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A Subsistence Linked Economy: The Case of the Solomon Islands

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Abstract

How are money demand, income, and the price level affected when a significant portion of the economically active population reverts to and withdraws from subsistence economic activity? This paper tries to find a quantitative answer to the question by highlighting the specific link between the monetized and the subsistence economy that exists in the Solomon Islands: the producer price of copra, the main cash crop. The paper includes this variable explicitly in the money demand function of an aggregated macroeconomic simultaneous equation model and finds a significant impact throughout the economy.

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Summary

How are money demand, income, and the price level affected when a significant portion of the economically active population moves in and out of subsistence economic activity? This paper tries to find a quantitative answer to the question. It does so by highlighting the specific link between the monetized and the subsistence economy that exists in the Solomon Islands: this is the producer price of copra, the main cash crop.

Some part of the economic activity in the rural areas of the Solomon archipelago is allocated between subsistence activities, such as fishing, agriculture, or construction, and monetized activities, particularly the production of copra. The current copra price offered by the central marketing board to all producers determines the allocation of economic activity between subsistence and monetized activities. High variation in the posted copra producer prices, low production and transportation costs for producers, ample and free supply of inputs, and a very short production time have led to a significant cyclical migration of activity between monetized and subsistence production activity.

The paper presents a simultaneous equation model that traces the impact of changes in the copra producer price throughout the economy. This variable is a proxy for the temporary degree of monetization of the entire economy. The model includes the copra producer price as a variable explicitly in a money demand function. The other equations of the simultaneous equation model refer to the income and price levels in the country. The paper establishes that a temporarily higher degree of monetization of economic activity has a significant impact on money demand, income, and prices.

I. Introduction

How are money demand, income and the price level affected when a significant portion of the economically active population reverts to and withdraws from subsistence economic activity in a cyclical manner? This is the case of the Solomon Islands; and it is the purpose of this paper to examine the impact of the fluctuation between monetized and subsistence economic activity on the economy of the Solomon Islands.

The Solomon Islands is an archipelago in the South Pacific comprising six main islands and many small ones and a population of about 280,000. The economy comprises a modern, monetized sector and a large subsistence sector, which usually provides occupation to the larger part of the economically active population. The monetized sector covers largely the production and export of primary commodities, among which copra plays a predominant role, and trade in consumer goods.

The subsistence sector is linked to the monetized economy via the production of copra, the main cash crop. Some part of the economic activity in the subsistence sector is allocated between non-pecuniary agricultural, fishing or construction activity and the pecuniary production of copra. The allocation of economic activity is determined by the current copra price offered to producers. This price is set by the Commodity Export Marketing Authority in relation to the world market price of copra. The supply response of subsistence producers (smallholders) to changes in the posted copra price has a short time lag because of the ample and free supply of the input for copra, raw coconuts; the low copra production costs for smallholders, valued basically at their opportunity costs of subsistence activity; and the short production cycle of copra. The low costs of shifting between monetized and subsistence activity, the short production cycle, and the large changes in the world price for copra have led to significant cyclical migration of activity between monetized and subsistence production activity.

The shift between monetized and subsistence production of a significant part of economic activity has an impact upon money demand, monetized income, and prices in the monetized economy. Money demand is affected when a larger part of the population resorts to pecuniary transactions rather than subsistence activity. Monetized income is affected because of the shift between nonmonetized and monetized economic activity. Prices are affected because of the lagged supply response of the domestic economy to changes in copra-related income.

The simultaneous equation model presented in this paper describes a small and open economy with a large subsistence sector that is linked to the monetized economy via production of a particular commodity, in this case copra. The model includes endogenously the interaction between

income changes, price level changes, and monetary expansion and exogenously the impact of external shocks like changes in the copra price. The interdependent growth of real money, real income, and prices take place in an environment of external shocks and slow adaptive processes. The model presented in this paper corresponds therefore to the category of Phillips-Bergström models, which include a concept of continuously emerging disequilibria in time. 1/ In the model, disequilibria are created by external shocks or by imperfect adjustment by economic agents to past changes. Policy created disequilibria, like changes in the level of government spending or exchange rate action, are implicitly included in the model.

The transmission mechanism of monetary expansion takes a central role in the model. Such an expansion will not only create inflationary pressures but will also have an impact on real income if such a monetary expansion is not completely anticipated. Theoretical work on the links between monetary expansion and economic activity can be found in the literature, 2/ as well as some model specifications for developing countries. 3/ Usually, these models take explicitly into account the specific economic conditions of the countries they analyze. A generalized model has been developed by Khan and Knight and tested with pooled data covering 29 developing countries. 4/ The transmission mechanism between monetary expansion and economic activity is modeled here in analogy to the Khan-Knight study.

II. The Model

The model contains three behavioral equations, which are fairly simple, but should be enough to provide a basic tool for analysis of main economic variables. The three behavioral equations describe money demand, real income and inflation.

1. Money demand

Demand for money theories can broadly be categorized as transaction theories or portfolio theories. Transaction theories emphasize the role of money as an exchange medium and portfolio theories emphasize the role of money as part of a portfolio of assets. The approach in this model emphasizes the transaction role of money, which seems justifiable in view of the severely limited number of available financial assets in the less developed island economy of the Solomon Islands and in view of the

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1/ Powell (1982).

2/ Aghevli and Khan (1978); Harberger (1978); Blejer and Fernandez (1980); Khan (1980); Levy (1981); Vogel (1984).

3/ For Indonesia, Aghevli (1977); For Korea, Otani and Park (1976); for Greece, Leventakis (1985).

4/ Khan and Knight (1981).

objective of the paper, that is, to test the significance of the transaction-based link between the monetized and the subsistence economy.

The demand for money M is assumed to be a function of the expected real income Y^{er} and the expected rate of inflation P^e. But in addition to these traditionally used variables, the model includes further a variable for the real producer price of copra, P^c/P, a proxy to measure short-term changes in the degree of monetization of the economy. A shift in economic activity towards monetized agriculture will increase the demand for money to carry out transactions derived from the copra trade.

The money demand function in this model is specified as:

$$(1) \qquad \frac{M_t}{P_t} = a_o + a_1 \underset{(+)}{Y_t^{er}} + a_2 \underset{(-)}{P_t^e} + a_3 \underset{(+)}{\frac{P_t^c}{P_t}}$$

The expected signs of the coefficients are indicated below the equation. The variables for real income and prices are formulated as expected real income and prices to include medium-term adaptive processes in response to monetary or income imbalances. The variable for income includes only income derived from activities other than copra production. This definition avoids multicollinearity as income derived from copra activity is closely linked to the copra price. The variable for copra price is neither specified in terms of expected price, nor is it lagged, as the supply response of copra producers to changes in copra prices has proven to be very fast. 1/ The difference in time horizons should also help avoid a problem of possible multicollinearity of the explanatory variables.

2. Real income

The model determines income endogenously, focusing on adjustment to past changes in real money and real income and taking into account lags in the adjustment process. Exogenous variables, like changes in government expenditure, have also been included. Real income in this model is not linked to changes in output or the accumulated investment of past periods. Other supply factors known from the theory of growth to contribute to an increase in real income, such as productivity growth or population growth, are not included in the model. Thus they are considered white noise, or are assumed to have a constant influence on

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1/ Real copra income could be used as a scale variable for the temporary monetized economic activity, but as copra production volume has proven to be a function of the current copra producer price, the price can be assumed to be the essential condition for the temporary monetization and useful as a proxy in the equation.

the included variables and therefore to be included in the coefficients of the variables.

$$(2) \quad \frac{(Y_t + Y^c_t)}{P_t} = b_o + b_1 \frac{Y_{t-1}}{P_{t-1}} + b_2 \frac{M_{t-1}}{P_{t-1}} + b_3 \frac{Y^c_{t-1}}{P_{t-1}} + b_4 \frac{(GC_t + GI_t)}{P_t}$$

$$(+) \qquad (+) \qquad (+) \qquad (+)$$

The left-hand variable represents real total income, i.e., real income from copra and from non-copra activities. The variable with the coefficient b_1 measures the income effect of the lagged adjustment of the economy to changes in non-copra income. The variable with the coefficient b_2 measures the spillover from monetary expansion to income. The variable with the coefficient b_3 measures the multiplicative impact of real copra related income, which depends on the exogenous variable copra producer price and the output response of producers. The variable with the coefficient b_4 is composed of real government consumption and investment and measures the effect of fiscal policy on real income.

3. Prices

The consumer price level is determined by domestic and foreign factors and is specified as follows:

$$(3) \quad P_t = c_o + c_1 \frac{Y_{t-1}}{P_{t-1}} + c_2 \frac{M_{t-1}}{P_{t-1}} + c_3 P^m_t$$

$$(+) \qquad (+) \qquad (+)$$

The first two right-hand terms are analogous to the terms determining the income function. The first term measures the lagged effects of a real income change on the price level. The impact reflects the supply response capacity of the economy. A lower supply response in the economy will lead to higher price responsiveness to changes in real income. 1/ The second term measures the spillover of a monetary expansion to prices. An expansion of the money stock beyond the expansion in the transaction needs in the economy will create inflationary pressure in the following periods. The third term P^m_t measures the influence of foreign prices on the level of domestic prices. This term can be expected to be highly significant, due to the high proportion of imported consumption and investment goods in the economy.

4. Expected inflation

The expected price level for the current period P^e_t, which is used as a variable in equation (1) is determined by adaptive expectations. The expectations of the economic agents are revised periodically taking

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1/ See Frenkel (1984); Fritz-Krockow (1986), p. 158-161.

partially into account the difference between the expected price level in the previous period and the outcome in that period. Several models of adaptive expectations of inflation rates have been proposed and tested elsewhere. 1/ Based on a model of Nugent and Glezakos (1979), this model uses the following adaptation equation:

$$(4) \quad P^e_t = P^e_{t-1} + \alpha(P_{t-1} - P^e_{t-1})$$

P^e_t represents the expected price level in period t. α is an adjustment coefficient that measures the degree of correction of expectations by economic agents when they confront the price levels they expected in the past with the actual outcome. An adjustment coefficient below 1 would indicate that the economic agents correct their expectations only partially, whereas a coefficient above 1 would indicate an overadjustment to past experiences. This latter behavior may be possible in the short run, but on a medium or long term average an adjustment coefficient between 0 and 1 can be expected. The present model is based on the assumption of a constant average adjustment behavior during the observation period, therefore the coefficient can be expected to have a value between 0 and 1.

The above equation is transformed into a distributed lag function by successive substitution:

$$(5) \quad P^e_t = \alpha P_{t-1} + \alpha(1 - \alpha)P_{t-2} + \alpha(1 - \alpha)^2 P_{t-3} + \ldots = \alpha \sum_{i=0}^{\infty} (1 - \alpha)^i P_{t-i-1}$$

Equation (5) cannot be estimated by ordinary econometric methods, because P^e_t is unobservable. Therefore, the coefficient α is estimated by iteratively minimizing the quadratic loss function L:

$$(6) \quad L = \sum_{t=1}^{n} (P_t - P^e_t)^2 = \sum_{t=1}^{n} [P_t - \alpha \sum_{i=0}^{m} (1 - \alpha)^i P_{t-i-1}]^2$$

L indicates the sum of squares of forecasting errors during the observation period. Individuals should tend to minimize their forecasting errors, while placing a particular emphasis on the results of the most recent periods in their process of adjusting their forecasts.

The number n stands for the number of observations in the sample period, while m is the number of periods that have a lagged influence on the estimated level of prices in the current period. Theoretically, m is infinite, as described in the distributed lag function (5). But in order to economize on the degrees of freedom, the magnitude of m was

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1/ See Lucas (1973); Barro (1977, 1978); Nugent and Glezakos (1979).

reduced to 3. Experimentation with higher values of m did not show significant differences.

The value of α, which minimizes the above function, can be used in equation (5) to produce endogenously a time-series of expected price levels P_t^e. The time-series for the expected income level Y_t^e was calculated using the same methodology. The corresponding adjustment coefficient is labeled β.

5. Exogenous or policy variables

Exogenous or policy variables are government expenditure, the foreign price index and the copra producer price. The foreign price level is expressed in domestic currency and includes both price changes due to exchange rate action and the effects of foreign price changes measured in the currency of origin. The copra producer price influences the degree of monetization of the primary sector and via the copra-related income influences total income and price behavior. The overall impact of changes in the posted copra producer price on the economy can be analyzed with a simultaneous equation model.

Equations (1), (2), and (3) constitute a simultaneous equation model with the exogenous or policy variables government expenditure, foreign price index and copra producer price, and the price and income adjustment coefficients α and β.

III. The Empirical Results

The model was tested for the Solomon Islands for the sample period 1980 through 1986, using quarterly data. The data was obtained from the International Financial Statistics and from the Central Bank and the Statistics Office of the Solomon Islands. 1/ In a first step, the adjustment coefficients α and β for expected prices and expected income were calculated. In a second step, the single equations were estimated to test the significance of the variables included. In a third step, the simultaneous equation model was solved, using endogenously calculated data and comparing it to actual data to test the forecasting capabilities of the model.

1. The adjustment coefficients

In order to estimate series of expected income and expected prices the price and income adjustment coefficients α and β were calculated. In both cases, four lagged periods were used, as the inclusion of a

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1/ Availability and reliability of data, common problems in small developing economies, constrained the scope of analysis and options of variables in the model. The quarterly time series for government expenditure and non-copra income had to be estimated from annual data using a cubic spline procedure.

fifth lagged period in the estimation of the adjustment coefficients did not significantly change their value. Experimentation with other time periods demonstrated that the adjustment coefficients were fairly stable during the entire observation period. The initial assumption of constant adjustment coefficients can therefore be considered acceptable. The adjustment coefficients estimated with the procedure described in section II showed values of $\alpha = 0.90$ for the price adjustment coefficient and $\beta = 0.83$ for the income adjustment coefficient, implying that economic agents adjusted their expectations to changes in their level of income slower than in the level of prices. This might find its explanation in the fact that consumer prices have increased at a steadier rate than income, which is subjected to variations of climate, seasons, and world prices.

2. The money demand function

The money demand function was estimated using expected values for real income and prices and the CPI deflated producer price of copra, and was specified in the form:

$$(1) \qquad \frac{M_t}{P_t} = a_o + a_1 Y_t^{er} + a_2 P_t^e + a_3 \frac{P_t^c}{P_t}$$

The estimated coefficients and the corresponding t-statistic values are:

Intercept	Expected income	Expected prices	Copra price
a_0	a_1	a_2	a_3
0.0325	0.3334	-0.0408	0.0147
(0.95)	(1.45)	(2.07)	(2.03)

The variables are in most cases significant at the 95 percent level, with the income variable significant at 90 percent and the intercept without significance. A correction of possible first and fourth order autocorrelation was used, because a Durbin-Watson test for both types of autocorrelation did not rule out positive correlation of residuals. The further analysis of the residuals did not reveal any misspecification of the function or heteroskedasticity. An estimation of the money demand function using logarithmic series yielded only insignificant variables and reduced distinctively the R^2 from its level of 0.82. This can be attributed to a change of elasticities over time, because the use of logarithmic variables assumes constant elasticities over the entire period. The instability of elasticities during the observation period can be explained by unusually strong annual variations of weather conditions and wide fluctuations of the world market price of copra, factors that both affected the income position and expectations of the Solomon Islanders. This explanation is substantiated by the low income

adjustment coefficient. The inclusion of other variables, like rates of return of different financial assets, did not prove to have a significant influence on the demand for money. This can be explained by the fact that the capital market of the Solomon Islands is underdeveloped, lacking alternatives for financial asset allocation.

The impact of the different variables included in the equation upon real money demand changes varied over time. In the entire sample period, inflation was relatively constant, providing during most of the time a fairly constant negative impact upon money demand. Negative growth in real money demand in 1981 and 1982 can be attributed to a decline in the copra price and in expected real non-copra income. The decline in expected real non-copra income can also in part be attributed to the declining copra price, as the reduction of copra related income affected adversely other types of income. This impact was significant because a substantial part of the non-copra economy is composed of trade and commercialization, which was directly affected by a slump in copra trade. In 1983 and 1984, the substantial increase in copra producer prices led to increased copra production and copra related income. The transaction needs involved with the temporary monetization of agricultural activity and the multiplicative effect in the economy forced a strong growth of money demand in that period. This process was reversed at the end of 1984, when the copra producer price was reduced continuously to reflect the sharp drop in the international commodity price.

3. The income function

The income function was specified in the form:

$$(2)\quad \frac{(Y_t + Y^c_t)}{P_t} = b_o + b_1 \frac{Y_{t-1}}{P_{t-1}} + b_2 \frac{M_{t-1}}{P_{t-1}} + b_3 \frac{Y^c_{t-1}}{P_{t-1}} + b_4 \frac{(GC_t + GI_t)}{P_t}$$

Coefficients and corresponding t-statistic values estimated for the function were:

Intercept	Lagged non copra income	Monetary expansion	Lagged copra income	Government expenditure
b_0	b_1	b_2	b_3	b_4
-0.0209	1.0444	-0.5838	1.9647	0.1830
(1.42)	(8.19)	(3.55)	(7.31)	(3.89)

The t-values given in the parenthesis below the coefficients show that, with the exception of the intercept, which is significant at the 90 percent level, all the variables are significant at the 99.5 percent level. The R^2 showed a value of 0.88 after a correction for possible first order autocorrelation was carried out. The value of the lagged

copra income coefficient is relatively high indicating a strong cyclical impact on the overall income in the economy. It is interesting to note the negative sign of the monetary expansion variable. This may be due to the structure of the financial market of the island economy, where financial assets are most likely to be used for transactions rather than investment purposes, having an impact on demand only on the short-term. Supply adjustments to increases in nominal domestic demand are very slow because of the production and transportation constraints of a less developed island economy. Money creation in this economy cannot be used to stimulate economic activity beyond the short-term, as it translates into price increases, which have a detrimental impact on economic activity. The significant impact of money creation on prices can be seen in the price function. The negative sign of the monetary variable might also indicate that the impact of real money creation on economic activity from the copra production and trade is insignificant in the macroeconomic context beyond the current period.

The impact of the variables upon real total income differed over time. Government expenditure did not show any particular pattern during the sample period, indicating the absence of an explicitly cycle-oriented fiscal policy. The impact of past non-copra income upon income displayed a seasonal pattern. Seasonally adjusted, the impact upon income became continuously negative until 1983. In mid-1983, copra prices increased sharply, leading to increases in copra related income and also in non-copra income. A sharp increase in income between mid-1983 and mid-1984 was the result (Chart 1). The subsequent sharp fall in international copra prices led to a decline and stagnation of copra and subsequently non-copra related income. The income variables fluctuated widely over the sample period, a fluctuation that can be attributed to the high variability of copra export prices and the short-term copra supply responses.

4. The price function

The price function was defined as:

$$(3) \quad P_t = c_0 + c_1 \frac{Y_{t-1}}{P_{t-1}} + c_2 \frac{M_{t-1}}{P_{t-1}} + c_3 P^m_t$$

The results of the least square regression analysis were as follows:

Lagged income	Monetary expansion	Import prices
c_1	c_2	c_3
2.8440	1.4317	0.6926
(4.37)	(2.02)	(11.63)

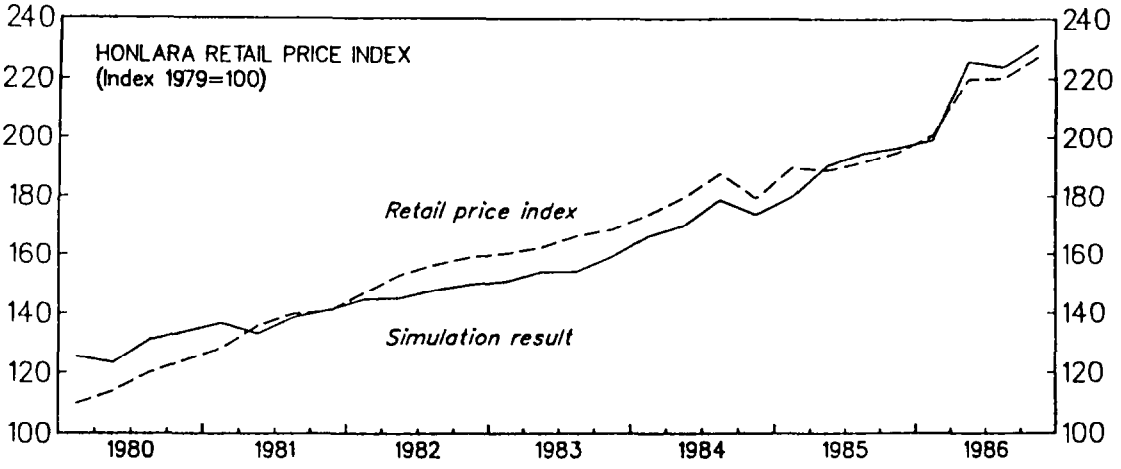
The R^2 showed a value of 0.98 and all variables were significant at more than 97 percent. An intercept was not included in the function, as it did not prove to have significance in the price equation itself and reduced the fit of the simultaneous equation model. The high significance of the import price variable can be explained by the production and consumption structure of an island economy. A high percentage of consumption goods and all investment goods are imported, with the islands exporting in return only a limited number of primary products. Production of goods for domestic consumption is limited mainly to basic agricultural products. The impact of import price changes upon the general consumer price level is therefore very high. The production structure, low inventories of goods, and long transport routes for imports make suppliers' responses to increases in nominal demand slow, explaining the high impact of past money or income increases on the price level.

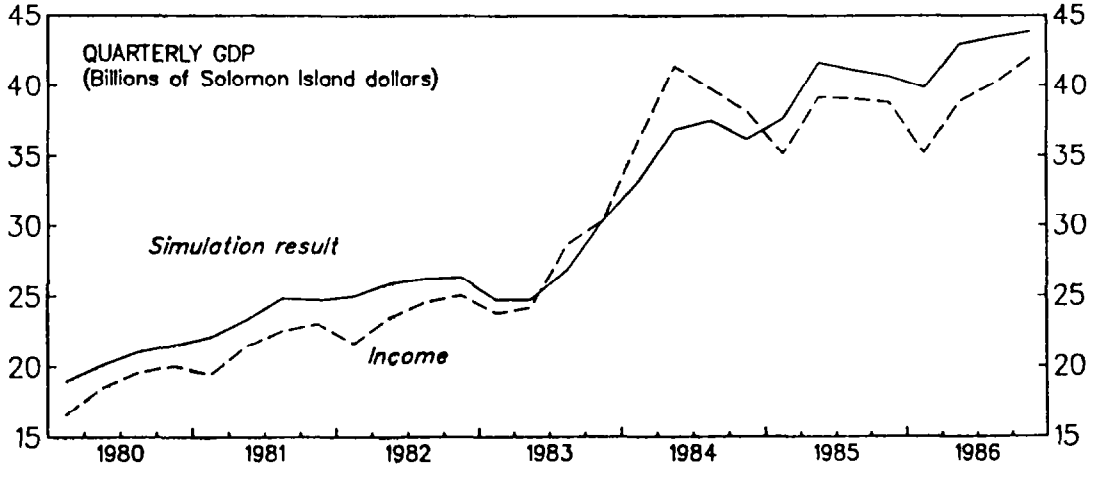
5. Forecasting capabilities of the simultaneous equation model

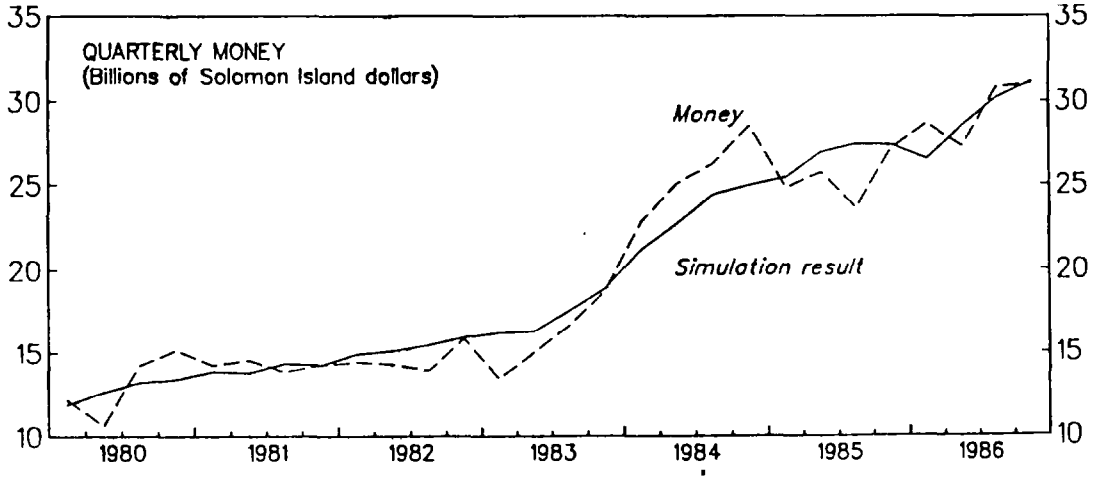
Chart 1 compares the actual data for broad money, GDP and the Honiara Retail Price Index in the sample period 1980 through 1986 with the endogenously estimated values in the model. A Theil U-statistic analysis to test the forecasting capabilities of the model displayed values of 0.08, 0.08, and 0.04, respectively for the three equations. 1/ The partial inequality coefficients revealed that about 90 percent of the forecasting deviations are attributable to the residuals in the linear regressions. This indicates that incorporation of additional information would not improve the forecasting capabilities of the model.

1/ Theil U-statistic values range from 1 to infinity, with 0 indicating a perfect fit and 1 indicating that the model forecasts no better than a naïve zero change prediction. A value of 0.4 is still accepted as a relatively good fit. Koutsoyiannis (1977), p. 492-495.

CHART 1
SOLOMON ISLANDS







IV. Conclusion

The empirical tests in this paper have shown that the structure of the economy is fairly accurately reflected in the structure of the model, thus providing a useful tool for analytical purposes. Particularly interesting results of the analysis are the fact that the link between the monetized and the subsistence agriculture proved to be significant enough to be incorporated in a highly aggregated model. The empirical results suggest that a temporary monetization of economic activities in the subsistence sector can have a measurable impact upon money demand due to increased transaction needs, as well as upon total income in the economy due to increased pecuniary demand for goods and services originating in the temporary monetized sector of the economy. The results also suggest that in the analysis of overall economic activity attention should be paid to the links between the subsistence economy and the monetized economy.

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