Does money matter in Fiji? An empirical study for the period 1970–2007

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This article investigates the role of money in the Fijian economy during a 38-year period (1970–2007). Our study findings confirm the existence of a long-run co-integrating relationship between output, prices, money, the interest rate and the exchange rate. It is also indicated that the linkage runs from money to output and not in the other direction. Further, there is a causal relationship running from money to prices, which establishes the pivotal role of money in the determination of the price level.

The views expressed are the authors' own and do not reflect those of the institutions they are affiliated with.

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The hypothesis that short-run changes in the money stock have important effects on output has been tested from time to time. Empirical investigations by Friedman and Schwartz (1963a, 1963b) on the effects of the money supply on aggregate output and price levels in the United States and several studies in other industrialised countries (Davis and Lewis 1977; Christiano and Ljungqvist 1988; Davis and Tanner 1997) kindled interest in the subject in the Pacific islands. In the latter region, Fiji received particular attention because of the availability of a long and consistent time series of data on money and national accounts. Studies on Fiji by Joynson (1997), Katafono (2000) and Gokal and Hanif (2004) concluded that there was a lack of robustness in the relationship between the monetary aggregates and output.

The objective of this article is to update past studies on Fiji by considering a longer time series of data covering a 38-year period (1970–2007). Also, by adopting the bounds testing procedure, we undertake a more intensive investigation through variance decomposition and impulsive response function analyses. The article is organised along the following lines. The second section presents a brief literature review;

the third section outlines the econometric techniques for the empirical investigation; the fourth section presents the results; and the fifth and final section is a summary with conclusions.

Literature review

Any review of empirical studies relating to money, output and the price level has necessarily to begin with Friedman and Schwartz's (1963a, 1963b) investigations of the relationship between money and business cycles, which continue to be the most influential empirical evidence on the relationship between money, output and prices. Tobin (1970) was the first to formally model the idea of a positive association between money and output. Using US data, Sims (1972) employed the Granger causality test and concluded that money 'led' income. In their studies on the Australian economy, Sheppard (1973), Davis and Lewis (1977) and Boehm (1983) found that there was strong evidence with regard to the impact of changes in monetary aggregates on real activity.

Sims (1980), utilising a vector autoregression (VAR) procedure with additional variables (prices and interest rate), found that the statistical significance of the effect of money on output was lower when other variables were included. King and Plosser (1984) demonstrated that narrow money had a weaker effect on output, while Stock and Watson (1989) used a three and four-variable VAR (in differences as well as in levels) and concluded that the narrow money aggregate (M1) was a significant predictor of output.

Reverse causation

King and Plosser (1984) studied a subsequent treatment of what is known as reverse causation, which was suggested by Friedman and Schwartz (1963a). Their study confirmed the possibility of output growth causing money growth. McCandless and Weber (1995) investigated the long-run relationship between money and output by analysing the data from 110 countries. Their study—covering a 30-year period and using several definitions of money—established the existence of correlation between prices and the money supply. Their finding of a positive relationship was consistent with the findings of many other studies based on smaller samples of countries and for different periods. For a sub-sample of Organisation for Economic Cooperation and Development (OECD) countries, McCandless and Weber (1995) reported a positive correlation between money and output, but not price.

Tallman and Chandra (1996) examined Australian data using a range of VAR systems. These included bivariate (monetary aggregate and output), three-variate (plus inflation), four-variate (adding the interest rate) and five-variate (including the exchange rate) VAR systems. They found that monetary aggregates contained no significant information for explaining fluctuations in output or inflation. In a further study, Tallman and Chandra (1997) found the absence of a relationship between output and price with any of the monetary aggregates. Hayo (1998) undertook a similar study for 14 countries in the European Union plus Canada, the United States and Japan and tested a number of hypotheses to determine money-output Granger causality. The results showed that the hypothesis of a positive relationship between output and different monetary aggregates did not hold for different periods or for different groups of countries.

Studies on Fiji

Fiji is one of the five Pacific island countries with independent currencies under fixed exchange rate regimes. Joynson (1997), who was the first to examine the possibility of a stable relationship between money, income and interest rates, cast doubts on monetary aggregates influencing output. Katafono (2000) studied the relationship between monetary aggregates and inflation and output using simple correlation and Granger causality tests under a VAR framework. The leading or lagging role of the monetary aggregates was also tested. Her results indicated a lack of robustness in the relationship between the monetary aggregates and the economic activity variables.

Several researchers have studied Fiji's money demand function (Jayaraman and Ward 2000; Katafono 2001; Gokal and Hanif 2004; Rao and Singh 2005; Narayan and Narayan 2008). Their findings are mixed. For example, using Granger causality tests under a VAR framework, Gokal and Hanif (2004) found that a weak negative correlation existed between inflation and output. Further, the causality linkage between the two variables ran only one way—from output to inflation. Using the bounds testing approach to co-integration, Narayan and Narayan (2008) re-examined the money demand function in Fiji for the period 1971–2002. They do not find any evidence of a long-run stable money demand function for Fiji. The findings of past studies on money output in Fiji are summarised (Table 1).

The ambiguity in the money-output relationship and money demand function in Fiji arises from the potential statistical biases such as stationarity, sample size and unobserved country-specific effects. These issues are often viewed as main concerns in the earlier literature. As argued by Narayan and Narayan (2008:74), 'previous studies estimating Fiji's money demand function have failed to search fully for the integrational properties of the data series, which has implications for cointegration tests'. Further, the small samples typically used for Fijian studies could significantly distort the power of standard tests and lead to different conclusions.[1] Narayan and Narayan (2008) stressed the need to ensure the use of data in the most efficient manner for drawing sharp conclusions and inferences.

Data and econometrics

The data series for Fiji covers a 38-year period (1970–2007). The three main variables are real gross domestic product (RGDP),[2] a monetary aggregate (M2)[3] and the consumer price index (P). Besides these three, we employed two other variables: the average nominal lending rate (*IR*) and the nominal exchange rate (*LER*, units of US dollar per unit of domestic currency). The annual data for the study are drawn from two sources: the monetary and exchange rate data come from international financial statistics published by the International Monetary Fund (IMF 2008) and output data come from the Asian Development Bank (ADB 2008) and UN Economic and Social Commission for Asia and Pacific (UNESCAP 2008).

Bounds testing approach

As the number of annual observations is small, we resort to the bounds testing procedure under the auto-regressive distributed lag (ARDL) model, which was developed by Pesaran, Shin and Smith (2001). The ARDL bounds testing model is a general dynamic specification, with lags of the dependent variable and the lagged and contemporaneous values of the explanatory variables, through which the short and long-run impacts can be estimated. The bounds testing approach allows testing for the existence of a co-integrating relationship between variables in levels irrespective of whether the underlying regressors are I(0) or I(1) (Pesaran and Shin 1999; Pesaran, Shin and Smith 2001). Pesaran and Shin (1999) have also shown that estimators of the short-run parameters are consistent and the estimators

Table 1 **Summary of the money output literature in Fiji**

Author(s)/year	Study period	Econometric technique	Variables used	Finding(s)
Waqabaca and Morling (1999)	1989–99 for interest rates	Error correction model (ECM)	Treasury bill rate, lending rate, savings deposit rate (1989–99)	Monetary policy in Fiji is conducted through open market operations and is transmitted through commercial bank interest rates influencing the real economy, the objective being price stability.
	1968–98 for inflation		Import prices, output prices, unit labour cost	
	1975–98 for output fluctuations		Terms of trade (TOT), trading partner GDP, real interest rate, agriculture supply-side shocks and 2 dummies	
Dewan, Hussein and Morling (1999)	1966–98	Unrestricted error correction model (UECM)	Prices, import prices, unit labour costs, output gap	The results suggest that about three-quarters of the long-term movement in the general price level in Fiji is due to import prices while about one-quarter has been due to movement in domestic factors, particularly increases in unit labour costs. The adjustment of domestic prices to foreign prices is relatively fast.
Jayaraman and Ward (2000)	1979:Q2 – 1997:Q4	Co-integration and error correction technique	Broad money (M2), real GDP (RGDP), real interest rate, inflation rate, real effective exchange rate index	There is a long-run demand-for-money function in Fiji for the entire period. The stability of money demand function is also found either before or after the financial liberalisation period. The study suggests that there is potential for achieving price stability by controlling the growth rate of money supply by the Reserve Bank of Fiji.
Katafono (2000)	1966–98	Vector auto-regression (VAR)	Currency in circulation, NGDP, RGDP, prices, M1, quasi-money, broad money and private sector credit	The results indicate a lack of robustness in the relationship between monetary aggregates and the economic activity variables, as well as in their predictive power.
Williams and Morling (2000)	1966–98	ECM	Fiji's output, trading partners' output, agricultural shocks, real interest rates, real exchange rates, terms of trade, government deficit	In the short term, supply-side shocks dominate the pattern of growth. Shifts in agricultural production account for more than half of annual change in economy-wide output and income. Changes in external demand also influence the year-to-year pattern of growth while monetary policies also play a marginal role. In the medium term, the pattern of growth is closely linked to the growth of Fiji's trading partners.

Gounder and Morling (2000)	1971–99	Linear trend, Hodrick Prescott filter, aggregate production function, structural VAR	Lagged inflation, output gap	This article estimates potential output and the output gap using four different methods and compares properties of the different estimates. The results suggest that the output gap is measured very imprecisely in Fiji and is dominated by supply-induced fluctuations in output and hence has very different implications for policymakers than in the more usual demand-induced case.
Katofono (2001)	1975–99	Co-integration and error correction technique	Consumer price index (CPI), RGDP, savings deposit rate, Treasury bill rate, REER, real broad money, real M1, real quasi-money	The demand for money in Fiji is unstable.
Dewan, Gokal and Hussein (2003)	1991–2002	Hodrick Prescott filter, Granger causality test	Monthly CPI, CPI excluding credit service charge, trimmed mean at different levels	The study recommends that the Reserve Bank of Fiji continue to use the 15 per cent trim mean as the official measure of underlying inflation.
Gokal and Hanif (2004)	1970–2003	VAR model, Granger causality	RGDP growth, annual average CPI inflation rate	Results reveal that a weak negative correlation exists between inflation and growth, while the change in the output gap has significant bearing. The causality between the two variables runs one way—from GDP growth to inflation.
Rao and Singh (2005)	1971–2002	Co-integration and ECM	Narrow money (currency in circulation and demand deposits), GDP deflator, RGDP, nominal interest rate (nominal 1–3 years weighted average interest rate on time deposits)	The demand-for-money function in Fiji is stable.
Rao and Singh (2006)	Survey article	Nil	Monetary aggregate, real output, interest rate, inflation rate, exchange rate	The Reserve Bank of Fiji should use money supply as its main policy instrument instead of the interest rate or bank rate.
Narayan and Narayan (2008)	1971–2002	Bounds testing approach to co-integration, multiple structural break test	Real money demand, RGDP, nominal interest rate	There is no long-run relationship among the variables. Using structural break analysis, the study suggests that the unstable nature of Fiji's money demand could be due to typical events, such as coups; the implementation of policies, such as devaluations and value-added tax; and the onset of trade liberalisation policies in the past two decades.

of long-run parameters are super-consistent in small sample sizes.

All variables are duly transformed into their natural logs before analysis. Consequently, first differences in the logs of variables — namely, RGDP, M2 and P — denote annual rates of change in percentages in RGDP, M2 and P. We also add a trend variable.[4]

There are two steps involved in estimating the long-run relationship between money, output and other variables. The first step is to examine the presence of a long-run relationship among all variables in the equation. Once the long-run relationship is confirmed in the model, the long-run coefficients are estimated using the associated ARDL model. To examine for co-integration by the bounds tests, the following models are constructed (Equations 1 and 2).

$$\begin{aligned}\Delta LRGDP_t &= \beta_0 + \beta_1 LRGDP_{t-1} + \beta_2 LP_{t-1} + \beta_3 LM2_{t-1} \\ &+ \beta_4 LIR_{t-1} + \beta_5 LER_{t-1} \\ &+ \beta_6 TREND + \sum_{i=1}^{p} \alpha_{1i} \Delta LRGDP_{t-i} \\ &+ \sum_{i=0}^{p} \alpha_{2i} \Delta LP_{t-i} + \sum_{i=0}^{p} \alpha_{3i} \Delta LM2_{t-i} \\ &+ \sum_{i=0}^{p} \alpha_{4i} \Delta LIR_{t-i} + \sum_{i=0}^{p} \alpha_{5i} \Delta LER_{t-i} + \varepsilon_{1t}\end{aligned} \quad 1)$$

$$\begin{aligned}\Delta LP_t &= \delta_0 + \delta_1 LP_{t-1} + \delta_2 LRGDP_{t-1} + \delta_3 LM2_{t-1} \\ &+ \delta_4 LIR_{t-1} + \delta_5 LER_{t-1} + \delta_6 TREND \\ &+ \sum_{i=1}^{p} \gamma_{1i} \Delta LP_{t-i} + \sum_{i=0}^{p} \gamma_{2i} \Delta LRGDP_{t-i} \\ &+ \sum_{i=0}^{p} \gamma_{3i} \Delta LM2_{t-i} + \sum_{i=0}^{p} \gamma_{4i} \Delta LIR_{t-i} \\ &+ \sum_{i=0}^{p} \gamma_{5i} \Delta LER_{t-i} + \varepsilon_{2t}\end{aligned} \quad (2)$$

In Equations 1 and 2, Δ is the first difference operator, ε_{1t} and ε_{2t} are white noise error terms and *TREND* is the trend, or time, variable. The joint significance of the lagged levels in both equations is examined by using the F-test, where the null and alternative hypotheses are expressed for Equation 1 (as Equation 3) and for Equation 2 (as Equation 4).

$$H_0 : \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = 0$$
(there is no long-run relationship)

$$H_1 : \beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq \beta_5 \neq 0$$
(there is a long-run relationship)

(3)

$$H_0 : \delta_1 = \delta_2 = \delta_3 = \delta_4 = \delta_5 = 0$$
(there is no long-run relationship)

$$H_1 : \delta_1 \neq \delta_2 \neq \delta_3 \neq \delta_4 \neq \delta_5 \neq 0$$
(there is a long-run relationship)

(4)

The distribution of the F-statistics is non-standard under the null and is derived from and provided by Pesaran, Shin and Smith (2001). Two sets of critical values are given based on Pesaran, Shin and Smith (2001) and Narayan (2005). Narayan and Narayan (2005) and Narayan (2005) show that the use of Pesaran, Shin and Smith's (2001) critical values for small samples can lead to misleading inferences, as the computed critical values are generally lower than those generated by Narayan (2005), who uses a similar GAUSS code to that provided by Pesaran, Shin and Smith (2001). Narayan (2005) has generated a set of critical values for small sample sizes ranging from 30 to 80 observations. Since the sample size in our study is small, we use the critical values generated by Narayan (2005).[5]

If the computed F-statistic is greater than the upper critical bound value, the null hypothesis of no co-integration is rejected irrespective of whether the variable is I(0) or I(1). In contrast, when the F-statistic is smaller than the lower critical bound value, the null hypothesis is not rejected, and we conclude that there is no long-run level relationship between the variables under study. If, however, the computed F-statistic lies within the lower and upper critical bound values, there is an inconclusive inference.

Granger causality test

If the variables are of I(1) and are co-integrated, the next step is to perform the Granger causality test to examine the short-run dynamic causality relationship between variables. Equations 1 and 2 can be reformulated into a vector error-correction model (VECM) framework in first differences in order to capture the short and long-run effects of the co-integrating vector. If Z_t is the vector of a set of endogenous variables, we can model Z_t as an unrestricted vector auto-regression (VAR) model with optimum lag length[6] (Equation 5).

$$Z_t = A_1 Z_{t-1} + A_2 Z_{t-2} + \ldots + A_k Z_{t-k} + U_t \quad \text{where } U_t \sim IN(0, \sigma) \tag{5}$$

In Equation 5, Z_t is a (5 x 1) vector comprising *LRGDP*, *LP*, *LM2*, *LIR* and *LER*. Each of the A_1 is a (5 x 5) matrix of parameters. The five-variable VAR model as shown in Equation 5 is used if there is no long-run relationship in the bounds testing approach. If there is a co-integration vector, the following VECM is used to examine the long and short-run causality relationships between the variables (Equation 6).

$$\Delta Z_t = \Gamma_1 \Delta Z_{t-1} + \Gamma_2 Z_{t-2} + \ldots + \Pi_k Z_{t-k} + U_t \tag{6}$$

In Equation 6, ΔZ_t = [*LRGDP*, *LP*, *LM2*, *LIR* and *LER*], $\Gamma_1 = -(I - A_1)$, $\Gamma_2 = -(I - A_1 - A_2)$ and $\Pi = -(I - A_1 - A_2 - A_3)$. Γ_1 reflects the short-run relationship of the changes in Z_t. The (5 x 5) matrix of Π (= $\alpha\beta'$) contains speed of adjustment to disequilibrium (α) and the long-run information (β) such that the term $\beta' Z_{t-3}$ embedded in Equation 6 represents the *(n-1)* co-integrating relationship in the model.

Empirical results

Unit root and bounds tests

Based on the ADF and Ng-Perron unit root tests (Table 2), we conclude that the logs of variables are non-stationary in levels and stationary in their first differences. Consequently, the suitable procedure for examining the dynamic behaviour of these macroeconomic variables, which are integrated of order 1, is the co-integration test together with an error-correction model.

We now proceed to test the long-run co-integration hypothesis between LRGDP, LP, LM2, LIR and LER. The results of co-integration tests are reported (Table 3). The null hypothesis of no co-integration for output (LRGDP) as the dependent variable is rejected at the 5 per cent level since the computed F-statistics are greater than the critical values given by Pesaran, Shin and Smith (2001) and Narayan (2005). On the other hand, the null hypothesis of no co-integration in regard to other equations with LP, LM2, LIR and LER as dependent variables is not rejected. The estimated coefficients of the co-integrating vector with LRGDP as the dependent variable are[7] shown in Equation 7.

$$LRGDP = 8.756 - 0.807LP^{*} + 0.442LM2^{**} - 0.156LIR - 0.573LER^{*}$$
$$t = (1.646) \quad (-1.924) \quad (2.512) \quad (-0.397)(-1.808) \qquad (7)$$

* significant at the 10 per cent level
** significant at the 5 per cent level

The model passes diagnostic tests such as the Breusch-Godfrey LM test (serial correlation), the ARCH test (heteroscedasticity), the Ramsey RESET test (functional form misspecification) and the Jarque-Bera (normality) test (Table 4). Moreover, the plots of cumulative sum (CUSUM) and cumulative sum of squares (CUSUMSQ) statistics sug-

Table 2 **Unit root tests**

Test/ variable	ADF		Ng and Perron	
	Level	First difference	Level	First difference
LRGDP	–2.59 (0)	–5.59** (0)	–6.48 (0)	–17.92** (0)
LP	–2.67 (0)	–2.79* (0)	–3.75 (1)	–10.40** (0)
LM2	–2.12 (0)	–5.73** (0)	–2.03 (0)	–8.62** (1)
LIR	–2.43 (0)	–7.63** (0)	–5.67 (0)	–16.60** (0)
LER	–1.43 (0)	–4.36** (0)	–13.17 (1)	–16.31** (0)
Critical value				
1 % level	–4.23	–3.63	–23.80	–13.80
5 % level	–3.54	–2.95	–17.30	–8.10
10 % level	–3.20	–2.61	–14.20	–5.70

* null hypothesis rejected at the 10 per cent level of significance
** null hypothesis rejected at the 5 per cent level of significance
Notes: The ADF critical values are based on McKinnon. The optimal lag is chosen on the basis of Akaike Information Criterion (AIC). The null hypothesis for the ADF and Ng-Perron tests is that a series has a unit root (is non-stationary).

Table 3 **Bounds test results**

Dependent variable				Computed F-statistic
LRGDP				4.71**
LP				1.66
LM2				0.92
LIR				1.40
LER				0.61
	Pesaran, Shin and Smith (2001)a		Narayan (2005)b	
Critical value	Lower bound value	Upper bound value	Lower bound value	Upper bound value
1 % level	3.41	4.68	4.537	6.370
5 % level	2.62	3.79	3.125	4.608
10 % level	2.26	3.35	2.578	3.858

* significant at the 10 per cent level ** significant at the 5 per cent level *** significant at the 1 per cent level
[a] Critical values are obtained from Pesaran, M.H., Shin, Y. and Smith, R., 2001. 'Bounds testing approaches to the analysis of level relationships', *Journal of Applied Econometrics*, 16(3):Table CI(iii) case III—unrestricted intercept and no trend, p. 300.
[b] Critical values are obtained from Narayan, P.K., 2005. 'The saving and investment nexus for China: evidence from cointegration tests', *Applied Economics*, 37(17):Table case III—unrestricted intercept and no trend, p. 10.

Table 4 **Diagnostic tests for the LRGDP equation**

Diagnostic test	Null hypothesis	Statistics	Decision
Jarque-Bera test	H0: normality of error term	$\chi^2 = 0.9502$ [0.6218]	Do not reject H0
Breusch-Godfrey serial correlation LM test	H0: no auto-correlation	F(1) = 1.5328 [0.2415]	Do not reject H0
ARCH test	H0: homoskedasticity	F(1) = 0.8044 [0.6715]	Do not reject H0
Ramsey RESET test	H0: the model is correctly specified	F(1) = 0.4362 [0.5225]	Do not reject H0

Note: Figures in brackets represent probability values of the test statistics.

Figure 1 **Plot of CUSUM test for the LRGDP equation**

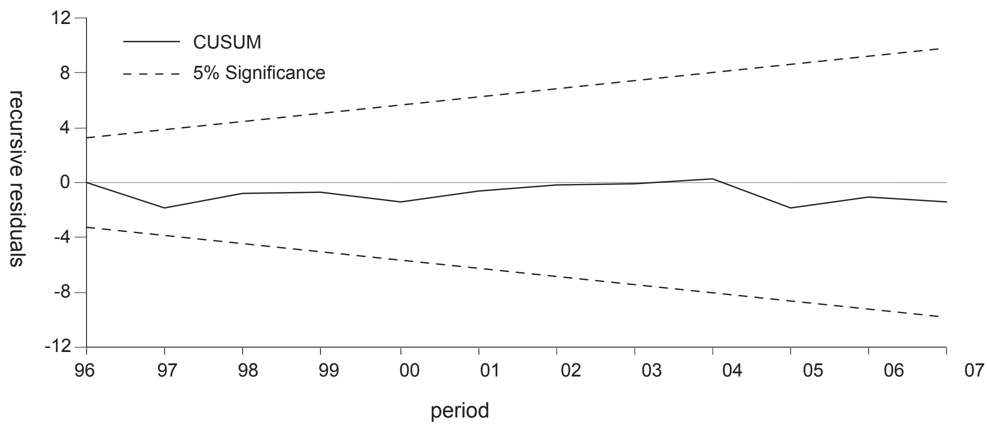
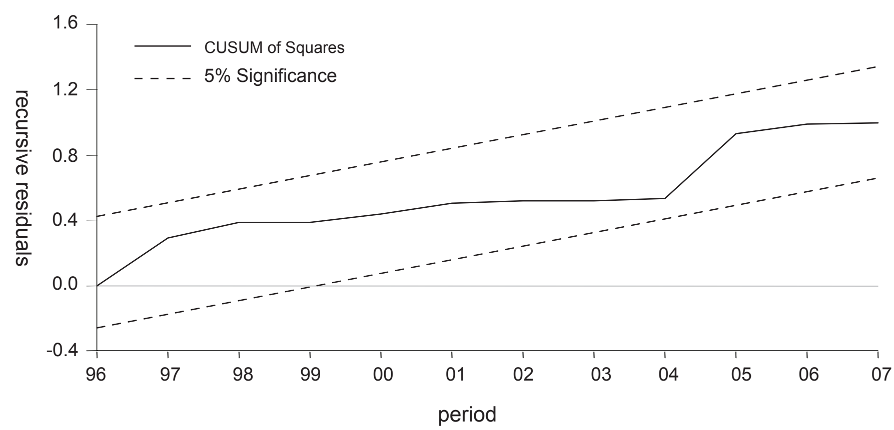


Figure 2 **Plot of CUSUM of squares test for the LRGDP equation**



gest that all coefficients in the estimated output regression are stable for the sample period (Figures 1 and 2). The diagnostic tests generally support the statistical validity of the long-run model.

As the variables are in logs, the coefficients indicate the magnitudes of their respective output elasticities. As shown in Equation 7, the estimated coefficients of the long-run parameters have the theoretically expected correct signs. Except for the interest rate, all the estimated coefficients are statistically significant. It is found that a 1 per cent increase in M2 would lead to about a 0.4 per cent increase in real output.[8] Further, a 1 per cent increase in inflation would reduce output by 0.8 per cent. Nevertheless, our results are different from those of Joynson (1997) and Katafono (2000), who found money did not have significant impacts on output, while Gokal and Hanif (2004) observed a weak negative correlation between price and output.

Granger causality tests

Although the co-integration test results show the presence of a long-run equilibrium between output, the monetary aggregate, prices, the interest rate and the exchange rate, the procedure by itself is not sufficient to indicate the direction of short or long-run causality running between variables. As the variables are of I(1) and they are co-integrated, we resort to an error correction model. The results of the Granger causality tests are reported (Table 5).

In Table 5, we note that the error-correction term (ECT) is statistically significant in the output equation, while ECTs are not significant in other equations with price, money, interest rate and exchange rate as dependent variables. The F-statistics (Wald tests) reveal Granger exogeneity of money[9]—that is, money is not influenced by any other variables in the system. In contrast, there is only one-way causality running from all variables (money, prices, interest rate and exchange rate) to output (LRGDP).

Table 5 **Results of Granger causality tests**

Dependent variable	F-statistics					ECT (t-statistics)
	ΔLRGDP	ΔLP	ΔLM2	ΔLIR	ΔLER	
ΔLRGDP	-	3.068*	11.780***	6.503**	6.837**	–0.0161*** (–2.867)
ΔLP	1.449	-	4.183**	2.396*	2.002	–0.0011 (–0.574)
ΔLM2	2.230	1.267	-	0.211	1.833	–0.0233 (–0.843)
ΔLIR	1.960	4.366**	5.352**	-	2.482*	–0.0136 (–0.555)
ΔLER	0.644	3.490*	3.351*	0.558	-	–0.0161 (–1.239)

- zero
* significant at the 10 per cent level ** significant at the 5 per cent level *** significant at the 1 per cent level
Note: Figures in parentheses are t-statistics.

Granger causality test results also confirm the result obtained from the bounds tests—that there is only one co-integration vector, which is the equation with output as the dependent variable. The magnitude of the coefficient of ECT in the LRGDP equation indicates the speed of adjustment in correcting any disequilibrium, which is found to be significant at the 1 per cent level. The ECT coefficient of 0.016 implies that adjustment towards the long-run equilibrium is about 1.6 per cent per annum. This suggests that disequilibrium from the long-run relationship is corrected slowly.

Variance decomposition analysis

We proceeded to conduct variance decomposition and impulse response function analyses with a view to investigating the dynamic interactions and strengths of causal relations among the variables. Variance decomposition is employed to measure the percentage of variability in the endogenous variables induced by the shocks (innovations) emanating from any of the variables. Since all variables are co-integrated, we enter the variables in their first differences in the VAR framework. We adopt the methodology of orthogonalised forecast error variance decomposition, which is based on Choleski factorisation with particular ordering—namely, LM2, LIR, LER, LP and LRGDP. We calculate the variance decomposition at forecast horizons of one–10 years. Since the study focuses on output and price, we decompose the forecast-error variance of output and price response to a one standard deviation innovation in other variables.

The relative importance of shocks in terms of their contribution to the forecast-error variance of output and price are shown (Tables 6 and 7, respectively). In Table 6, it is seen that 77 per cent of the forecast-error variance of output is explained by its own shock in the first year; however, the impact of its own shock on output declines over the remaining time horizon to 25 per cent in the long run. The money variable is the most important in explaining the variance in output in the short run—accounting for about 14 per cent. An exchange rate shock explains less than 10 per cent of the forecast-error variance of output in the first seven years but thereafter explains about 20 per cent of the variance in output for the remaining years of the time horizon. We note that price explains little of the forecast-error variance of output for the entire period.

Looking at the forecast-error variance of price in Table 7, we note the interest rate's contribution relative to other policy variables is low, not only in the short run but also in the long run. Output also explains the variance in price to a negligible extent (less than 1 per cent throughout the period). The monetary aggregate (M2) is the most important explanation for the variation in the price level, accounting for more than 50 per cent of the variation in the price level. The exchange rate is the next most important factor in explaining the variation in the price level—in the short run (15 per cent) and the long run (24 per cent).

Thus, the finding that monetary and exchange rate shocks have been the dominant sources of real output and price variation is consistent with the Granger causality test results that both money and exchange rate 'Granger cause' real output and price. Moreover, there is no reverse causality running from output and prices to money and the exchange rate.

Correlation matrix of reduced-form VAR residuals

With a view to testing the robustness of the variance decomposition results—which would vary depending on the ordering of the variables—we test the correlation of the reduced-form VAR residuals. The correlation matrix of the reduced-form VAR residuals based on the ordering of

Table 6 **Variance decomposition analysis for real output**

Period	S.E.	LRGDP	LP	LM2	LIR	LER
1	0.0507	77.9816	1.0269	14.1369	6.7887	0.0659
2	0.0610	61.1627	5.0208	17.6509	15.6203	0.5454
3	0.0696	50.7150	7.1043	15.6769	26.0851	0.4186
4	0.0763	45.0155	9.8209	13.8404	30.6212	0.7020
5	0.0818	40.3117	11.9227	12.0361	33.3493	2.3802
6	0.0869	36.5196	13.3266	10.9654	33.7906	5.3978
7	0.0920	33.0227	14.2832	10.7721	32.6906	9.2313
8	0.0967	30.0124	14.8507	11.2768	30.8877	12.9724
9	0.1010	27.5813	15.1757	12.1101	28.9468	16.1862
10	0.1046	25.7265	15.3351	12.9762	27.2162	18.7461

Note: Cholesky ordering = LM2, LIR, LER, LP and LRGDP.

Table 7 **Variance decomposition analysis for prices**

Period	S.E.	LRGDP	LP	LM2	LIR	LER
1	0.0249	0.0000	75.2974	0.1899	9.1189	15.3939
2	0.0326	0.4033	71.3535	3.4582	6.1804	18.6046
3	0.0391	0.3317	60.5964	14.9169	4.3964	19.7586
4	0.0457	0.5390	49.2478	26.4886	3.2482	20.4763
5	0.0520	0.6245	40.3754	35.3943	2.6452	20.9606
6	0.0578	0.6734	33.9894	41.4529	2.2976	21.5867
7	0.0629	0.7048	29.4979	45.4034	2.0938	22.3002
8	0.0674	0.7224	26.2951	48.0283	1.9573	22.9969
9	0.0713	0.7390	23.9572	49.8169	1.8582	23.6288
10	0.0748	0.7552	22.2032	51.0891	1.7802	24.1723

Note: Cholesky ordering = LM2, LIR, LER, LP and LRGDP.

Table 8 **Correlation matrix of the reduced form VAR residuals**

	LRGDP	LP	LM2	LIR	LER
LRGDP	1.0000	–0.1603	0.3760	-0.2549	0.1238
LP		1.0000	0.0436	0.3026	–0.3697
LM2			1.0000	0.0150	0.2587
LIR				1.0000	–0.0027
LER					1.0000

the variables—namely, money, price and output—is presented (Table 8). Low magnitudes of correlation coefficients indicate that contemporaneous feedback is not a problem, implying the ordering of the variables in the Choleski decomposition is not of major concern.

Impulse response function analysis

Although the variance decomposition procedure estimates the proportion of the variance caused by a shock in a variable, it does not indicate whether the impact would be positive or negative. Therefore, impulse response function (IRF) analysis is undertaken with a view to obtaining indications of the system's dynamic behaviour, since it traces the response of the endogenous variables to a shock in another variable in the system. IRF analysis is depicted over a horizon of 10 years in Figure 3. The shock is indicated by a one standard deviation of the disturbance term in the underlying structural model for the variable.

The response of output to shocks in money is positive for the first five years. It is significant, however, for only the first year, as the lower dotted line is below the zero line after the second year. Similarly, the response of prices to a monetary shock is positive and is significant for the first five years. After

Figure 3 **Results of impulse response function analysis on real output**

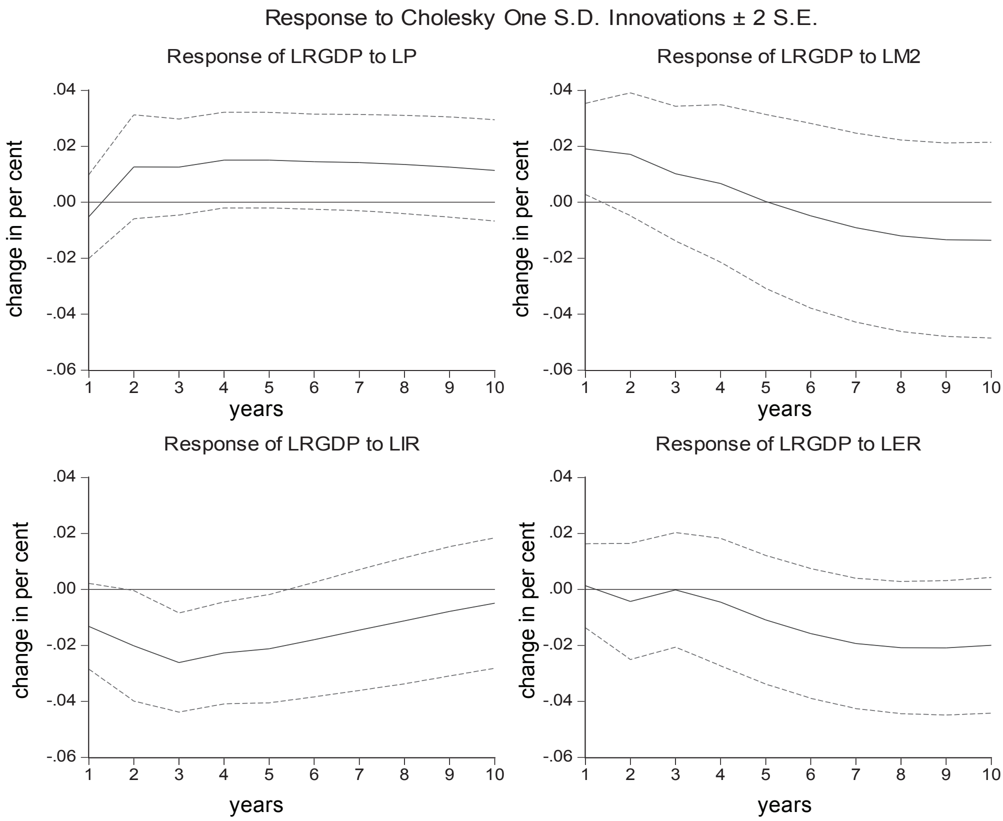
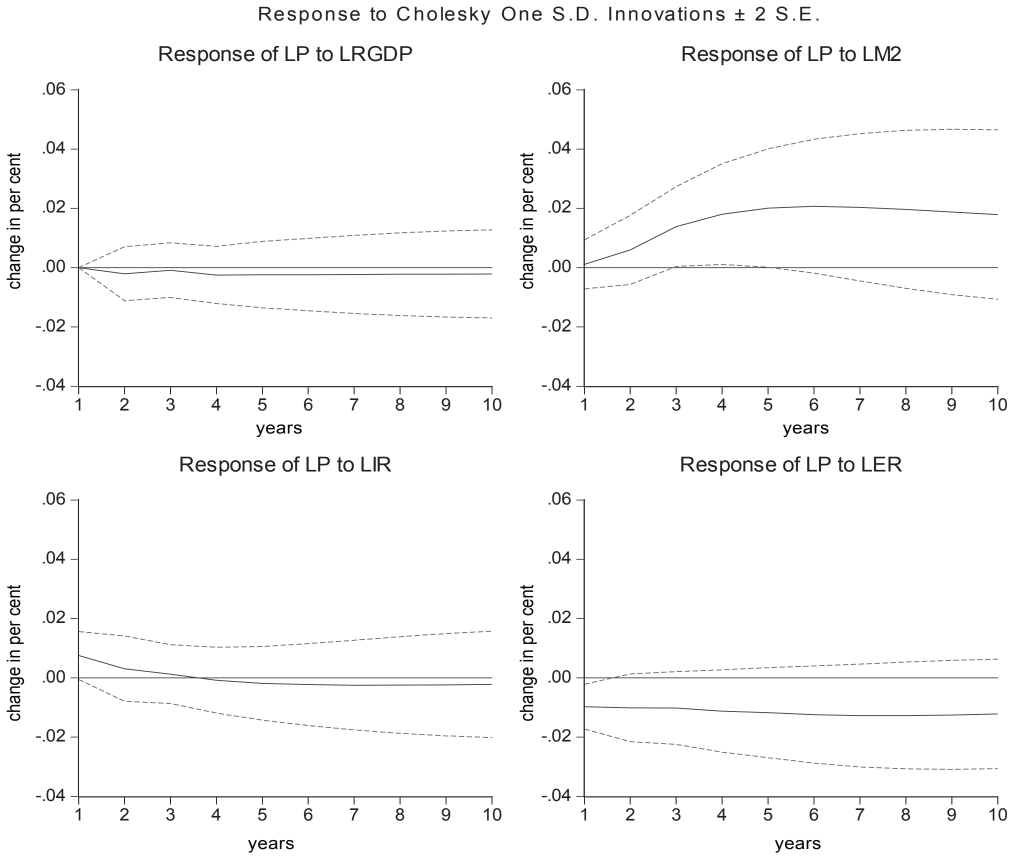


Figure 4 **The results of impulse response function analysis for prices**



that, the response is not significant as the lower dotted line is below the zero line over the whole horizon.

Summary and conclusions

The relationship between money, output and prices in Fiji has attracted considerable attention not only from economists in the Reserve Bank of Fiji (RBF) but also from academics. The first available RBF staff study was by Joynson (1997), which cast doubt on monetary aggregates influencing output. It was followed by Katafono (2000), another RBF staffer, who also found a lack of robustness in the relationship between the monetary aggregates and economic activity variables.

Subsequent studies—notably, by Gokal and Hanif (2004), again of the RBF, and academics Rao and Singh (2005, 2006) and Narayan and Narayan (2008)—came to conclusions of a mixed nature. Gokal and Hanif (2004) found a weak negative correlation between inflation and output and that causality ran only in one direction—from output to inflation. Rao and Singh (2005, 2006) concluded that the demand-for-money function was stable in Fiji and therefore the central bank should use the money supply as its main policy instrument, instead of the interest rate or the bank rate. Narayan and Narayan (2008) did not find any evidence of a long-run stable money demand function for Fiji.

The ambiguity in the money-output relationship and in the money-demand function in Fiji, as Narayan and Narayan (2008) noted, arose from potential statistical biases such as stationarity, the sample size, the period of study and others factors, including unobserved country-specific effects. These issues, which were often viewed as major concerns in the earlier literature, would continue to daunt all empirical studies. Given these limitations, the present study, which covers a longer period (1970–2007), is yet another attempt aimed at the use of data in the most efficient manner for drawing sharp conclusions.

Our study findings confirm the existence of a long-run co-integrating relationship between output, prices, money, the interest rate and the exchange rate. It also indicates that the causality runs from money to output and not in the other direction. Also, changes in the money stock 'Granger cause' output in the short run. Furthermore, there is a causal relationship running from money to prices, which establishes the pivotal role of money in the determination of the price level.

Using variance decomposition and impulse response function analysis, we again find that most of the variability in output and prices is explained substantially by money shocks and money has a significantly predictable effect on output. Therefore, money does matter in Fiji. Thus, the study's findings affirm the conclusion reached by Rao and Singh (2006) in their survey article on monetary policy that Fiji's central bank should use the money supply as its main policy instrument, instead of the interest rate or the bank rate.

Notes

1. This argument could be true for both unit root and co-integration inferences for Fijian studies, which employed varying short time spans. It will be recalled that the periods of study by the aforementioned researchers varied. Joynson (1997) investigated the long-run relationship between money, income and interest rates in Fiji during the period 1966–96 (31 observations); Katafono (2000) examined the relationship among monetary aggregates, inflation and output in Fiji from 1966 to 1998 (33 observations); Katafono (2001) re-examined the demand for money function in Fiji in the period 1975–99 (25 observations); and Rao and Singh (2005) estimated the demand for money in Fiji from 1971 to 2002 (32 observations).
2. Several studies have used real GDP in examining the relationship between output and money. See, for example, Katafono (2000, 2001) and Starr (2005).
3. M2 is broad money, which is M1 plus quasi-money, comprising savings and time deposits.
4. Narayan and Smyth (2006) have extensively discussed the inclusion of a time trend variable in the estimation.
5. See Table 2 for these critical values.
6. The optimum lag length is chosen based on Akaike's information criterion.
7. We excluded the trend or time variable as it was found to be not significant. The exclusion of the trend variable did not change the sign and significance of the explanatory variables substantially. The results including the trend variable are not reported here but are available on request.
8. Studies that found a positive relationship between money and output include Sheppard (1973); Davis and Lewis (1977); Lucas (1980); Boehm (1983); Kormendi and Meguire (1984); Stock and Watson (1989); and McCandless and Weber (1995).

[9] Exogeneity of money in the Granger causality test is consistent with the findings of the co-integration test. That is, we found M1 is weakly exogenous for the co-integration parameters.

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