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How does monetary policy transmission mechanism work in Fiji?

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Abstract The study aims to examine the impact of changes in policy variables namely, monetary aggregate (M1), exchange rate and interest rate on two monetary goal variables, namely output and price level in Fiji from 1970 to 2006 by applying the procedures of variance decomposition and impulse response functions. We conclude that the money channel is the most effective channel of transmission mechanism among the three channels.

Keywords Monetary transmission mechanisms · Real output · Price · Variance decomposition · Impulse response

JEL classifications E52 · E64 · N15

1 Introduction

Fiji is one of six Pacific island countries (PICs), which have independent currencies, the other five being Papua New Guinea, Samoa, Solomon Islands, Tonga and Vanuatu. Three years after gaining independence in 1970, Fiji set up a Central Monetary Authority (CMA) and pegged its currency to the US dollar, severing the fixed link with the British pound under a currency board arrangement. Ending the

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short-lived link with the US dollar in 1975, Fiji decided to peg the Fiji dollar to a trade weighted basket of currencies of its major trading partners, an arrangement continuing till today. The CMA was replaced by Reserve Bank of Fiji (RBF) in 1984, which was set up by an Act of the country's parliament.[1] The RBF has since then been using monetary policy to achieve the twin objectives of price stability and safeguarding foreign reserves, in coordination with the ministry of finance, which is responsible for fiscal policy to promote economic growth and development.

Although there are several studies available including those dealing with demand for money (Rao and Kumar 2007; Rao and Singh 2006, 2005; Jayaraman and Ward 2000), money multiplier (Jayaraman and Ward 2004) and monetary approach to balance of payments (Fontana 1998), there is no specific study on how monetary policy changes have been influencing economic growth in Fiji. This paper seeks to fill the gap by undertaking an empirical study of Fiji's monetary policy transmission mechanism during a 37-year period since the country's independence. The rest of the paper is organised, as follows. Section 2 provides a very brief literature survey on transmission mechanism together with a review of Fiji's experiences in implementation of monetary policies; Sect. 3 outlines the methodology adopted for the study and reports results. Section 5 is a summary of the findings with policy implications.

2 Monetary policy transmission mechanism: a brief literature survey and limitations

The process through which monetary policy decisions affect real gross domestic product (RGDP) and price level (P) is described as monetary transmission (Meltzer 1995). Since monetary policy is aimed at influencing interest rate and availability of loanable funds for investment through central bank's control of money supply, real output is influenced by changes in consumption of durable goods by households, and investment decisions of households, business and financial intermediaries.

Monetary transmission mechanism refers to the general conceptual framework, while the channel of monetary influences refers to "the route through which the monetary disturbances influence the goal variables" (Pierce and Tysome 1985, pp. 22). Thus, by differentiating between a given transmission mechanism and a channel of monetary influence, it is possible for a number of channels of monetary influences to operate within the same transmission mechanism.

There are at least six channels through which monetary policy appears to be impacting economic activities in developed countries. These are: (1) interest rate channel; (2) money supply channel; (3) credit channel; (4) balance sheet channel; (5) asset price channel; (6) exchange rate channel; and (7) expectations channel (Mishkin 2006).

[1] The principal purposes of RBF as stated in Part II, Sect. 4 of RBF Act 1983 are to: "(1) regulate the issue of the currency, and the supply, availability, and international exchange of money;(2) promote monetary stability; (3) promote a sound financial structure; and (4) foster credit and exchange conditions conducive to the orderly and balanced economic development of the country".

Table 1 Fiji: growth rates and monetary statistics

	Growth rate (%)	M1 (F$ Million)	M2 (F$ Million)	M1 (% of GDP)	M2 (% of GDP)	CPI (index)	RBF indicator rate (%)	Money market rate (%)	Nominal exchange rate (index)
1985–1989 (average)	0.4	276.0	810.0	15.7	46.2	57.4	NA	5.2	139.6
1990–1994 (average)	2.9	331.4	1274.0	14.4	55.2	84.3	NA	3.4	117.3
1995–1999 (average)	2.8	500.4	1454.2	15.6	46.2	98.8	2.10	2.2	111.7
2000	−1.7	593.7	1513.8	16.5	42.2	100.0	2.30	1.0	100.0
2001	2.0	620.9	1467.8	16.4	38.8	102.3	1.25	1.0	99.4
2002	3.2	712.0	1583.0	17.7	39.3	106.0	1.25	0.9	101.1
2003	1.1	900.6	1980.4	20.6	45.2	109.6	1.19	0.9	106.0
2004	5.3	1018.0	1926.0	21.5	40.7	113.2	1.75	0.9	107.8
2005	0.7	1197.0	2241.0	23.6	44.2	115.7	2.25	2.1	107.7
2006	2.0	1142.4	3012.8	21.3	44.2	118.8	4.25	5.3	105.9

Sources: Government of Fiji (2007); ADB (2007); IMF (2007), Authors' calculations

2.1 Financial sector in Fiji

Table 1 presents some of the key growth and monetary statistics including interest and exchange rates of Fiji. Before examining the limitations of applicability of transmission channels to Fiji, a look at Fiji's financial sector would be useful. Fiji's financial sector comprises three major sectors, namely the banking system, insurance industry and non-bank financial institutions. The banking system[2] had a major setback in 1995–1996, when the state-owned National Bank of Fiji (NBF) failed. The failure of NBF, which once accounted for one-third of total bank credit, was a wake-up call to the nation. Improvements in bank supervision and regulatory reforms were quickly undertaken (Chandra et al. 2004).

There are three non-bank licensed credit institutions (LCI), which cater to the credit needs of the private sector in various areas, which include consumer credit, real estate, transport and storage, wholesale and retail trade. The insurance sector covers life insurance and general insurance. There are two life insurance companies, eight general insurance companies, and five insurance brokers with a large number of insurance agents. A major proportion of assets of insurance institutions are invested in government securities as well as in term deposits with commercial banks (RBF 2007a).

In addition to these institutions, there is a state-sponsored pension institution, known as Fiji National Provident Fund (FNPF), which collects a stipulated percentage of the salaries of employees in the formal sector matched by a similar contribution from the employers. The FNPF's investments are concentrated in fixed income securities, the bulk of which is in long-term government and government

[2] The banking system consists of five commercial banks, four of which are being foreign owned and the fifth one is a joint venture, These are: Australian and New Zealand Banking Group Limited (ANZ), Westpac Banking Corporation (Westpac), Bank of Baroda (BOB), Colonial National Bank and Bank of South Pacific.

guaranteed bonds. Its short-term funds are kept with commercial banks as deposits of varying duration or invested in government short-term treasury bills.

The government and public enterprises are the only source of financial securities. These include short-term treasury bills and long-term bonds. Fiji's stock market is at a nascent stage, handling a limited number of privately issued equity stock. There is no secondary market in these securities. Therefore, most of the holders of debt securities hold them until their dates of maturity.

2.2 Fiji's monetary policy measures

The monetary policy measures by RBF until 1988 were direct. In addition to statutory reserve deposit (SRD) ratio requiring the commercial banks to hold with monetary authority a stipulated proportion of their deposits mainly meant for prudential purpose, RBF relied on other direct interventions as well. One such intervention was that all the licensed financial institutions including commercial banks were required to maintain a minimum of not more than 35% of deposits and other liabilities in minimum holding of unimpaired liquid assets (ULA) in terms of treasury bills of the government and securities issued by government and by official agencies. Further, RBF was fixing credit limits and controlling both deposit and lending rates, along with mandated priority sector lending targets. These quantitative restrictions were gradually relaxed beginning from 1989 and discontinued in the early 1990s, as part of its financial sector liberalisation programme. The statutory reserve ratio has, however, been retained and stands at 5% of all deposits.

In 1989, RBF began an open-market type of operations in its own short-term debt paper of various maturities, known as RBF Notes, ranging from 91 to 180 days, primarily as a measure towards liquidity management. The yield to maturity of the 91-day RBF Notes has now come to be officially recognised as the policy indicator rate (PIR), signalling the monetary policy stance of RBF. The rate is set in line with RBF's declared monetary policy objectives of low inflation of about 3% and an adequate level of international reserves to cover about 4 months of imports of goods and services. When the actual 91-day rate is not aligned with the policy indicator rate, RBF would exert pressure on the market for short-term funds by selling or redeeming RBF Notes to influence the amount of funds in their market. The open market operations are conducted to drain out the excess liquidity in the system until the 91-day yield to maturity rate of RBF Notes is brought in alignment with the policy indicator interest rate. By maintaining a continuous pressure on the system, the RBF expects to influence short-term interest rates including the money market interest rate (MMR).[3] The

[3] Changes in PIR are expected to affect other interest rates in a number of ways. First, changes in PIR are expected to affect the money market rate (MMR), the inter-bank lending rate, and other short-term as well as capital market interest rates. Since the primary source of non-bank financial institutions is through issuance of securities in the market, a change in PIR affects the cost of funds, which are raised through the issue of securities and accordingly their lending rates. Changes in non-bank financial institutions' lending rates affect commercial bank rates as they compete in the same market. The RBF Notes provide an alternative investment avenue for investors, as the latter can park their funds in. Therefore, commercial banks would find it imperative to offer a competitive rate for attracting/retaining depositors. Thus, changes in PIR are transmitted to changes in deposit rates. Lending rates are thereafter adjusted in order for banks to maintain the interest rate spread between lending and deposit rates.

discount rate, at which commercial banks can borrow from RBF known as minimum lending rate (MLR), is linked to the policy indicator interest (PIR). The MLR is normally fixed at 50 basis points above PIR. Thus, changes in the PIR are automatically reflected in the MLR.

2.3 Limitations of applicability of transmission channels

Fiji's under-developed money and capital markets with limited financial assets, limit the effectiveness of monetary policy transmission mechanism acting through various channels. Commercial banks in Fiji dominate the financial sector, since the non-bank financial sector (stock market, debt securities market, mortgage market and insurance market) is still in its infancy. Its financial sector with only a few participants is not deep enough to absorb debt instruments and equities. Furthermore, there is no vibrant secondary market, in which these financial assets could be traded with ease and speed. Thus, there are obvious limitations to the efficient functioning of the interest rate channel.

The balance sheet approach presupposes that financial assets are important constituents of firms'/consumers' portfolios and assumes the existence of convertibility between illiquid (consumer durables) and liquid (financial) assets. Fiji's money and capital markets have not attained such a degree of sophistication that would enable it to function as an efficient conduit for monetary policy. As regards the asset price channel mechanism and its variants of Tobin's *q* theory (valuation of equities) and Modigliani's wealth and consumption model, an important precondition, namely presence of financial assets constituting a key component of borrowers' and wealth holders' portfolios does not exist in Fiji.

The exchange rate channel transmission mechanism for its full efficiency presupposes a floating regime as well as the condition that financial assets are perfectly substitutable and desirable from the point of view of foreigners. Since Fiji follows a fixed exchange rate regime[4] with adjustable pegs from time to time, together with imperfect substitutable nature of Fiji's financial assets with exchange controls still in place, the exchange rate transmission mechanism is ruled out.

The official view of RBF is that demand for money is unstable. Since 1997, the monetary authority began to target interest rate under the belief that transmission of monetary policy is envisaged to be mainly through the interest rate channel.[5] The RBF's stand that demands for money was unstable was examined by various studies on demand for money. Notable among them are Rao and Singh (2005, 2006) and Jayaraman and Ward (2000). In their most definitive study, Rao and Kumar (2007)

[4] The Fiji dollar is pegged to a basket of the US, Australian and New Zealand dollars, the euro, and the Japanese yen. The weights are based on a 3-year moving average of Fiji's direction of trade, which are reviewed annually but not published. The exchange rate is currently allowed to move within the existing band from ±0.07%, which was once reportedly considered to be expanded to ±2%.

[5] There are three main stages identified by RBF (2007b) in the transmission mechanism: (1) the flow on of changes in short-term money market interest rates to other interest rates in the economy, particularly commercial bank lending and deposit rates; (2) the effects of changes in economic activity; and (3) the effects of economic activity on inflation and foreign exchange reserves.

established that since demand for money was stable in Fiji, RBF should use money supply as an instrument of policy.

3 Modelling, methodology and results

3.1 Data constraints

Since Fiji's national income data series are available on a consistent basis only from 1970, we are constrained to restrict the empirical study to a 37-year period: 1970–2006. In the absence of quarterly national income data series as well as quarterly data on any proxy variable such as industrial/agricultural production, our study has to employ only annual GDP figures.[6] As observed by Rao (2007), empirical studies on developing countries have to recognise the limitations imposed by the small size of the available number of annual observations.[7] Keeping in view the degrees of freedom needed for a meaningful analysis, we now proceed to model the transmission mechanism confining to four variables.

Since the short-term interest rate is endogenously determined in the event of including monetary aggregate in the estimation procedure, we decided to focus on one of the two variables, either monetary aggregate or short-term interest rate. The policy indicator interest (PIR) data series are available only from 1989. Since changes in PIR, which signifies RBF's monetary stances are transmitted to MMR, whose data series is available from 1970 onwards, we choose MMR to represent PIR.

The monetary aggregate chosen is narrow money (M1) rather than broad money. As noted by a recent study on New Zealand (Haug et al. 2003), holding of liquid assets in a developing country plays a much larger role in the transmission of monetary policy.[8]

Besides the two variables, in the context of the fixed exchange rate regime, we decided to consider exchange rate as one of variables, as the monetary policy is clearly anchored to it. The exchange rate (E) refers to the domestic currency (Fiji dollar) units per unit of foreign currency (US dollar). The reason for using the nominal exchange rate is that we can isolate changes in the nominal exchange rate on real economic activity separately from changes in prices, since the real exchange rate is already adjusted for changes in prices and using this variable would make it difficult to isolate price changes (inflation) from exchange rate changes (Dabla-Norris and Floerkemeir 2006). Since the final policy goals are output (RGDP) and price level (PRICE).

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[6] We ruled out the alternate method of employing quarterly estimates of annual GDP obtained through interpolating annual GDP data by various available procedures including cubic spline, since the inferences based on such quarterly estimates of GDP are not likely to be robust enough for policy making purposes.

[7] In a VAR analysis, if number of variables is k and number of lags is m, we then have to estimate parameters numbering, $k(k \cdot m + 1)$ or $k^2 \cdot m + k$.

[8] We also tried broad money (M2) instead of M1, but found that the results were not sensible.

Table 2 Unit root tests

Variable	ADF test		Ng and Perron MZ test	
	Level (constant with trend)	First difference (constant without trend)	Level (constant with trend)	First difference (constant without trend)
logRGDP	−3.31 (1)	−7.62[a] (0)	−7.39 (0)	−17.41[a] (0)
logM1	−2.83 (2)	−8.14[a] (0)	−15.47 (0)	−16.98[a] (0)
logMMR	−2.63 (0)	−3.96[a] (1)	−13.65 (0)	−17.36[a] (0)
logE	−2.81 (1)	−4.38[a] (0)	−15.26 (1)	−16.80[a] (0)
logPRICE	−2.32 (0)	−5.21[a] (0)	−4.06 (0)	−8.41[a] (0)

The ADF critical value at 5% level is −2.9640 and −3.5629 for constant without trend and constant with trend regressions, respectively. These critical values are based on Mckinnon. The optimal lag is selected on the basis of Akaike Information Criterion (AIC). The Ng and Perron critical value is based on Ng and Perron (2001) critical value and the optimal lag is selected based on Spectral GLS-detrended AR based on SIC. The null hypothesis of the test is: a series has a unit root. The figures in *brackets* denote number of lags

[a] The rejection of the null hypothesis at the 5% level of significance

The data sources employed in the model, covering a 37-year period (1970–2006) are drawn from three sources. The data sources for real GDP are Government of Fiji (2007) and RBF (2007a); and the data source for M1, MMR, E and PRICE is International Monetary Fund (IMF) (2007). All four variables were duly transformed into logarithmic form for regression analysis and entered into vector autoregressive (VAR) framework to calculate the variance decomposition at forecast horizons of 1 through 10 years as well as undertake impulse response analysis. The ordering is set as follows: logM1, logMMR, logE, logPRICE and logRGDP.[9]

In regard to the ordering of the variables, if there is no contemporaneous feedback from the non-policy variable to the policy variable, it is theoretically sound to place the policy variable first in the recursively ordered system. If the contemporaneous correlation among the shocks in the reduced-form VAR is high (Ahmed 2003), ordering becomes a matter of concern.

4 Results and interpretation

4.1 Unit root tests

The empirical study begins investigation into the time series properties of each variable used in the study. A number of unit root tests are used to examine the order of integration of the series under study. The results are shown in Table 2. They include Augmented Dickey–Fuller (ADF) test and Ng–Perron MZ test, which is based on the null hypothesis that a unit root exists in the autoregressive representation of the time series. As reported in Table 2, all variables at level are

[9] Other orderings were also tried but the results were not sensible.

non-stationary. However, the series in first differences are stationary as both ADF and Ng and Perron unit root tests indicate that logM1, logMMR, logE, logPRICE and logRGDP are integrated of order one.

4.2 Cointegration tests

We then proceed to investigate the existence of any long-run relationship between the variables by checking whether the variables are cointegrated; that is, if there exists a linear combination of them that is stationary. The results of the multivariate cointegration analysis following Johansen and Juselius (1990) are shown in Table 3.

As can be seen from Table 3, both the trace and the maximum eigenvalue statistics confirm the existence of a long-run relationship between logM1, logMMR, logE, logPRICE and logRGDP

$$\begin{aligned} \log \mathrm{RGDP} &= 1.968 + 0.643\ \log \mathrm{M1}^{**} - 0.036\ \log \mathrm{MMR} \\ &\quad - 1.015\ \mathrm{E}^{***} - 0.001\ \log \mathrm{PRICE} \\ t &= \quad (3.079) \quad (-0.284) \quad (-6.893) \quad (-0.008) \end{aligned} \tag{1}$$

** and *** denote significance at 5 and 1% levels, respectively.

The estimates of the long-run parameters have the theoretically expected, correct signs. While the coefficients of logE and logM1 are found statistically significant at the 5% level (Panel II, Table 3), the coefficients of both logMMR and logPRICE are not significant. The magnitudes of long-run elasticities range from 0.001 (in regard to PRICE) to 1.015 (in regard to E). Overall, the regression results in Table 3 are acceptable, as they pass the diagnostic tests against serial correlation, heteroscedasticity, functional form misspecification (RESET) and non-normal errors.

Unit root tests showed that although the variables in levels are of I (0), in their first differences they are of I (1). Further, they are also found to be cointegrated. We, therefore, estimate a vector error correction model (VECM) for purposes of variance decomposition and impulse response analysis.[10] The variables entered are in the order: logM1, logMMR, logE, logPRICE and logRGDP.

4.3 Granger causality tests

The VECM procedure also enables us to check Granger causality among the variables both in the short-run and long-run. We search for a parsimonious specification by using the variable deletion tests and by deleting the variables with insignificant coefficients to get the final short-run dynamic equations. Since our interest centres around the impact of monetary policy changes on output and price

[10] We are grateful to Professor Gary Koop for guidance on this point (personal correspondence). Haug et al. (2003) in their study on monetary policy transmission mechanism in Australia and New Zealand resorted to VECM specifications, rather than levels of VAR on the ground that the latter procedure would produce poorly estimated impulse response paths in finite samples, as borne out by the Monte Carlo results of Phillips (1998).

Table 3 Results of Johansen and Juselius multivariate procedure (VAR with 2 lags)

Panel I: Variables: logRGDP, logM1, logMMR, logE, logPRICE

Sample period: 1970–2006 (27 observations)

Hypothesis	Maximum eigenvalue		Trace	
	Test statistic	95%	Test statistic	95%
$P = 0$	35.942	33.876	71.357	69.818
$P \leq 1$	20.238	27.584	35.414	47.856
$P \leq 2$	11.544	21.131	15.176	29.797
$P \leq 3$	3.072	14.264	3.631	15.494
$P \leq 4$	0.559	3.841	0.559	3.841

Panel II: Cointegration estimates

logRGDP	logM1	logMMR	logE	logPRICE
−1.00	0.643**	−0.036	−1.015***	−0.001
	(3.079)	(−0.284)	(−6.893)	(−0.008)

Panel III: Diagnostic checking

VEC residual serial correlation LM tests

Lags	LM-Stat
1	23.327 [0.5585]
2	23.397 [0.5544]
3	11.308 [0.9913]
4	25.992 [0.4080]

VEC residual heteroskedasticity tests: $\chi = 330.247$ (0.4858)

VEC residual Jarque–Bera normality test: $\chi^2 = 17.950$ (0.058)

** Significant at 5% level and *** significant at 1% level

VAR specification: lag-length 2

Critical values of trace and maximum eigenvalue according to Osterwald-Lenum (1992)

Values in *bracket* [] are probability value of the test statistics

Values in *parentheses* () are *t* value of the test statistics

Jarque–Bera test, null hypothesis: normal residuals; Breusch–Godfrey serial correlation LM tests, null hypothesis: no autocorrelation; and heteroskedasticity tests, null hypothesis: no heteroskedasticity

level, we present the results of the parsimonious VECM equation results in regard to logRGDP (Table 4) and logPRICE (Table 5).

The error correction term (ECT) in the Equation with RGDP is statistically significant at the 5% level for Eq. 1, indicating the presence of a long-run causality linkage running from logM1, logMMR, logE and logPRICE to logRGDP. The coefficient of ECT, which measures the speed of adjustment at which RGDP would adjust to changes in M1, interest rate, exchange rate and price before converging to their equilibrium level, has the correct sign, implying that the series is non-explosive and that long-run equilibrium is attainable. The estimated coefficient of

Table 4 Results of parsimonious vector error correction model for real output (logRGDP)

Panel I: Estimated model

Variable	Coefficient	t Statistic
ECT(1)	−0.196	−2.215**
D[logRGDP(−2))	0.698	2.768**
D[logM1(−1)]	−0.095	−1.102
D[logM1(−2)]	−0.143	−1.719
D[logM1(−4)]	−0.225	−2.164*
D(logMMR)	0.033	1.425
D[logMMR(−1)]	−0.100	−3.529***
D[logMMR(−2)]	−0.092	−2.777**
D[logMMR(−4)]	−0.111	−3.839***
D[logMMR(−5)]	−0.034	−1.617
D[logE(−1)]	0.234	1.816*
D[logE(−2)]	0.218	1.521
D[logE(−3)]	0.366	3.029**
D[logE(−4)]	−0.226	−1.662
D[logPRICE(−1)]	0.563	1.414
D[logPRICE(−2)]	−0.811	−1.783
D[logPRICE(−4)]	0.804	3.163***
D[logPRICE(−5)]	0.246	1.122
Intercept	−0.034	−1.300

Panel II: Wald test for RGDP equation (*F* statistics)

logM1	logMMR	logE	logPRICE
2.707*	5.329***	3.873**	5.262**

Panel III: Diagnostic checking

Jarque–Bera normality test	0.5350 [0.7653]
Breusch–Godfrey serial correlation LM test	0.2544 [0.1417]
ARCH test	0.1641 [0.6885]
Ramsey RESET test	2.6526 [0.1344]

*, ** and *** the rejection of the null hypothesis at the 10, 5 and 1% levels of significance, respectively

ECT (−0.196) for RGDP, indicates speed of adjustment to reach the equilibrium following a shock. In other words, about 19.6% of disequilibrium of the current year's shock converges and is eliminated within a year and the economy returns to long-run equilibrium within 5 years. In the short-run dynamics, the Wald tests (Panel II, Table 4) confirm the existence of Granger causality relationship running from logM1, logMMR, logE and logPRICE to logRGDP as well.

Referring to parsimonious VECM equation results in regard to logPRICE (Table 5), we observe that the error correction term is significant at 5% significance level, confirming the presence of long-run relationship running from logM1, logMMR, logE

Table 5 Results of parsimonious vector error correction model for price (logPRICE)

Panel I: Estimated model

Variable	Coefficient	*t* Statistic
ECT(1)	−0.191	−2.908**
D[logRGDP(−1)]	0.848	5.795***
D[logRGDP(−2)]	0.502	3.806***
D[logGDP(−3)]	0.290	3.308**
D[logM1(−1)]	−0.213	−4.193***
D[logM1(−2)]	−0.256	−4.300***
D[logM1(−3)]	−0.414	−6.005***
D[logM1(−4)]	−0.326	−4.867***
D[logMMR)	−0.031	−2.301*
D[logMMR(−1)]	−0.091	−4.300***
D[logMMR(−2)]	−0.134	−5.458***
D[logMMR(−3)]	−0.114	−−5.030***
D[logMMR(−4)]	−0.096	−4.274***
D(logE)	0.443	5.531***
D[logE(−1)]	0.322	3.921***
D[logE(−2)]	0.189	2.513**
D[logE(−3)]	0.185	2.360*
D[logE(−4)]	0.206	3.842***
D[logE(−5)]	0.267	3.950***
D[logPRICE(−1)]	0.919	6.659***
D[logPRICE(−3)]	0.637	3.897***
D[logPRICE(−4)]	0.565	4.207***
Intercept	−0.068	−3.843***

Panel II: Wald test for RGDP equation (*F* statistics)

logRGDP	logM1	logE	logMMR
12.492***	9.489***	6.403**	6.827**

Panel III: Diagnostic checking

Jarque–Bera normality test	0.4595 [0.7947]
Breusch–Godfrey serial correlation LM test	1.3678 [0.2865]
ARCH test	0.3235 [0.5741]
Ramsey RESET test	0.2126 [0.6609]

*, ** and *** The rejection of the null hypothesis at the 10, 5 and 1% levels of significance

and logRGDP. In the short-run, all variables are either significant at the 5 or 1% levels (Panel II, Table 5), suggesting the presence of a short-run Granger causality relationship running from logRGDP, logE, logMMR and logM1 to logPRICE. The model does not show evidence of non-normality, autocorrelation or heteroscedasticity.

4.4 Variance decomposition of RGDP

We calculate the variance decomposition of logRGDP and logPRICE at forecast horizons of 1–10 years. While 1 year would denote the short run, 2–5 years represent the medium term, while 5 years ahead is the long-run. VAR for each variable was estimated, which included 1 lag. The results are reported in Tables 6 and 7, respectively for logRGDP and logPRICE, indicating the percentages of variance of the variable forecast as attributable to each variable at a 10-year horizon. The first column lists the years ahead, whereas the second column refers to standard error (SE), which is the forecast error of the variable at different years. Variables were ordered in the same way they appear in the table. That is, the third column refers to logM1, the fourth column logMMR, the fifth column logE, the sixth column logPRICE and the last column logRGDP.

The results indicate that most of the forecast error variance in real GDP can be explained by its own shocks, especially in the short-term. The impact of a shock in

Table 6 Variance decomposition of output (logRGDP)

Period	SE	logM1	logMMR	logE	logPRICE	logRGDP
1	0.0394	1.9659	2.8108	16.0984	0.0000	79.1249
2	0.0480	5.2013	9.5909	17.8540	0.9794	66.3744
3	0.0536	6.4161	9.2053	17.3804	1.2988	65.6994
4	0.0591	9.7239	10.1530	16.7365	1.6079	61.7788
5	0.0636	12.4777	11.2938	15.9907	1.9775	58.2603
6	0.0680	15.5387	12.2345	15.1632	2.2827	54.7808
7	0.0722	18.4830	13.2861	14.3324	2.5872	51.3114
8	0.0762	21.2895	14.2066	13.5302	2.8592	48.1144
9	0.0802	23.9291	15.0727	12.7700	3.1069	45.1214
10	0.0840	26.3643	15.8545	12.0639	3.3301	42.3872

Cholesky Ordering: logM1 logMMR logE logPRICE logRGDP

Table 7 Variance decomposition of log price

Period	SE	logM1	logMMR	logE	logPRICE	logRGDP
1	0.0274	5.8521	9.2791	12.2003	65.4978	7.1707
2	0.0416	5.0061	6.6250	13.3475	62.2939	12.7275
3	0.0553	10.7925	6.8744	12.4665	53.4926	16.3740
4	0.0700	14.7912	8.1309	12.3866	43.0553	21.6360
5	0.0849	18.2308	8.6409	12.5815	35.3505	25.1963
6	0.1002	20.8534	9.0995	12.7045	29.3365	28.0061
7	0.1155	22.8180	9.3704	12.8322	24.8796	30.0999
8	0.1306	24.3461	9.5597	12.9165	21.4996	31.6781
9	0.1455	25.5278	9.6919	12.9793	18.8998	32.9012
10	0.1600	26.4671	9.7845	13.0242	16.8671	33.8571

Cholesky ordering: logM1 logMMR logE logPRICE logRGDP real GDP to its own future values is around 79.12% in the near term, but decreases to 42.38% in the long-term (10th year). While the impact of interest rate on RGDP is around 2.81% in the short-run and around 15.85% in the long-run, the impact of M1 on RGDP increases from 1.96% in the 1st year and achieves its peak by the 10th year. In the long run M1 accounts for approximately 26.36% of the variance in real GDP. The exchange rate shock is important in explaining the variation in real GDP which accounts for about 16% in the short- and medium-terms, but the influence of the shock is decreasing in explaining the real output variability compared to the role of price in the long-run (around 12% of the variation in output).

4.5 Variance decomposition of PRICE

From Table 7, we observe that the impact of shock in monetary aggregate (logM1) on variability in price is relatively low (it fluctuates from 5 to 14% in the first 4 years) while its longer term impacts explain about 18–26% of the forecast error variance of price. The influences of interest rate (MMR) and exchange rate to price are quite small over the short-, medium- and longer-term, overall less than 13% over the period. Price is mostly explained by its own shock in the short- and medium-terms. The own shock accounts for 65.49% in the 1st year, decreases to 43.05% in the 4th year, and the impact continues to decline to 16.86% in the long-term. Although the variation in price that can be explained by RGDP is low (around 7%) in the short-term, the variation in RGDP is increasing over the period, beginning from 12% in the 2nd year to 33.85% in the 10th year.

4.6 Correlation matrix of reduced-form VAR residuals

With a view to testing the robustness of the VAR results, which would vary based on different orderings of the variables, we tested the correlation of reduced-form VAR residuals. Table 8 presents the correlation matrix of the reduced-form VAR residuals based on the ordering of variables, which were entered into VAR. The elements of the correlation matrix between the variables and the rest of the system are low, indicating that the contemporaneous feedback is not a problem. These correlations suggest that the ordering of the variables in a Choleski decomposition is not of any major concern.

Table 8 Correlation matrix of reduced-form residuals

	logM1	logMMR	logE	logPRICE	logRGDP
logM1	1	−0.5388	−0.0760	0.2457	0.3403
logMMR		1	−0.1460	−0.3288	−0.1686
logE			1	0.1803	−0.2674
logPRICE				1	−0.1185
logRGDP					1

4.7 Impulse response function

Impulse responses are depicted in Figs. 1 (logRGDP) and 2 (logPRICE). In Fig. 1, a shock to monetary aggregate (logM1) has positive impact on output (logRGDP) not only in the short-run, but also in the long-run. Further, the responses of logRGDP to other channels such as interest rate (logMMR), exchange rate (logE), and price (logPRICE) initially exhibit a negative pattern, but they eventually die out in the long-term.

In Fig. 2, it is seen that price responds to monetary aggregate (logM1) shock in a positive and steady manner in the short-term, increasing both in the medium- and

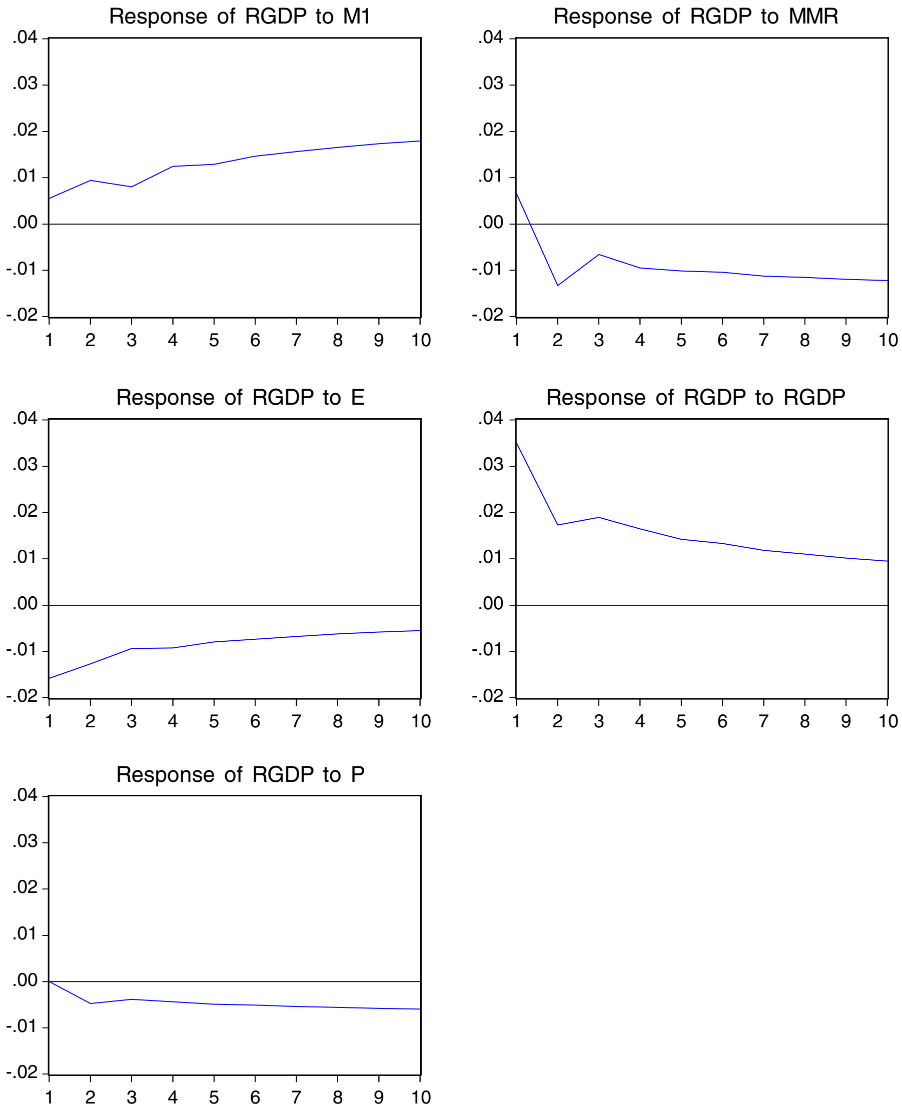

Fig. 1 Response of output (logRGDP) in Fiji

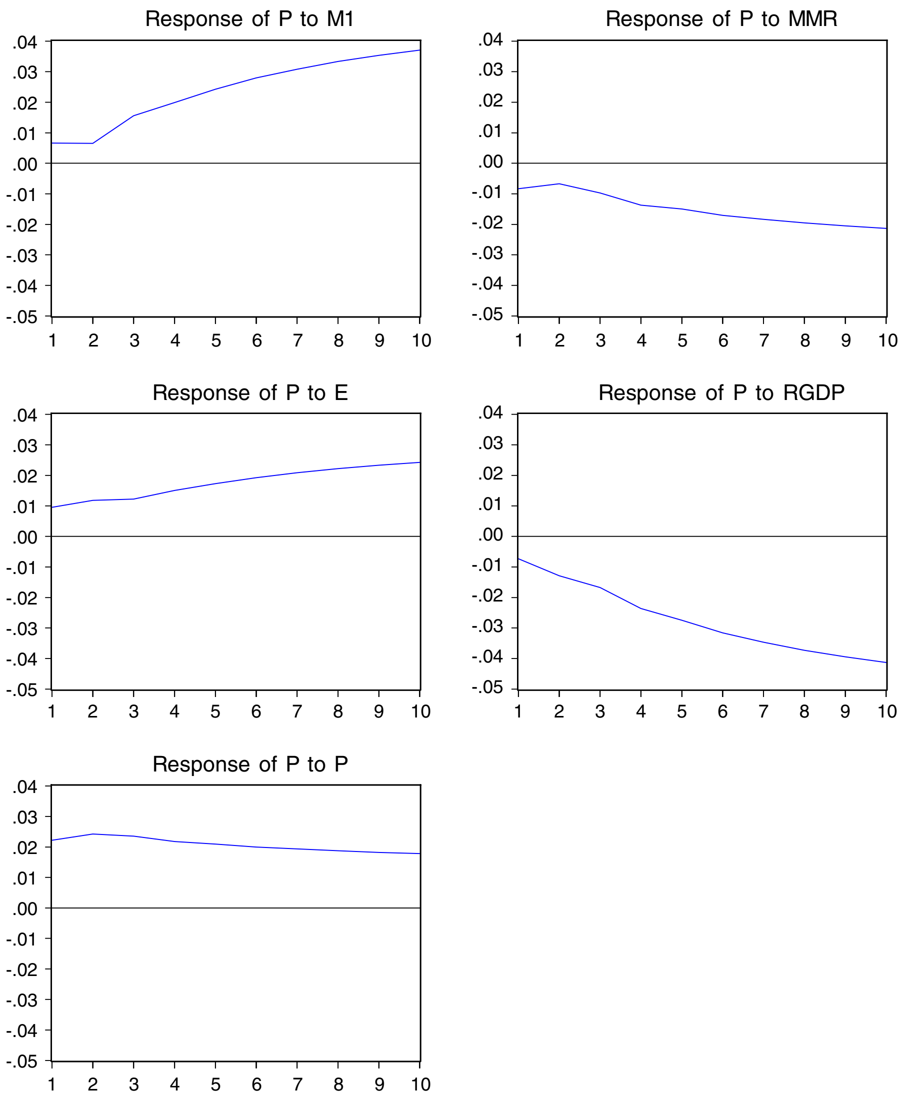

Fig. 2 Response of price (logPRICE) in Fiji

long-terms. Price response to a shock in real GDP and exchange rate is the least over the period while interest rate responds negatively in the 1st year and thereafter the response is positive and remains so until the shock dies out.

5 Conclusion and policy implications

This paper undertook a study of monetary policy transmission mechanism in Fiji. Utilising annual observations over a 37-year period (1970–2006), the study focussed on five variables. Among the five variables, there were three policy variables namely, monetary aggregate represented by M1, exchange rate, and interest rate represented by money market rate; and two monetary goal variables were output and price level. As the unit root tests showed that all the five variables were found to be integrated of order one, further cointegration tests were conducted, which revealed the existence of one cointegrating vector. In the only one cointegrating vector with output as dependent variable, only two of the three monetary policy variables were found to be statistically significant in the long-term relationship. The two significant variables were monetary aggregate and exchange rate, while interest rate was not significant.

As the variables were cointegrated, a vector error correction model was constructed to determine the long-run and short-run causality relationships. In the equation with output as dependent variable, the error correction term, which was found significant with the appropriate negative sign, confirmed the causality linkage running in the long-run from all the monetary variables to output. The tests for short-run causality also confirmed the presence of causality relationship running from all the three monetary policy variables to output. Similar were the findings in regard to price. Both in the long- and short-runs, we find the existence of long-run Granger causal linkage running from all the three monetary policy variables and of short-run Granger causal linkage relationship running from each of the three monetary variables to price.

However, the relative impact of change in monetary variables on output is better gauged by variance decomposition and impulse response analyses. The impact of changes in monetary aggregate on output is much higher than the impacts of changes in interest rate and exchange rate on output in the medium- and long-terms, although in the short- run the impact of changes in interest rate on RGDP was higher. As regards impact on price, changes in monetary aggregate have a greater impact on price than those in interest rate and exchange rate. Overall, the results of variance decomposition and impulse response function are fully consistent with the cointegration and Granger causality test within a VECM framework.

The conclusions are clear: in Fiji, the money channel has had a larger impact on output than the interest rate channel. In regard to the price level, the money channel exhibited far greater influence than the interest rate. These conclusions and findings are similar to the findings arrived at by various studies on small, developing economies where money and capital markets are at nascent stages of development that the interest rate channel has been found to be less effective. These conclusions have policy implications. In Fiji, money and capital markets are still at rudimentary stages with very few securities. These markets are shallow and not deep enough to absorb them. The interest rate channel transmission mechanism is weak, as borne out by the study findings. It is, therefore, recommended that monetary authorities target monetary aggregate as a policy variable for effective monetary policy implementation.

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