0.09, Britain 0.05, Netherlands 0.05, and Australia 0.04. E_i is the nominal exchange rate between Indonesia and each of its trading partners (foreign currency/rupiah). CPI^*_i refers to the CPI of each of

Indonesia's major trading partners, and CPI is Indonesia's consumer price index.

The RER Determination Model

In the previous chapter the monetary approach to exchange rate determination was discussed. In general the theory is supported by empirical evidence. In this study, the monetary approach will be used as a basic framework. This framework is combined with the government deficit to represent fiscal variables. The basic assumption is that money demand is a stable function of a limited number of economic variables. Our model allows deviation from the Purchasing Power Parity (PPP) condition, implying that RER is not constant over time as suggested by evidence in Indonesia (Dorosh). In this study, the Hooper-Morton model combined with the government deficit variable is adopted.

Following Dutton and Grennes, the RER is defined as:

$$RER=E(CPI/CPI^*) \qquad 3.4$$

where all variables are as defined before. Expressing equation 3.4 in logarithmic form:

$$\ln RER=\ln E + \ln(CPI/CPI^*). \qquad 3.5$$

The nominal exchange rate is stated as:

$$\ln E=b_0+b_1\ln(MS/MS^*)_t+b_2\ln(MS/MS^*)_{t-1}+b_3\ln(GNP/GNP^*)_t +b_4(INF-INF^*)_t+b_5(i-i^*)_t+b_6(TB-TB^*)_t+u_t \qquad 3.6$$

where MS_t =Indonesia money supply defined as currency plus demand deposit (M_1) in billion US$,

MS^*_t =weighted average of Indonesia's major trading partner money supply (M_1) in billion US$. Warr's weight is used for aggregation,

GNP_t =Indonesia's real income in billion US$, calculated as the nominal income divided by CPI (1980=100),

GNP^*_t =foreign real income in billion US$, calculated as a weighted average of real income of Indonesia's major trading partners (1980=100),

INF_t =inflation rate in Indonesia, measured as percent change of CPI in Indonesia from the previous period,

INF_t^* =weighted average of inflation rate of Indonesia' major trading partners ,

i_t =nominal interest rate in Indonesia taken as the interest rate in the Jakarta money market in percent per quarter basis,

i_t^* =weighted average nominal interest rate of Indonesia's trading partners. Money market rate of each of trading partner is used for calculation,

TB_t =Indonesia's trade balances, measured as exports minus imports in billion US$,

TB_t^* =weighted average of trade balances of

Indonesia's major trading partners in billion US$, and

u_t =disturbance.

Substituting equation 3.6 into equation 3.5 and adding the government deficit variable (DEF) yields:

$$\ln RER^{*}=b_0+b_1\ln(MS/MS^{*})_t+b_2\ln(MS-MS^{*})_{t-1}+b_3\ln(GNP/GNP^{*})_t$$
$$+b_4(INF-INF^{*})+b_5(i-i^{*})_t+b_6(TB-TB^{*})_t+b_7\ln(CPI/CPI^{*})_t+b_8DEF_t$$
$$+u_t \qquad 3.7$$

where CPI_t =consumer price index in Indonesia (1980=100),

CPI_t^{*}=weighted average of consumer price index of Indonesia's trading partners (1980=100),

DEF_t =Indonesia's government deficit or surplus in billion US$.

The partial adjustment mechanism is employed to take into account the actual exchange rate adjustment towards the RER equilibrium rate according to:

$$(\ln RER - \ln RER_{-1}) = h(\ln RER^{*}-\ln RER_{-1}) \qquad 3.8$$

where $0<h<1$ denotes the partial adjustment coefficient and RER^{*} denotes the equilibrium RER defined in equation 3.7. Substituting equation 3.7 into equation 3.8 and solving for the RER results in equation 3.9, the estimating equation:

$$LRER_t=b_0h+b_1h(LMSDF_t)+b_2h(LMSDF)_{t-1}+b_3h(LGNPDF)_t$$
$$+b_4h(INDF)_t+b_5h(IRDF)_t+b_6h(TBDF)_t+b_7h(LCPIDF)_t$$
$$+b_8hDEF_t+b_9h(LRER_{t-1})+u_t \qquad 3.9$$

where LRER=lnRER, LMSDF=ln(MS/MS*), LGNPDF=ln(GNP/GNP*), INDF=(INF-INF*), IRDF=(i-i*), TBDF=(TB-TB*), LCPIDF=ln(CPI/CPI*), and all other variables are as defined previously.

The RER model above assumes that prices are sticky and consequently PPP does not hold in the short run. Equation 3.9 implies that the RER is determined by relative money supply, relative real income, differences between interest rates, differences between inflation rates, differences between trade balances, ratio of price level in domestic and foreign economy, budget deficit in the domestic economy, and the lagged dependent variable.

An increase in the supply of domestic money increases prices, causing a proportionate depreciation in the RER (lower RER in equation 3.9), other things equal. Similarly, an increase in the domestic interest rate increases capital inflow causing appreciation in the RER. In terms of equation 3.9, the coefficient of the nominal interest differential is hypothesized to be positive. An increase in domestic income or a fall in the expected rate of inflation raises the demand for money and the RER (increase RER in equation 3.9). We expect therefore that the RER is positively related to the real income differential, but negatively related to the inflation differential.

Budget deficit could raise the relative prices of home goods and thus increase the RER. This would occur regardless of whether the deficit is financed by domestic borrowing, by money supply expansion, or by higher taxation. Thus, a government deficit appreciates the RER which reduces profitability of producing export commodities, retards competitiveness, and eventually lowers exports.

The Real Interest Rate Model

The starting point in modeling the real interest rate is the Fisher equation which states that the nominal interest rate is the sum of the real interest (r) and expected inflation rate:

$$i=r + INF \text{ or } r = i - INF$$

where all variables are as defined earlier. According to macroeconomic theory, movements in IS and LM curves determine the nominal interest and inflation rates. The real interest rate is assumed to be determined by movements in the IS and the LM curves and changes in inflation rates.

In this study the IS shifter is assumed to be the government deficit or government surplus. Theoretically, private investment will also determine the IS curve position. However, private investment is very small in Indonesia and therefore is not incorporated in the model. The LM shifter is taken as the actual stock of real balances. The real interest rate is specified as:

$$r_t=d_0 + d_1DEF_t + d_2EMS_t + u_t \qquad 3.10$$

where DEF is budget deficit, and EMS is excess money supply. The excess money supply is defined as:

$$EMS_t = \ln MS_t - \ln M_t^d \qquad 3.11$$

where M^d is the desired equilibrium stock of real balances. The equilibrium demand for money is assumed to be the Cagan functional form (in logarithms):

$$\ln M^d = f_0 + f_1 \ln GNP_t - f_2 i_t + f_3 INF_t. \qquad 3.12$$

Equation 3.12 states that long-run demand for money is a function of nominal interest rate, real output, and rate of inflation. Further, assume that the stock of real money balances adjust according to:

$$(\ln MS_t - \ln MS_{t-1}) = g(\ln M_t^d - \ln MS_{t-1}) \qquad 3.13$$

where $0<g<1$ is the coefficient of adjustment. Substituting equation 3.12 into 3.13 and solving for MS_t. The EMS_t can then be solved as a function of MS_{t-1}, GNP_t, i_t, and INF_t. By adding the lagged real interest rate to allow for the adjustment mechanism and replacing $i=r+INF$, the real interest rate equation can be written as:

$$r_t = f(\ln GNP_t, \ln MS_{t-1}, c_t, DEF_t, INF_t, r_{t-1}). \qquad 3.14$$

Equation 3.14 is a realistic description in a closed economy. In an open economy such as Indonesia without restrictions on capital flows, domestic interest rates will be influenced by exchange rate fluctuations. The RER, therefore, is incorporated into equation 3.14 to capture this effect. The real interest rate equation (with L denotes ln) becomes:

$$r_t = h_0 + h_1 LGNP_t + h_2 LMS_{t-1} + h_3 INF_t + h_4 LRER_t + h_5 DEF_t + h_6 r_{t-1} + u_t \qquad 3.15$$

where r = real interest rate in the Jakarta money market in percent per quarter , calculated as i minus INF

INF = inflation rate , calculated as percent change of CPI in Indonesia over previous period, and all other variables are as defined previously.

Variable DEF is assumed to be exogenous. The GNP, RER, and INF are endogenous, and MS_{t-1} and r_{t-1} are predetermined variables. The conventional view holds that government deficits raise the real interest rate, given the money supply. Large budget deficits increase credit demand and hence real interest rates. Rising credit demand relative to supply increases the RER which lowers exports. So government deficits eventually depress exports. On the other hand, an increase in the money supply decreases the nominal interest rate, driving up inflation and thus lowering the real interest rate. The coefficient of money supply therefore is assumed to be negative. An increase in real income increases demand for money which drives up the nominal interest rate. The net impact is rising real interest rate at a given inflation rate.

The Inflation Model

In the previous chapter, some approaches to inflation studies in LDCs were discussed. The monetary theory of inflation has been widely employed in those studies. The naive monetary approach assumes inflation is a function of money growth, income growth, and the cost of holding money. This simple theory is basically the quantity theory of money. One of the drawbacks of this theory is that it assumes output as an exogenous variable. This assumption leads to simultaneity bias because the output level may react to changes in money supply and other variables. Considering this possibility, this study treats output as an endogenous variable.

Following Blejer and Halevi, import prices and the exchange rate are included in the inflation model. The inclusion of the RER as a regressor is justified in modeling inflation because a decrease in RER raises import prices -- an inflationary element in Indonesia. The price level generally has risen after devaluation.

The inflation model is specified as:

$$INF_t = g_0 + g_1 MSR_t + g_2 GNPR_t + i_t + g_3 MIR_t + g_5 RER_t + INF_{t-1} + u_t \qquad 3.16$$

where MSR = domestic money supply growth, GNPR= domestic real income growth , MIR = rate of change in import price index , and all other variables are as defined before. MSR_t, i_t, and MIR_t are assumed to be exogenous. The output growth GNPR and RER are endogenous to the system, and INF_{t-1} is a predetermined variable. Theoretically, inflation is positively related to the money supply growth but negatively related to the output growth. An increase in money supply increases aggregate demand, bringing upward pressure on the price level. An increase in output growth tends to decrease the price level. An increase in MIR and the RER will increase the domestic price level and thus inflation rates. The interest rate variable (i_t) measures the cost of holding cash. When the expected cost of holding cash rises, people lower their real cash balances, thereby tending to increase the upward pressure on price. In theory the wage level should be included in equation 3.16. Unavailability of wage data, however, precludes such analysis.

The output growth is assumed to be a function of domestic money supply growth, inflation rate, budget deficit, labor growth, and output growth lagged one period. Labor growth is included as an independent variable based on the assumption that marginal productivity of labor in Indonesia is not zero:

$$GNPR_t=k_0+k_1MSR_t+k_2INF_t+k_3DEF_t+k_4POPR_t+k_5GNPR_{t-1}+u_t \qquad 3.17$$

where $POPR_t$ = population growth rate as a proxy for labor growth, and all other variables are as defined earlier. DEF_t, $POPR_t$, and MSR_t are assumed to be exogenous. All independent variables are assumed to have a positive relationship with output growth.

Conclusion

This chapter develops an econometric model to test the hypotheses stated in Chapter I. The model consists of seven equations including three equations for agricultural export commodities, the real exchange rate equation, the real interest equation, the inflation equation, and the income growth equation. The model is capable of explaining the link between the macroeconomic policy and agricultural export through the real exchange rate, real interest rate, and inflation rate.

The model predicts that an increase in the money supply in Indonesia, other things equal, will depreciate the exchange value of the rupiah. The trade effect of this depreciation is to increase agricultural exports which increases income generated from agricultural exports.

The second linkage is the interest rate. An expansionary monetary policy will decrease the real interest rate which reduces the cost of production, and thus stimulates the supply of agricultural commodities. On the other hand, large budget deficits increase the real interest rate which raise the cost of production, and lower the supply of agricultural commodities.

The third linkage is the inflationary effect. Higher inflation is reflected in the cost of inputs used to produce agricultural commodities. A monetary-policy-induced higher general price level increases the cost of non-farm inputs which eventually decreases the supply of agricultural products.

CHAPTER IV

Data Sources and Empirical Results

This chapter identifies data sources and variable constructions employed in this study. The estimated parameters of the model described in Chapter III will also be reported and discussed. The parameters of the model were estimated by the Ordinary Least Square (OLS) technique using quarterly data from the beginning of 1975 to the end of 1985. The first section describes the data and variable constructions. Empirical results are then presented and analyzed.

Data Sources and Variable Constructions

This study utilized secondary time series data from several sources. The main sources were the International Financial Statistics (IFS) published by the International Monetary Fund, Main Economic Indicators published by Organization for Economics Cooperation and Development, Bulletin of Quarterly Statistics for Asia and Pacific published by the United Nations, and Indikator Ekonomi of Indonesia's Central Bureau of Statistics (CBS). Complementary sources included Bulletin of Indonesian Economic Studies (BIES), Bank Indonesia, and Monthly Digest of Statistics published by Department of Statistics, Singapore.

Wholesale price indices, export quantity, and prices for rubber, coffee, and palm oil were obtained from the Bulletin of Quarterly Statistics for Asia and Pasific. The exchange rate data were taken from the Ekonomi Indikator. GNP, GNP deflator, CPI, trade balance, money supply, budget deficit, import price indices, and population were available from the Main Economic Indicators and IFS. Interest rates for Singapore were taken from the Monthly Digest of Statistics. Interest rates for Indonesia were obtained from Bank Indonesia, BIES, and the IFS, while those for other countries were from the IFS.

The GNP data series for Indonesia, Singapore, and Netherlands; the trade balance data for Indonesia and Singapore; and population data for Indonesia are available on an annual basis. Since the model required quarterly data, annual data series were converted into a quarterly basis following a procedure developed by Goldstein and Khan (1976, Appendix II). The Procedure is as follows. Let x_{t-1}, x_t, and x_{t+1} be three successive annual observations of variable x_t. Then the quadratic function passing through the three points is such that

$$\int_0^1 (as^2+bs+c)ds=x_{t-1}$$

$$\int_{1}^{2} (as^2+bs+c)ds=x_t$$

$$\int_{2}^{3} (as^2+bs+c)ds=x_{t+1}.$$

Integrating and solving for a, b, and c yields

$$a=0.5x_{t-1} + 1.0x_t + 0.5x_{t+1}$$

$$b=-2.0x_{t-1}+3.0x_t - 1.0x_{t+1}$$

$$c=1.83333x_{t-1} -1.1666x_t + 0.333x_t.$$

The four quarterly figures in any year can then be interpolated by

$$\int_{1}^{1.25} (as^2+bs+c)ds=0.0546x_{t-1}+0.2345x_t-0.0392x_{t+1}$$

$$\int_{1.25}^{1.50} (as^2+bs+c)ds=0.0079x_{t-1}+0.2657x_t-0.0238x_{t+1}$$

$$\int_{1.50}^{1.75} (as^2+bs+c)ds=-0.0235x_{t-1}+0.2344x_t+0.0077x_{t+1}$$

$$\int_{1.75}^{2.0} (as^2+bs+c)ds=-0.0391x_{t-1}+0.2344x_t+0.0547x_{t+1}$$

Empirical Results

The Export Equation Model

Rubber. An experiment was conducted to select the length of lags on the real price and the real exchange rate (RER) variables using equation 3.2. Initially, six lags on these variables were included. Results show that the real price had an impact after one to two quarters, while the real exchange rate had an impact after two to six quarters. Coefficients of the current, first, third, and fifth lag of the RER, and of dummy variables were not significant and therefore the variables were deleted from the original model. Statistical results are provided in Equation 1A, Table I.

To conserve degrees of freedom the lags of the RER were combined to form a single variable as follows:

$$LRER^{*}=\log[a_1RER_{t-2}+a_2RER_{t-4}+a_3RER_{t-6}]$$

where a_1, a_2, and a_3 are arbitrarily selected weights based on theoretical sign, significance of variables, and adjusted R^2. Various values for a_1, a_2, and a_3 were tried, and the best result was $a_1=0.032$, $a_2=0.16$, and $a_3=0.8$. Equation 1B shows statistical results of this estimation. All variables except for log real price lagged two quarters ($LRPR_{t-2}$) and time variable T were statistically significant. $LPRP_{t-2}$ and

T were further dropped from equation 1B. The final results are provided in Equation 1C.

The adjusted R^2 in equation 1C was 0.494, and all coefficients were statistically significant. The Durbin-Watson (D.W.) statistic was 1.522 indicating a low probability of serial correlation. The coefficient of LRER* indicates the long-run elasticity of rubber export with respect to RER. It shows that a 10 percent depreciation of the RER increases rubber export 2.01 percent, other things remaining the same. The coefficient of $LRPR_{t-1}$ was 0.152 implying that each 10 percent increase in the real export price of rubber increases exports 1.52 percent after one quarter. The positive sign indicates that excess supply elasticity was greater than excess demand elasticity for rubber. Foreign income (LGNPF) had a positive impact on rubber export as anticipated. The coefficient of foreign income implies that each 10 percent increase in Indonesia's trading partners' income increases rubber export 5.09 percent.

Palm Oil. A first attempt was made using six period lags for real price (LRPP) and real exchange rate (LRER) variables for estimation of the palm oil export equation. The coefficients of current and of lagged values for one to three periods of LRPP were not significantly different from zero. Likewise, the coefficient of current and of lagged (one to four periods) values of LRER were not significant.

TABLE I

OLS REGRESSION RESULTS FOR RUBBER EXPORT-THE DEPENDENT VARIABLE

Variable	Equation 1A Parameter Estimate	Equation 1A t Ratio	Equation 1B Parameter Estimate	Equation 1B t Ratio	Equation 1C Parameter Estimate	Equation 1C t Ratio
Constant	-1.313	-1.084	1.832	1.457	1.508	1.762
$LRPR_{t-1}$	0.363	2.966	0.288	1.876	0.152	2.220
$LRPR_{t-2}$	0.267	1.876	-0.145	-1.002	-	-
$LRER_{t-2}$	0.481	3.160	-	-	-	-
$LRER_{t-4}$	0.291	2.424	-	-	-	-
$LRER_{t-6}$	-0.393	-4.359	-	-	-	-
$LRER^*$	-	-	-0.245	-2.208	-0.201	-2.491
LGNPF	0.418	2.024	0.461	1.699	0.509	3.383
T	0.013	3.365	-0.001	-0.068	-	-
D_1	-0.039	-1.243	-	-	-	-
D_2	-0.001	-0.025	-	-	-	-
D_3	0.014	0.447	-	-	-	-
	Adjusted R^2=0.663 D.W=1.872 F=8.293		Adjusted R_2=0.464 D.W=1.451 F=7.226		Adjusted R^2=0.494 D.W=1.522 F=13.053	

The model was reestimated using four lagged periods of LRPP and the fifth and the sixth lagged period of LRER. Results of this estimation are summarized in Equation 2A, Table II. The coefficient of LRPP was positive and significant. The coefficients of foreign income and time trend (T) were not significant and the variables were deleted from equation 2A. The coefficient of a dummy variable for the second quarter (D_2) was significant, indicating a seasonal variation in export volume for the second quarter.

The coefficients of LRER showed a cyclical pattern. The coefficient was positive in the fifth quarter, negative in the sixth quarter and both were highly significant. To reduce multicollinearity , a new variable, LRER*, a linear combination of the LRER in the fifth and the sixth periods, was constructed:

$$LRER^*=\log[b_1RER_{t-5}+b_2RER_{t-6}]$$

where b_1 and b_2 are weighting factors selected based on the theoretical sign and significance level of the coefficients, and the adjusted R^2. The chosen values were $b_1=0.95$, and $b_2=0.05$. Equation 2B shows statistical results of this estimation. Palm oil exports responded positively to real price LRPP, but the impact was realized after four quarters.

The coefficient of the LRER* was significant at the 10 percent level and has a correct sign. A 10 percent real

TABLE II

OLS REGRESSION RESULTS FOR PALM OIL EXPORT-THE DEPENDENT VARIABLE

Variable	Equation 2A Parameter Estimate	Equation 2A t Ratio	Equation 2B Parameter Estimate	Equation 2B t Ratio
Constant	-5.644	-0.549	-5.507	-2.444
$LRPP_{t-4}$	1.344	2.587	1.399	4.066
$LRER_{t-5}$	4.348	3.531	-	-
$LRER_{t-6}$	-4.769	-3.914	-	-
$LRER^*$	-	-	-1.308	-1.680
LGNPF	0.041	0.020	-	-
T	0.011	-0.522	-	-
D_1	-0.182	-3.328	-0.506	-1.329
D_2	-1.132	-1.197	-1.222	-3.198
D_3	-0.389	0.339	-0.434	-1.173
	Adjusted R^2=0.508 D.W.=1.758 F=5.771		Adjusted R^2=0.356 D.W.=1.704 F=5.090	

exchange rate depreciation is predicted to increase palm oil exports 13.08 percent after six quarters. The D.W. statistic was 1.704 and shows no serial correlation.

Coffee. In the preliminary analysis, six period lags on the real price (LRPC) and the real exchange rate (LRER) were tried . The coefficients of lagged one to six periods of LRPC, and lagged four to six periods of the LRER were not significant, and therefore were deleted from the equation. Results of this analysis are displayed in equation 3A Table III.

All coefficients with the exception of the coefficient of the foreign income (LGNPF) were significant at the 10 percent level or better. Coefficient signs of real price and real exchange rate variables, however, showed a cyclical pattern. The sign was negative in the first quarter and positive in the next period for the real price variable. A similar pattern was found for the exchange rate variable.

In the next analysis, LGNPF was deleted from the model. In addition, a single variable for real exchange rate was generated:

$$LRER^{*}=\log[d_1RER_t+d_2RER_{t-1}+d_3RER_{t-2}+d_4RER_{t-3}]$$

where d_1, d_2, d_3, and d_4 are weighting factors. Again these coefficients were selected by trial and error. The best results were $d_1=0.800$, $d_2=0.16$, $d_3=0.032$, and $d_4=0.0064$.

A similar attempt was tried for LRPC but the impact of the real price was insignificant. Variables LRPC and $LRPC_{t-1}$ were retained in subsequent analysis. Equation 3B reports results of such analysis.

All coefficients were significant at the 10 percent level or better. The real exchange rate variable coefficient was highly significant with a magnitude of -0.603. This indicates that a 10 percent depreciation of real exchange rate increases coffee exports 6.03 percent within four quarters. Time trend T showed a positive response to export volume. Coefficients of dummy variables were also significant indicating seasonal variations in the net export volume. Regression analysis shows insignificant serial correlation as apparent from the D.W. value (1.683).

The export equations discussed above fit reasonably well, and in general all coefficient signs meet apriori expectations. The estimated parameter of the RER had the correct sign and was significant after four to seven quarters. However, the impact appeared to be rather small for rubber and coffee. On the other hand, net exports of palm oil showed an elastic response to RER changes.

The impact of price was also small, especially for rubber and coffee exports. The impact of price on net palm oil exports was found to be elastic. Price impact was realized after two to five quarters. In general the results show a positive relationship between the export price and

TABLE III

OLS REGRESSION RESULTS FOR COFFEE EXPORT-THE DEPENDENT VARIABLE

Variable	Equation 3A Parameter Estimate	Equation 3A t Ratio	Equation 3B Parameter Estimate	Equation 3B t Ratio
Constant	0.270	0.079	3.608	5.925
LRPC	-0.497	-3.012	-0.324	-2.176
$LRPC_{t-1}$	0.483	2.924	0.311	2.015
LRER	-0.875	-2.502	-	-
$LRER_{t-1}$	0.992	2.461	-	-
$LRER_{t-2}$	-0.880	-2.205	-	-
$LRER_{t-3}$	0.521	1.713	-	-
$LRER^*$	-		-0.603	-3.056
LGNPF	0.596	0.984	-	-
T	0.011	2.380	0.010	2.210
D_1	-0.081	-1.025	-0.138	-1.690
D_2	0.227	2.582	0.259	2.944
D_3	0.252	3.287	0.250	3.044
	Adjusted R^2=0.769 D.W.=1.760 F=12.185		Adjusted R^2=0.725 D.W.=1.683 F=14.904	

net exports. As export price increases net exports also increase. This indicates that excess supply elasticity is greater than excess demand elasticity for the three commodities as discussed in Chapter III.

Foreign income did not significantly impact export of palm oil and coffee. But the impact was significant with the correct sign in the case of rubber. This phenomenon may be explained by the fact that rubber has a strong market and less restrictions in international trade. So foreign income increases foreign rubber imports from Indonesia (i.e. rubber exports from Indonesia to its trading partners). Foreign income does not significantly increase palm oil and coffee imports. Coffee exports were subject to quota limits set by the International Coffee Organization in accordance with the International Coffee Agreement (Pan-American Coffee Bureau, 1974). Indonesia was a signatory of that agreement and therefore limited by the quota restrictions. This, to some extend, may distort the impact of foreign income on coffee exports. In the case of palm oil, exports were sometimes banned to maintain domestic consumption. In contrast, as noted by Glassburner (1985), a number of agricultural commodities have been substantially protected from international competition. These commodities include corn, peanuts, soybeans, dairy products, fruits, and vegetables.

Real Exchange Rate Model

The OLS estimate of equation 3.9 for real exchange rate is reported in Table IV. Coefficients of GNP ratio (LGNPDF), inflation differential (INDF), trade balances differential (TBDF), and CPI ratio (LCPIDF) were not significantly differed from zero. The coefficient of budget deficit (DEF) was marginally significant at the 13 percent level according to a two-tail t-test. Further test showed that LCPIDF was highly correlated with the GNP ratio (LGNPDF) (correlation coefficient of -0.78). Thus the impacts of LCPIDF and LGNPDF cannot easily be separated.

When LCPIDF, INDF, and TBDF were excluded from equation 4A, the coefficient of the GNP ratio became significant at the 4 percent level. The t value for the coefficient of IRDF fell slightly, whereas that for DEF increased. Results of this analysis are provided in equation 4B. The interest rate differential did not seem to explain the RER variation. In equation 4C the IRDF variable was deleted. In general, the estimates improved slightly. Coefficient of the DEF was marginally significant according to a two tail t-test. Other coefficients were highly significant at a 4 percent level or better.

Based on equation 4C, factors that significantly influence the RER variability are real income ratio and money supply ratio. Higher domestic income induces more money demand, appreciating the real value of the rupiah, other things equal. Real income ratio is positively related to the real exchange rate. This explanation is based on the monetary view of exchange rate determination as explained in Chapter II.

Results also show that higher domestic money supply in relation to that abroad appreciates the RER initially but depreciates it in the next quarter. A probable reason for this was because increasing money supply induced inflationary expectation but the exchange rate did not adjust immediately. As market adjusts, the rupiah began to depreciate in the second quarter.

The h-statistic was -0.586 indicating no significant serial correlation at the 5 percent probability level. The model appears to fit rather well as evidenced by the adjusted R^2.

Real Interest Rate Model

The estimated equation for the real interest rate model is presented in Table V. Results of equation 5A indicate that the coefficient of real interest lagged one period was negative and insignificant. The coefficients of LMS_{t-1}, DEF, and LRER were not significant as well. Subsequently, R_{t-1}, and LMS_{t-1} were excluded from equation 5A. The resulting estimated regression is equation 5B. The results can be considered as an improvement over the original estimates

TABLE IV

OLS REGRESSION RESULTS FOR THE REAL EXCHANGE RATE-THE DEPENDENT VARIABLE

	Equation 4A		Equation 4B		Equation 4C	
Variable	Parameter Estimate	t Ratio	Parameter Estimate	t Ratio	Parameter Estimate	t Ratio
Constant	0.395	0.397	0.646	1.961	0.686	2.109
LGNPDF	0.164	0.479	0.250	2.083	0.259	2.170
LMSDF	0.468	2.115	0.427	3.550	0.431	3.600
$LMSDF_{t-1}$	-0.415	-2.957	-0.444	-3.954	-0.444	-3.966
INDF	-0.002	-0.290	-	-	-	-
IRDF	0.014	0.955	0.012	0.896	-	-
TBDF	0.004	0.367	-	-	-	-
LCPIDF	-0.135	-0.308	-	-	-	-
DEF	-0.00005	-1.567	-0.00004	-1.730	-0.00004	-1.610
$LRER_{t-1}$	0.726	5.620	0.739	6.589	0.728	6.548
	Adjusted R^2=0.888 D.W= 2.168 h= -1.038 F=37.898		Adjusted R^2=0.896 D.W=2.224 h=-1.086 F=61.516		Adjusted R^2=0.897 D.W=2.122 h=-0.586[a] F=74.054	

[a]The h-statistic replaces the D.W.-statistic to detect first-order serial correlation in autoregressive models. The h-statistic is computed as follows:

h=(1-0.5D.W.)SQRT[N/{1-N(var of lag dependent variable)}]

where N=sample size, D.W.=Durbin-Watson statistic, and SQRT=square root.

based on higher adjusted R^2, F-statistics and t-ratios.

Coefficients of domestic real income (LGNP) and inflation (INF) were highly significant, while that for LRER was significant at 10 percent level. All coefficients have correct signs. However, the low D.W. statistics of 1.148 signals the presence of positive first order serial correlation. To correct this problem, equation 5B was reestimated using the Cochrane-Orcutt procedure. The results are reported in equation 5C. The correction for the serial correlation improves the fit of equation 5B as seen by the higher adjusted R^2 of 0.850. The coefficient of the budget deficit variable (DEF) was significant at the 6 percent level while that of LGNP was marginally significant at the 13 percent level. On the other hand, the coefficient of the LRER was not significant although it had the correct sign.

These results suggest that real interest rate variation can be explained by budget deficit, real income, and inflation rates. Larger deficits are associated with higher interest rates as suggested by the conventional view. Higher real income depresses the general price level, resulting in lower real interest rate, other things equal. Finally, the negative sign of the inflation coefficient implies that higher inflation reduces the real interest rate in conformity with the Fisher equation.

TABLE V

OLS REGRESSION RESULTS FOR THE REAL INTEREST RATE-
THE DEPENDENT VARIABLE

	Equation 5A		Equation 5B		Equation 5C	
Variable	Parameter Estimate	t Ratio	Parameter Estimate	t Ratio	Parameter Estimate	t Ratio
Constant	-8.426	-1.852	-8.588	-2.183	-5.555	-1.012
LGNP	1.353	1.711	1.267	2.933	0.948	1.560
LMS_{t-1}	-0.217	-0.225	-	-	-	-
INF	-0.819	-8.927	-0.823	-9.497	-0.928	-11.978
LRER	1.906	1.491	1.887	1.669	1.009	0.726
DEF	0.0004	1.066	0.0004	1.104	0.0005	1.942
r_{t-1}	-0.026	-0.766	-	-	-	-

Adjusted R^2=0.800 Adjusted R_2=0.810 Adjusted R^2=0.850
D.W=1.188 D.W=1.148 D.W=1.977
h=3.248
F=28.304 F=44.677 F=47.325

Inflation Model

Table VI summarizes the OLS regression results for inflation model. In equation 6A coefficients of four variables (the money supply growth, income growth, a change in import prices index, and lagged dependent variable) were significant at the 10 percent or better according to a two-tail t-test, and all have the correct signs. In such cases a one-tail test applies, implying coefficients significant at the 5 percent level or better.

Because the coefficient of RER was not significant, equation 6A was reestimated by excluding the RER variable. Elimination of the RER is expected to reduce multicollinearity because import prices might be affected by the RER. The results were very similar to the original estimates, but the adjusted R^2 in equation 6B was slightly higher than that in equation 6A. The F-statistic also improved from 5.198 to 6.357. Serial correlation was not significant as seen from the h-statistic of -0.268.

The results suggest some policy implications. One is that faster growth of the money supply leads to higher inflation rates predominantly within one quarter. When the money supply rises 1 percent, inflation rate increases about 15 percent within one period, other things remaining the same. Thus if the inflation rate is 7 percent, a 1 percent increase in the money supply increases the inflation rate to 8 percent. This reflects the importance of monetary policy to deal with inflation. The fact that faster growth of the money supply creates inflation can be used to explain why higher growth of the money supply leads to appreciation in the real exchange rate initially as mentioned before.[b]

Another policy implication flows from the coefficient of the real income, -12.955, implying that a 1 percent increase in income will lower inflation about 13 percent, other things equal. This conforms with the classical quantity theory of money. So a policy to increase output through greater productivity and efficiency would allow the money supply to expand at a faster rate without raising the inflation rate. The coefficients for money supply and income probably are not reliable for values outside the historic range of data.

Finally, as is the case with most underdeveloped economies, import prices play a significant role in the determination of domestic price level (Aksoy, 1982). In our case, each 1 percent increase in import price is predicted to increase inflation 16 percent. Evidence also shows that higher interest rates result in higher inflation rates as expected.

---

[b]Given time, foreign exchange markets adjust for relative inflation rates among countries so that a 10 percent increase in the general price level in Indonesia relative to that of its trading partners causes the nominal exchange rate to fall so that the real exchange rate is unchanged. However, before such adjustments occur, the rise in inflation in Indonesia increases the real exchange rate because the nominal exchange rate has not had time to adjust.

One problem with the model was the low adjusted R^2 value which indicates that only about 40 percent of the variation in inflation rates was explained by independent variables. In theory, the wage level or the unemployment level should be included in the inflation model. Unfortunately, these data were not available.

Income Growth Model

As argued in Chapter III, output growth is an endogenous variable. Output, measured as real income growth (GNPR), is related to domestic money supply growth (MSR), labor growth (proxied by population growth, POPR), inflation (INF), and budget deficit (DEF). The regression results of the original model (equation 3.17) are displayed in equation 7A ,Table VII. Coefficients of only two variables, MSR and INF, were significant at the 5 percent probability level or better. The rest were highly insignificant although the signs were as expected with the exception of the coefficient of the lagged dependent variable.

The model was then modified by deleting DEF, POPR, and the lagged dependent variable ($GNPR_{t-1}$). The results are reported in equation 7B. The fit was slightly better than the original specification as apparent from the higher adjusted R^2 (0.700 in equation 7A versus 0.720 in equation 7B), and the F-statistics (20.130 in equation 7A versus

53.829 in equation 7B). Again all signs of the coefficients are consistent with apriori expectations. An increase in money supply growth leads to increase income growth. More specifically, each of ten percent increase in money supply is associated with about 7 percent increase in income. This result is consistent with the quantity theory of money which implies that the money supply can keep pace with real income growth without resulting in inflation. Too rapid an increase in money supply causes inflation. And a ten percent increase in inflation rate, other things equal, decreases income growth 0.06 percent.

TABLE VI

OLS REGRESSION RESULTS FOR INFLATION-THE DEPENDENT VARIABLE

Variable	Equation 6A Parameter Estimate	Equation 6A t Ratio	Equation 6B Parameter Estimate	Equation 6B t Ratio
Constant	-0.447	-0.272	0.089	0.100
MSR	14.454	2.737	14.708	2.840
GNPR	-12.955	-1.750	-12.953	-1.770
i	0.292	1.173	0.263	1.120
MIR	15.984	2.460	15.402	2.464
RER	0.538	0.392	-	-
INF_{t-1}	0.361	2.722	0.369	2.856
	Adjusted R^2=0.381 D.W.=2.049 h=-0.311 F =5.198		Adjusted R^2=0.395 D.W.=2.045 h=-0.268 F =6.357	

TABLE VII

OLS REGRESSION RESULTS FOR INCOME GROWTH-THE DEPENDENT VARIABLE

	Equation 7A		Equation 7B	
Variable	Parameter Estimate	t Ratio	Parameter Estimate	t Ratio
Constant	-0.007	-0.516	-0.003	-0.256
MSR	0.675	9.962	0.674	10.369
INF	-0.007	-2.126	-0.007	-2.441
DEF	0.00001	0.093	-	-
POPR	0.781	0.498	-	-
$GNPR_{t-1}$	-0.021	-0.232	-	-
	Adjusted R^2=0.700 D.W=2.288 h =-1.146 F= 20.130		Adjusted R^2=0.720 D.W=2.332 F=53.829	

CHAPTER V

MODEL SIMULATION

In the preceding chapter the estimated parameters of the econometric model were presented and discussed. This chapter presents the simulation experiments (changes in endogenous variables resulting from assumed changes in baseline values of predetermined variables) to analyze the impacts of specific economic policies. Simulation experiments are for years 1986, 1987, and 1988.

The first task is to generate baseline predictions. For these solutions the actual historical data for exogenous variables during the periods of the study are used whereas those for the "forecast" years 1986, 1987, and 1988 are linear extensions of their past trends. After the baseline predictions have been constructed the simulation predictions are derived from the same predetermined values as in the base prediction except for the specific policy action variables altered for the experiment. The baseline predictions and simulation predictions are then contrasted. For illustration, two simulation experiments are examined: domestic money supply simulation and foreign income simulation.

Money Supply Simulation

The money supply in the baseline prediction grew between 1.1 and 1.7 percent per quarter for the "forecast" years 1986, 1987, and 1988. In the simulation experiment, the domestic money supply is assumed to grow 2.5 percent per quarter (10 percent annually) from 1975/1 through 1988/4 periods. This action is expected to influence the real exchange rate, inflation rate, real interest rate, and real income growth (and thus real income). In turn, a change in real income will affect the real exchange rate. The real exchange variable is linked to the agricultural export model as discussed in Chapter III.

Given the inflation rate, increasing the money supply is expected to depreciate the value of the rupiah. The real exchange rate model is also linked to the domestic real income growth. Thus the actual changes in the real exchange rate are determined by changes in the money supply and domestic real income.

Table VIII shows the impact of changes in the money supply on the real exchange rate. Baseline and simulation predictions show depreciation in the real exchange rate continually from 1986/1 to 1988/4 periods. However, simulation predictions are not significantly different from those of baseline predictions; the percentage differences between the two predictions are small. Other things equal, a

10 percent increase in the domestic money supply does not markedly affect the real exchange rate. The nominal value of the rupiah depreciates. But a higher money supply also creates inflation. If the market is rational, the higher nominal value of the rupiah will just offset inflation to leave the real exchange rate constant. Table VIII provides no basis to reject this hypothesis: The real exchange rate remains relatively unchanged.

Because the real exchange rate is not significantly influenced by money supply and inflation, it is not surprising to note also that net agricultural exports are not significantly affected. Tables IX, X, and XI report the consequences of the more rapid money supply growth on rubber, coffee, and palm oil respectively. Simulation predictions are very close to those of baseline predictions, implying that expansionary monetary policy does not significantly impact agricultural exports.

It is apparent in Table XII that increasing domestic money supply at a 10 percent annual rate has a sizable impact on inflation. In general, the simulated inflation rate is predicted to be higher than that in the baseline prediction by 2 to 5 percent from 1986/2 to 1988/4 periods.

Higher money supply raises nominal domestic income. As explained in previous chapters, real income is a function of money supply growth and inflation rate. Higher inflation caused by money supply growth offsets the higher nominal income. The result is insignificant changes in the real income as indicated in Table XIII.

The inflationary effect of increasing the money supply is also apparent in the real interest rate. The real interest rate is predicted to be lower if historic macroeconomic trends continue except for a more rapid increase in money supply. With the money supply increasing 10 percent annually, Table XIV indicates that the real interest rate is lower than that of baseline prediction by 2 to 16 percent during the 1986-1988 periods. However, the absolute change in real interest rate is not large.

One important conclusion from this experiment is that a higher money supply creating inflation results in only small changes in the real exchange rate, domestic real income, and the net agricultural exports.

TABLE VIII

MONEY SUPPLY SIMULATION

Quarterly Index of Real Exchange Rate with a 2.5 percent Quarterly Increase in money supply beginning in the first quarter of 1975

YEAR/QUARTER	BASE PREDICTION	SIMULATION PREDICTION	% DIFFERENCE
	Index 1980=1.00 Quarterly		
86/1	0.55	0.56	1.60
86/2	0.55	0.56	1.83
86/3	0.53	0.54	2.01
86/4	0.53	0.54	2.16
87/1	0.52	0.53	2.28
87/2	0.51	0.52	2.37
87/3	0.50	0.51	2.45
87/4	0.49	0.50	2.50
88/1	0.48	0.49	2.54
88/2	0.47	0.48	2.57
88/3	0.46	0.47	2.59
88/4	0.45	0.46	2.60

TABLE IX

MONEY SUPPLY SIMULATION

Quarterly Net Exports of Rubber with a 2.5 percent Quarterly Increase in money supply beginning in the first quarter of 1975

YEAR/QUARTER	BASE PREDICTION	SIMULATION PREDICTION	% DIFFERENCE
	Thousands of Tons Quarterly		
86/1	255.92	251.29	-1.81
86/2	255.48	252.69	-1.09
86/3	258.77	256.39	-0.92
86/4	258.76	257.18	-0.61
87/1	263.39	261.51	-0.71
87/2	264.55	263.79	-0.28
87/3	267.00	266.11	-0.34
87/4	267.95	266.94	-0.38
88/1	269.96	268.85	-0.41
88/2	271.50	270.31	-0.44
88/3	273.41	272.16	-0.46
88/4	275.19	273.88	-0.47

TABLE X

MONEY SUPPLY SIMULATION

Quarterly Net Exports of Coffee with a 2.5 percent Quarterly Increase in money supply beginning in the first quarter of 1975

YEAR/QUARTER	BASE PREDICTION	SIMULATION PREDICTION	% DIFFERENCE
	Thousands of Tons Quarterly		
86/1	66.12	65.52	-0.98
86/2	99.76	98.70	-1.07
86/3	100.90	99.72	-1.17
86/4	79.98	78.97	-1.26
87/1	71.10	70.15	-1.33
87/2	107.98	106.48	-1.39
87/3	109.25	107.68	-1.43
87/4	86.87	85.60	-1.47
88/1	77.28	76.12	-1.50
88/2	117.52	115.74	-1.51
88/3	118.96	117.15	-1.53
88/4	94.66	93.21	-1.53

TABLE XI

MONEY SUPPLY SIMULATION

Quarterly Net Exports of Palm Oil with a 2.5 percent Quarterly Increase in money supply beginning in the first quarter of 1975

YEAR/QUARTER	BASE PREDICTION	SIMULATION PREDICTION	% DIFFERENCE
	Thousands of Tons Quarterly		
86/1	16.68	15.38	-7.81
86/2	9.16	8.59	-6.19
86/3	15.96	15.25	-4.44
86/4	28.42	26.98	-5.05
87/1	16.94	16.62	-1.88
87/2	8.39	8.22	-2.04
87/3	18.01	17.59	-2.33
87/4	27.86	27.15	-2.56
88/1	16.68	16.22	-2.75
88/2	8.16	7.93	-2.90
88/3	17.96	17.42	-3.02
88/4	27.82	26.95	-3.11

TABLE XII

MONEY SUPPLY SIMULATION

Quarterly Inflation Rate with a 2.5 percent Quarterly Increase in money supply beginning in the first quarter of 1975

YEAR/QUARTER	BASE PREDICTION	SIMULATION PREDICTION	% DIFFERENCE
	Percent Quarterly		
86/1	2.36	2.32	-1.54
86/2	2.53	2.57	1.72
86/3	2.63	2.71	3.06
86/4	2.68	2.78	3.70
87/1	2.71	2.82	4.08
87/2	2.72	2.83	4.35
87/3	2.72	2.84	4.56
87/4	2.72	2.85	4.75
88/1	2.72	2.85	4.91
88/2	2.72	2.86	5.06
88/3	2.72	2.86	5.19
88/4	2.72	2.86	5.32

TABLE XIII

MONEY SUPPLY SIMULATION

Quarterly Real Income with a 2.5 percent Quarterly Increase in money supply beginning in the first quarter of 1975

YEAR/QUARTER	BASE PREDICTION	SIMULATION PREDICTION	% DIFFERENCE
Billions of 1980 U.S. Dollars Quarterly			
86/1	13.00	13.08	0.58
86/2	12.88	12.96	0.57
86/3	12.75	12.83	0.59
86/4	12.61	12.69	0.62
87/1	12.47	12.55	0.65
87/2	12.32	12.40	0.68
87/3	12.17	12.25	0.71
87/4	12.02	12.10	0.73
88/1	11.86	11.95	0.75
88/2	11.71	11.80	0.77
88/3	11.56	11.65	0.79
88/4	11.40	11.49	0.81

TABLE XIV

MONEY SUPPLY SIMULATION

Quarterly Real Interest Rate with a 2.5 percent Quarterly Increase in money supply beginning in the first quarter of 1975

YEAR/QUARTER	BASE PREDICTION	SIMULATION PREDICTION	% DIFFERENCE
	Percent Quarterly		
86/1	1.49	1.54	3.34
86/2	1.02	0.99	-2.18
86/3	1.07	1.01	-5.09
86/4	0.90	0.83	-7.84
87/1	0.90	0.82	-8.83
87/2	0.83	0.75	-10.32
87/3	0.82	0.73	-11.11
87/4	0.78	0.68	-12.21
88/1	0.75	0.66	-13.08
88/2	0.72	0.62	-14.14
88/3	0.69	0.59	-15.16
88/4	0.66	0.55	-16.33

Foreign Income Simulation

Income of Indonesia's trading partners has declined since 1981 as a result of world recession. Indonesia's agricultural exports, especially rubber and palm oil, have also declined. Foreign real income grew at an average 1.2 percent per quarter from 1975/1 to 1988/4 in the baseline prediction. This section examines the predicted impacts of an exogenous increase of 2.5 percent quarterly rate(10 percent annual rate) in real foreign income beginning in the first quarter of 1981 based on the model estimated in this study.

Results of this simulation on the net exports of rubber, coffee, and palm oil are summarized in Tables XV, XVI, and XVII respectively. Net agricultural exports rise dramatically if domestic macroeconomic policy trends continue but with increased foreign income. Rubber exports are predicted initially to increase by 27 percent and eventually by 45 percent as a consequence of increasing foreign income. Coffee exports increase by 23 to 34 percent, whereas palm oil exports jump by 50 to 71 percent.

These large gains in the net exports are the result of two effects. First consider the direct effect. Foreign income is linked directly to the export model. As foreign income increases, Indonesian agricultural exports also increase . This is especially apparent in the case of rubber where the foreign income variable entered significantly into the export model (see Chapter IV). Second, higher foreign income tends to depreciate the real value of the rupiah. According to the monetary explanation of exchange rate determination, income rising faster abroad than in Indonesia tends to increase relative foreign money demand and appreciate the value of foreign currency (i.e. depreciate the rupiah). And given that domestic inflation is not directly affected by increasing foreign income, the real value of rupiah depreciates. The rupiah depreciation is predicted to be in the range of 30 to 39 percent in the simulation periods (Table XVIII). The rupiah depreciation expands agricultural exports of Indonesia by making them more competitive in international markets (indirect effect).

TABLE XV

FOREIGN INCOME SIMULATION

Quarterly Net Export of Rubber with a 2.5 percent Quarterly Increase in foreign income beginning in the first quarter of 1981

YEAR/QUARTER	BASE PREDICTION	SIMULATION PREDICTION	% DIFFERENCE
	Thousands of Tons Quarterly		
86/1	255.92	325.99	27.38
86/2	255.48	330.09	29.20
86/3	258.77	338.90	30.96
86/4	258.76	343.21	32.64
87/1	263.39	352.80	33.94
87/2	264.55	357.51	35.14
87/3	267.00	364.51	36.52
87/4	267.95	369.85	38.03
88/1	269.96	376.98	39.64
88/2	271.50	383.72	41.33
88/3	273.41	391.21	43.08
88/4	275.19	398.70	44.88

TABLE XVI

FOREIGN INCOME SIMULATION

Quarterly Net Export of Coffee with a 2.5 percent Quarterly Increase in foreign income beginning in the first quarter of 1981

YEAR/QUARTER	BASE PREDICTION	SIMULATION PREDICTION	% DIFFERENCE
	Thousands of Tons Quarterly		
86/1	66.17	81.23	22.76
86/2	99.76	122.76	23.05
86/3	100.90	124.77	23.65
86/4	79.98	99.56	24.48
87/1	71.10	89.21	25.47
87/2	107.98	136.68	26.58
87/3	109.25	139.60	27.78
87/4	86.87	112.11	29.05
88/1	77.28	100.74	30.36
88/2	117.52	154.79	31.71
88/3	118.96	158.32	33.09
88/4	94.66	127.31	34.49

TABLE XVII

FOREIGN INCOME SIMULATION

Quarterly Net Export of Palm Oil with a 2.5 percent Quarterly Increase in foreign income beginning in the first quarter of 1981

YEAR/QUARTER	BASE PREDICTION	SIMULATION PREDICTION	% DIFFERENCE
	Thousands of Tons Quarterly		
86/1	16.68	25.08	50.33
86/2	9.16	14.13	54.27
86/3	15.96	25.17	57.70
86/4	28.42	44.78	57.58
87/1	16.94	26.45	56.08
87/2	8.39	13.09	55.99
87/3	18.01	28.28	57.02
87/4	27.86	44.27	58.86
88/1	16.68	26.90	61.31
88/2	8.16	13.41	64.20
88/3	17.96	30.07	67.44
88/4	27.82	47.55	70.95

TABLE XVIII

FOREIGN INCOME SIMULATION

Quarterly Index of Real Exchange Rate with a 2.5 percent Quarterly Increase in foreign income beginning in the first quarter of 1981

YEAR/QUARTER	BASE PREDICTION	SIMULATION PREDICTION	% DIFFERENCE
	Index 1980=100 Quarterly		
86/1	0.55	0.39	-28.81
86/2	0.55	0.39	-29.19
86/3	0.53	0.37	-29.83
86/4	0.53	0.37	-30.66
87/1	0.52	0.35	-31.60
87/2	0.51	0.34	-32.62
87/3	0.50	0.33	-33.68
87/4	0.49	0.32	-34.77
88/1	0.48	0.31	-35.86
88/2	0.47	0.30	-36.95
88/3	0.46	0.28	-38.03
88/4	0.45	0.27	-39.10

CHAPTER VI

SUMMARY AND CONCLUSIONS

The central purpose of this study was to identify the interrelationship between macroeconomic policies and agricultural exports through exchange rates, interest rates, and inflation linkages in Indonesia. Three export commodities were selected: rubber, palm oil, and coffee. The econometric model was constructed to address the objectives, test the hypotheses, and carry out the simulation experiments. Four main regression equations were estimated using the Ordinary Least Squares (OLS) technique: export equations for rubber export, coffee export, and palm oil export; real exchange rate equation; real interest rate equation; inflation equation; and real income growth equation. The estimated equations were combined and used to simulate the impact of macroeconomic shocks to the system. Two simulation experiments were conducted: money supply shock simulation and foreign income shock simulation.

The estimated equation for the real exchange rate indicated that the money supply variable affected the real exchange rate(RER) in a cyclical pattern. Higher money supply appreciates RER initially but depreciates it after one quarter. Both econometric analysis and simulation experiment results indicated that a higher money supply was not translated into lower real value of the rupiah but into a higher inflation rate and lower real interest rate. No significant support was evident for the view that money supply growth influences the real exchange rate in Indonesia. The hypothesis that an increase in the money supply has no impact on the real exchange rate cannot be rejected.

Econometric results indicated that the real exchange rate significantly affected agricultural exports. In general, the effect was realized after six quarters. Estimated equations and the simulation results suggest that a lower real exchange rate increases agricultural exports. The hypothesis that changes in real exchange rate do not change agricultural exports is rejected. This finding is consistent with previous studies (for example Barclay and Tweeten ,1986).

The third hypothesis of this study stated that an increase in budget deficit has no influence on the real interest rate. The regression equation for the real interest rate suggests a positive and significant (at 6 percent level) relationship between the budget deficit and the real interest rate. Thus larger deficits are associated with higher real interest rates as suggested by the conventional view. The hypothesis that an increase in budget deficit has no influence on the real interest rate is rejected.

Foreign income was found to directly and significantly influence net rubber exports. When foreign income rises, net rubber exports also rise. In contrast, foreign income did not significantly influence palm oil and coffee net exports. However, the estimated equation and the simulation experiments provide evidence that higher foreign income caused rupiah depreciation making Indonesian agriculture more competitive in world markets. The net effect is a sizable increase in the net agricultural exports from increased foreign income. The hypothesis that higher foreign income increases agricultural exports cannot be rejected. The agricultural export sector in general seems to be strongly influenced by international linkages through foreign income.

Policy Implications

Because of the strong link between the real exchange rate and agricultural exports, a policy to avoid the rupiah appreciation can assist agricultural exports. This implies that if the domestic inflation rate is higher than that of trading partners, an adjustment (devaluation) in the nominal exchange rate to offset inflation will be needed to maintain competitiveness and encourage exports. Devaluation will be most effective if combined with monetary policy restraint to control inflation.

Money supply, a policy variable in Indonesia, seems to have a small direct impact on the real exchange rate and thus agricultural exports but had a sizable impact on the inflation rate. In most developing countries expansionary monetary policy is pursued to finance budget deficits. Higher money supply creates more aggregate demand, but since supply is inadequate, the general price level must rise. Higher inflation tends to appreciate and overvalue the currency. A more nearly balanced budget seems to be appropriate to help the agriculture sector because it reduces tendencies for an overvalued currency. A more balanced budget also avoids high real interest rates. This study did not find that changes in real interest rates affect the real exchange rate and hence agricultural exports directly. But most smallholder farmers in Indonesia are net borrowers. These smallholders dominate production of rubber and coffee. Lower real interest rates lower their production costs which increases profitability.

A policy to influence the real exchange rate alone is not sufficient to increase agricultural exports. Measures to reduce or eliminate export taxes and to relax export and import bureaucratic procedures can stimulate exports. Evidence indicates little technological improvement in the production of any smallholder cashcrops over the past 50 years (Booth, 1984). Efforts to increase productivity by adopting new technology will help smallholder farmers.

Limitations

Some problems were faced when working with the data. The model required quarterly data from 1975/1 to 1985/4 periods. But some data were available only on an annual basis. These annual data were converted to a quarterly basis using a procedure described in Chapter IV. Inaccuracies in this conversion may affect the analysis. Furthermore, some important variables such as wage and unemployment rates were not available. Lack of such data may account in part for the rather low adjusted R^2 (0.395) in the estimated inflation equation. For lack of a more appropriate measure of technology and weather, a simple time trend variable was used to capture these effects in the export model.

This study failed to capture the impact of monetary and fiscal policies on capital flow. This potentially important causal link in explaining movements of the exchange rates remains obscure and needs to be included in further analysis of the real exchange rate.

The real exchange rate model used in this study is the monetary version of exchange rate determination. Literature in international finance have only partially identified factors that determine the real exchange rate. It is possible that some other exogenous variables not included in this study could affect the RER. It is also possible that the data series used in this study are not long enough to capture a significant relationship between the interest rate and the real exchange rate.

SELECTED BIBLIOGRAPHY

Aksoy, M. Ataman. "Structural Aspects of Turkish Inflation, 1950-1979." World Bank Staff Working Papers No. 540. The World Bank, Washington D.C., 1982.

Bank Indonesia. Report for the Financial Year., 1976/1977, 1977/1978, 1978/1979, 1979/1980, 1980/1981.

________________. Statistik Ekonomi-Keuangan Indonesia. December 1982-January 1983.

Barclay, Thomas N. and L.G. Tweeten. "Macroeconomic Policy Impacts on Agriculture: A Simulation Analysis." Oklahoma State University: Department of Agricultural Economics, Journal Article of the Oklahoma Agricultural Experiment Station, 1986.

Bautista, Romeo. M. "Exchange Rate Adjustment Under Generalized Currency Floating. Comparative Analysis Among Developing Countries." World Bank Staff Working Papers No. 436. The World Bank, Washington D.C., 1980.

Batten, D.S. and M.T. Belongia. "The Recent Decline in Agricultural Exports:Is the Exchange Rate the Culprit." Review, Federal Reserve Bank of St. Louis , 66(October, 1984): 5-14.

____________. "Monetary Policy, Real Exchange Rates, and U.S. Agricultural Exports." American Journal of Agricultural Economics 68(1986):422-427.

Belongia, Michael T. and Courtenay C. Stone. "Would Lower Federal Deficits Increase U.S. Farm Exports? " Review, Federal Reserve Bank of St. Louis, 67(November,1985): :5-19.

Bilson, J. "The Monetary Approach to the Exchange Rate-Some Empirical Evidence." International Monetary Fund Staff Papers 25(1978): 48-75.

Biro Pusat Statistik, Indonesia. "Indikator Ekonomi: Monthly Statistical Bulletin." January, 1975-December, 1986.

Blejer, Mario I. and Nadav Halevi. "Components of Effective Devaluation and the Domestic Rate of Inflation: The Case of Israel." Journal of Development Economics 7(1980): 117-122.

Booth, Anne. "Survey of Recent Developments. " Bulletin of Indonesian Economic Studies, Vol 20, No. 3 pp. 1-35, December 1984.

Chambers, Robert G. and R. E. Just." A Critique of Exchange Rate Treatment in Agricultural Trade Models." American Journal of Agricultural Economics 62(1979):249-257.

___________. "An Investigation of the Effect of Monetary Factors on Agriculture." Journal of Monetary Economics 9(1982):235-247.

Colaco, F.X. "Harberger's Inflation Model: A Critique Test Using Data for Brazil and India." Indian Economic Journal 26(1969):434-444.

Clements, W.K. and Jacob A. Frenkel. "Exchange Rates, Money, and Relative Prices: The Dollar-Pound in the 1920's." Journal of International Economics 10(1980):249-262.

Connolly, Michael and Dean Taylor. "Testing the Monetary Approach to Devaluation in Developing Countries." Journal of Political Economy 84(1976):849-859.

Cooper, R.N. "An Assessment of Currency Devaluation in Developing Countries." in G. Ranis (ed.) Government and Economic Development. New Haven: Yale University Press, 1971.

Department of Statistics, Singapore. "Monthly Digest of Statistics." December, 1977-December, 1986.

Devados, S. "The Impacts of Monetary Policies on U.S. Agriculture." (Unpub. Ph.D. dissertation, Department of Economics, Iowa State University, 1985).

Dornbusch, R. "Expectations and Exchange Rate Dynamics." Journal of Political Economy 84(1976):1161-1175.

Dorosh, Paul A. "Linkages Between The Macro-Economy And Agriculture: A Study of Indonesia's Food Sector From 1949 to 1984." (Unpub. Ph.D. dissertation, Department of Food Research, Stanford University, 1986).

Dutton, John and Thomas Grennes. "The Measurement of Effective Exchange Rates Appropriate for Agricultural Trade." North Carolina State University: Department of

Economics and Business, Economics Research Report No. 51, November, 1985.

Edwards, S. "The Exchange Rate and Noncoffee Exports" in Vinod Thomas (ed.)., Linking -- Macroeconomic and Agricultural Policies for Adjustment with Growth --The Colombian Experience. Baltimore: The Johns Hopkins University Press for the World Bank, 1985.

Frankel, J.A. "On the Mark: A Theory of Floating Exchange Rates Based on Real Interest Differentials." American Economic Review 69(1979):610-621.

Frenkel, J.A. "A Monetary Approach to the Exchange Rate: Doctrinal Aspects and Empirical Evidence." Scandinavian Journal of Economics 78(1976):200-224.

Glassburner, Bruce. "Macroeconomics and the Agricultural Sector." Bulletin of Indonesian Economic Studies Vol.21 No. 2 pp. 51-73, 1985.

Glytsos, Nicholas P. "Determinants of Wage and Price Changes in Less Developed Countries. An Intertemporal Cross-country Analysis." Journal of Development Economics 4(1977):315-342.

Goldstein, Morris and Mohsin S. Khan. "Large Versus Small Price Changes and the Demand for Imports." International Monetary Fund Staff Papers 23(March, 1976):200-225.

Greenville, Stephen. "Monetary Policy and the Formal Financial Sector." in Anne Booth and P. McCawley (eds.), The Indonesian Economy During the Soeharto Era. Kuala Lumpur: Oxford University Press, 1981.

Hanson, J.A. "The Short-Run Relation Between Growth and Inflation in Latin America: A Quasi-Rational or Consistent Expectations Approach." American Economic Review 70(December, 1980):972-989.

Harberger, Arnold C. "The Dynamics of Inflation in Chile." in C. Christ et.al. (eds.), Measurement in Economics, Stanford University Pres, 1963.

Henneberry, David M., Shida Henneberry, and L.G. Tweeten." The Strength of the Dollar: An Analysis of Trade-Weighted Foreign Exchange Rate Indices With Implications for Agricultural Trade. Oklahoma State University, Department of Agricultural Economics.

Hooper, Peter and John Morton. "Fluctuations in the Dollar: A Model of Nominal and Real Exchange Rate Determination. " Journal of International Money and Finance 1(1982):39-56.

International Monetary Fund. International Financial Statistics. Washington, D.C., 1975-1986.

ILO Mission. Employment, Incomes, and Equality: A Strategy for Increasing Productive Employment in Kenya. International Labour Organization, Geneva, 1972.

Kincaid, G.R. "A Test of the Efficacy of Exchange Rate Adjustments in Indonesia." International Monetary Fund Staff Papers 31(1984):62-92.

Kost, E. William. "Effects of Exchange Rate Change on Agricultural Trade." Agricultural Economics Research 28(1976):99-106.

McKinnon, Ronald I. Money and Capital in Economic Development. The Brooking Institution, Washington D.C., 1973.

Muir, Ross. "Survey of Recent Developments." Bulletin of Indonesian Economic Studies, Vol. 22, No. 2, pp. 1-27, 1986.

Orcutt, Guy H. "Measurement of Price Elasticities in International Trade." Review of Economics and Statistics, 32(1950):117-132.

Organization for Economic Co-operation And Development. Main Economic Indicators. OECD, Paris: January 1975-December 1986.

Pan-American Coffee Bureau. Annual Coffee Statistics, No. 38 (1974).

Schuh, Edward G. "The Exchange Rate and U.S. Agriculture." American Journal of Agricultural Economics 56(1974):1-13.

______________. "The Exchange Rate and U.S. Agriculture: Reply." American Journal of Agricultural Economics 57(1975):696-700.

______________. "Trade and Macroeconomic Dimensions of Agricultural Policy." Department of Agricultural and Applied Economics, University of Minnesota., Staff Paper P84-20, 1984.

Sheehey, Edmund J. "Money, Income and Prices in Latin America." Journal of Development Economics 7(1980):345-357.

Timmer, C. Peter, Walter Falcon, and Scott Pearson. Food Policy Analysis. Baltimore: The Johns Hopkins University Press for the World Bank, 1983.

Timmer, C. Peter. "Food Price Policy in Indonesia". Draft., Graduate School of Business Administration, Harvard University, March, 1986.

Tweeten, L.G. "Farm Financial Stress, Structure of Agriculture and Public Policy." Paper presented at American Enterprise Institute conference on U.S. Agricultural Policies. Washington D.C., January 28, 1985.

United Nations. Quarterly Bulletin of Statistics for Asia and The Pacific. UN, Bangkok: March 1975-December 1985.

__________. Statistical Indicators for Asia and The Pacific. UN, Bangkok: March 1986-June 1986.

U.S. Department of Agriculture. "Southeast Asia. World Agriculture Regional Supplement. Review of 1982 and Outlook for 1983." Economic Research Service, Supplement 10 to WAS 31, Washington, D.C., 1983.

U.S. Department of Agriculture. "Wheat Outlook and Situation Yearbook." Economic Research Service, WS-271, February 1985.

Valdes, Alberto. "Impact of Trade and Macroeconomic Policies on Agricultural Growth: The South American Experience." in Inter-American Development Bank., Economic and Social Progress in Latin America, 1986 Report, Washington D.C.

Velliantis-Fidas, Amalia. "The Impact of Devaluation on the U.S. Agricultural Exports." Agricultural Economics Research 28(1976):107-116.

Vogel, R. "The Dynamics of Inflation in Latin America, 1950-1960." American Economic Review 64(March, 1974):102-114.

Warr, Peter G. "Exchange Rate Protection in Indonesia." Bulletin of Indonesian Economic Studies, Vol. 20 NO.2, pp. 53-89, August 1984.

VITA

Kaman Nainggolan

Candidate for the Degree of

Doctor of Philosophy

Thesis: MACROECONOMIC IMPACTS ON INDONESIAN AGRICULTURAL EXPORTS

Major Field: Agricultural Economics

Biographical:

Personal Data: Born in Pematangsiantar, North Sumatera, Indonesia, May 12, 1951, the son of Mareas Nainggolan and Kornelia boru Samosir.

Education: Graduated from Sekolah Analis Kimia Menengah Atas, Bogor, April, 1971; received Sarjana degree with honors in Agricultural Product Technology from Institut Pertanian Bogor in April, 1976; received Master of Science degree in Applied Statistics from Institut Pertanian Bogor in April, 1979; completed requirements for the Doctor of Philosophy degree at Oklahoma State University in December, 1987.

Professional Experience: Chemical Analyst in The National Agency for the Nuclear Power, Jakarta, Indonesia, 1971-1972; Teaching Assistant in Organic Chemistry, Institut Pertanian Bogor, Indonesia, 1974-1976; Statistician, Center for Agricultural Data Processing, Ministry of Agriculture, Jakarta, Indonesia 1976-1980; Head Computer Center, Center for Agricultural Data Processing, Ministry of Agriculture, Jakarta, Indonesia, 1981-1983.

Professional Organizations: American Agricultural Economic Association, Western Agricultural Economics Association, Southern Agricultural Economics Association.

Honor: Golden Key National Honor Society, Gamma Sigma Delta.