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Role of Money in Pacific Island Countries

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Abstract

There has been a general consensus among economists that while the long-run effects of money are felt only on prices with no impact on real variables, monetary policy changes do have important short-run effects on real variables. The objective of the paper is to investigate whether money has played any significant part in output growth as well as determination of prices in five Pacific island countries (PICs) under fixed exchange rate regimes, namely Fiji, Samoa, Solomon Islands, Tonga and Vanuatu. After applying bound test, Granger causality test, variance decomposition and impulse response function analyses, we find that broad money (M2) has a short-run as well as long-run causal relationship with both output and prices in all PICs.

Keywords: Real output, money, prices. bounds testing approach, causality

1. Introduction

Out of the 14 Pacific island countries[1] (PICs), which achieved political independence during the second half of the last century, eight are dollarised[2] with one of the three currencies of the metropolitan countries in the region. The remaining six PICs have their own independent currencies. Five of them have fixed exchange rate regimes. They are Fiji, Samoa, Solomon Islands, Tonga, and Vanuatu, whereas the sixth country, Papua New Guinea has a floating exchange rate arrangement since 1994. This paper deals with the five PICs under fixed exchange rate regimes. In the context of exchange controls in place restricting capital mobility, it is expected that monetary policy could be effectively pursued.

Limited availability of time series of data on a consistent basis, since national accounts data of most of the PICs were compiled only from the 1980s, has been the reason for the absence of quantitative studies on the causal relationship between money and output and other macroeconomic variables. The present study seeks to fill the gap by attempting at quantitative analyses through bounds testing approach, which does not require large sample size data as well as other stricter requirements of order of integration of variables employed.

The paper is organized as follows: Section 2 provides a background of the selected PICs; Section 3 is a short summary of the theoretical contributions to the subject of relationship between money and output, reviewing the past empirical studies on the subject of relationship between money and output; Section 4 deals with the methodology adopted for the empirical analysis; Section 5 reports the results; and the sixth and final Section presents conclusions with policy implications.

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[1] The 14 PICs are: Cook Islands, Fiji, Kiribati, Marshall Islands, Federated States of Micronesia, Nauru, Niue, Palau, Papua New Guinea, Samoa, Solomon Islands, Tonga, Tuvalu and Vanuatu. These 14 PICs, together with two metropolitan countries, namely Australia and New Zealand form the regional inter-governmental organization, known as Pacific Islands Forum (the Forum).

[2] The eight dollarized economies, using one of the three major currencies as legal tender, are: Kiribati, Nauru, and Tuvalu (Aus $); Cook Islands and Niue (NZ $), Marshall Islands, Federated States of Micronesia and Palau (US $).

2. A Background

The five PICs, whose selected key indicators are given in Table 1, share many commonalities amongst themselves. Barring Fiji, which has some manufacturing base, all of them are heavily subsistence oriented, dominated by agriculture and fisheries. Because of the communal land tenure system, which is unique to all Pacific islands in terms of the inalienable nature of communally held land to any private individual for land based activities, the development in the private sector has been seriously hampered. The commercial banks find it difficult to lend in the absence of land as collateral.

Table 1: Key Economic and Social Indicators of Pacific Island Countries

Countries	**Population ('000) 2006**	**Area ('000) Sq.km**	**Per Capita GDP (US$) 2006**	**Human Dev Index Ranking (2006)**
Fiji	853	18.3	3,306	103
Samoa	186	2.8	2,227	96
Solomon Islands	489	28.9	684	134
Tonga	102	0.7	2.176	85
Vanuatu	215	12.2	1799	123

Source: World Bank (2007); AusAid (2008)

All the five PICs, which are the focus of our study, have adopted fixed exchange rate regimes[3]. Being small countries with no mineral resources and limited land resources for commercial agriculture, they are heavily dependent on imports ranging from food and beverages, to fuel and capital and transportation machinery and equipment. Further, their range of exports is narrow and is dominated by sugar and garments until recently in the case of Fiji, and copra, fisheries and timber in the case of other four PICs. In these circumstances, their fixed exchange rate regimes have served them well. Since most of

[3] While the currencies of Fiji, Samoa, and Vanuatu are pegged to a basket of currencies of major trading partners, the exchange rate regime of Solomon Islands dollar is a crawling peg and Tonga's is within horizontal band of plus or minus 5 percent (IMF 2007, 2008).

the imports have been sourced from Australia and New Zealand, whose monetary policies have been targeting inflation, inflation in the PICs has been kept low.

The financial sectors in the five selected PICs comprise, besides a central bank and government owned national provident fund institutions with the exception of Tonga, which does not have any pension fund; government owned development banks (except in Vanuatu); and commercial banks (five in Fiji: four of them being foreign owned and the fifth one a joint venture; four in Samoa: two of them foreign owned and the other two domestic owned; three in Solomon Islands: two being foreign owned and a locally owned private bank; three in Tonga: three commercial banks, all foreign owned; and three in Vanuatu: a government-owned bank, the other two being foreign owned) and a number of insurance companies and several smaller financial institutions.

Vanuatu stands out as a unique country among the PICs. It has no exchange controls of any kind and there are no currency restrictions. Its citizens and residents are permitted to hold their deposits with commercial banks in foreign currencies. Further, the country has no direct taxes of any kind, on its citizens or resident expatriates and business enterprises. Its offshore financial center (OFC) institutions, inherited from the pre-colonial days, thus enjoy a pure tax haven status and they include 24 banks with offshore banking licenses, and 16 insurance companies. However, Vanuatu's OFC institutions are not allowed to accept local deposits from, or make loans to, residents in Vanuatu. As there are restrictions on the ability of the offshore banks to deal in domestic currency and to do business with the domestic institutions, the commercial banks play a dominant role in the domestic financial system and the offshore banks have no direct impact on the conduct of monetary policy[4].

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[4] However, one cannot rule out the possibility of indirect impact of the activities of the offshore banks on monetary conditions. The funds received from nonresidents are usually deposited with one of the domestic banks, which in turn, deposit the funds with banks abroad, primarily with their European or Asian offices. However, a small segment would leak into the domestic system, which then would become part of the money supply. Domestic banks do make loans in foreign currency to local businesses and residents, but amount of foreign currency loans is small (IMF 2004).

Table 2 presents monetary statistics of the five PICs. The monetary aggregates, shown as percentages of GDP follow the conventional definitions, except in the case of Vanuatu. While for four PICs namely, Fiji, Samoa, Solomon Islands, and Tonga, narrow money (M1) consists of currency held by the public outside the banks and demand deposits and broad money comprises M1 plus savings and time deposits, M1 for Vanuatu consists of currency (vatu) and demand deposits in vatu, broad money consists of M1 and demand deposits in foreign currency and savings and time deposits in both vatu and foreign currency.

Banking activities are largely confined to urban centres, in which formal sector activities are concentrated, the deepening process of financial sector over the period, as reflected in the ratios of narrow and broad money, has been slow. As PICs lack vibrant bond and equity markets, there are no other attractive financial assets other than saving and time deposits for savers to invest in. Following liberalisation of the economy in general and financial sectors, with discontinuance of controls on lending and deposit rates from the late 1980s in Fiji, and other countries, since the mid 1990s, the ratio of broad money to GDP has been on the rise. It has been in the range of 50 percent to 60 percent, while Vanuatu’s broad money has been a close 200 percent of GDP.

Monetary policy objectives of central banks with fixed exchange rate regimes in PICs are very similar to each other: maintaining stability of domestic currency and exchange rate stability. The former means stable price level (acceptable inflation of 3 percent per annum) and the adequate level of international reserves (3 to 4 months of imports equivalent). All the central banks have discontinued direct controls on credit and interest rates All the central banks of five PICs have imposed statutory reserve deposit requirements of certain percentages. However, only Fiji’s central bank, the Reserve Bank of Fiji (RBF) remunerates the commercial banks for their statutory reserve deposits with the central bank, (which do not include excess reserves), at the prevailing policy indicator rate, which is the yield to maturity of its own 91- day securities.

Table 2: Output and Monetary Statistics in Selected PICs

	Output Growth (%)	Inflation (%)	Interest Rate (%)	Exchange Rate (US$/Dom Currency)	M1 (% of GDP)	M2 (% of GDP)
Fiji						
1970-79 (Ave)	5.6	11.0	9.7	1.2	16.2	34.8
1980-89 (Ave)	1.3	7.5	13.9	0.9	12.5	44.7
1990-99 (Ave)	2.9	4.2	11.1	0.6	15.2	52.7
2000-04 (Ave)	2.0	2.6	7.9	0.5	18.5	42.3
2005	0.7	2.4	6.8	0.6	24.6	51.6
2006	3.6	2.5	7.4	0.6	21.5	56.6
2007	-3.9	4.8	9.0	0.6	29.7	60.2
Samoa						
1983-89 (Ave)	2.0	9.0	36.2	0.5	9.5	25.3
1990-99 (Ave)	1.4	4.8	12.4	0.4	12.0	34.9
2000-04 (Ave)	3.3	5.9	11.3	0.3	13.6	45.4
2005	6.0	1.8	11.4	0.4	16.1	48.4
2006	1.8	3.7	11.7	0.4	16.1	52.2
2007	3.0	5.6	12.7	0.4	15.6	53.3
Solomon Islands						
1980-89 (Ave)	7.4	12.5	13.3	0.8	12.2	30.1
1990-99 (Ave)	2.9	10.7	16.2	0.3	14.2	28.5
2000-04 (Ave)	-2.1	8.2	14.5	0.2	15.9	26.6
2005	5.0	7.3	14.1	0.1	24.0	38.5
2006	6.2	11.2	13.9	0.1	27.5	42.6
2007	5.4	7.7	14.1	0.1	32.9	49.0
Tonga						
1980-89 (Ave)	2.3	9.6	10.2	0.8	13.3	31.2
1990-99 (Ave)	2.0	4.5	11.6	0.7	12.8	35.9
2000-04 (Ave)	2.9	9.5	11.4	0.5	15.1	45.9
2005	2.3	8.3	11.4	0.5	15.3	50.5
2006	1.3	6.4	12.0	0.5	13.5	49.4
2007	-3.5	5.9	12.2	0.5	16.6	54.9
Vanuatu						
1980-89 (Ave)	8.8	8.8	16.7	0.0	39.9	219.0
1990-99 (Ave)	5.1	3.2	13.6	0.0	31.1	218.0
2000-04 (Ave)	0.6	2.5	7.9	0.0	30.2	191.6
2005	6.8	1.2	7.5	0.0	34.5	197.6
2006	5.5	1.9	8.3	0.0	38.7	196.6
2007	4.7	NA	8.2	0.0	39.2	198.0

Source: International Monetary Fund (2008)

The RBF was the first central bank in the region to introduce in 1988 the use of indirect instrument of monetary policy by issuing its own papers of different maturity for mopping up excess liquidity in the system[5] and declaring the yield to maturity of 91-day paper as policy indicator rate. Other central banks followed suit, once Fiji's experiment proved successful. However, the Central Bank of Solomon Islands (CBSI) and National Reserve Bank of Tonga (NRBT) discontinued in early 2000s the open market operations in their own papers, since the expenditures on liquidity management including administrative costs and interest payments happened to be substantial, resulting in overall annual budget losses and the two governments were unwilling to finance their central banks' liquidity management operations. Confronted with a rapid credit growth, Tonga's central bank resorted to administrative measures owing to its inability to support on its own the financial costs that involved a tightening of monetary policy.

Only three central banks, namely RBF, Central Bank of Samoa (CBS) and Reserve Bank of Vanuatu (RBV) have been conducting liquidity management for an uninterrupted period for now more than 10 years by open market type operations in the central bank issued securities[6]. Since the money markets are shallow and not deep enough, with no secondary markets for financial securities, effectiveness of monetary policy measures is seriously hampered.

3. A Brief Literature Review

Relationship between money and output has been the subject of a vigorous debate for a long time. Different schools of thought, ranging from Classical, the Keynesian, the Monetarist, the New Classical, the New Keynesian, and the recent Real Business Cycle (RBC) have discussed the relationship in different ways (Zulkhibri 2007).

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[5] The International Monetary Fund (2004) describes the liquidity management by Fiji's central bank as open market type operations, rather than OMO. The reason is that central bank does not participate in the money market and its operation does not cover buying and selling assets outright in the secondary market, , but rather adopts the auction techniques.

[6] There were no issues of Reserve Bank of Fiji (RBF) Notes since November 2006. Ever since then, RBF has been relying on direct instruments such as credit ceilings to deal with the unprecedented situation following the military coup of 2006.

The Classical school believed that an increase in money supply would result only in a proportionate increase in the price level without any increase in economic activity. Other schools including the recent school of RBC theory, however, have acknowledged that monetary shock, giving rise to an aggregate demand shock, would have a positive effect on real economic activity. Thus, money would lead, rather than lag economic activity.

Although there was a general agreement between the Keynesian, the Monetarist, the New Classical, and the New Keynesian schools that monetary shocks have a positive effect on output, the difference between them was in regard to the nature and the transmission channels of these positive shocks. The Keynesians believed that a positive monetary shock would increase both economic activity and price level through the interest rate and investment variables. The Monetarists led by Friedman, who recognized the Keynesian transmission channel mechanism as a short run phenomenon, however stuck to the Classical stand. The Monetarists believed that monetary expansion would be eventually dissipated in terms of higher interest rates and prices rather than output, which would return to "natural level" as soon as the inflationary expectations have been fully adapted. There would be a proportionate rise in price level, amounting to neutrality of money. Thus, the Monetarists integrated the Keynesian short-run theory with the Classical long-run theory (Mishkin, 2006). The expectation-augmented long-run supply curve, according to them, will be fully vertical, although in the short run it could be upward-sloping, as postulated by the Keynesian (Zulkhibri, 2007).

It was the New Classical School, which introduced the concepts of anticipated and unanticipated monetary expansion. They decomposed monetary effect into output and price effect, not on the basis of short and long run but on whether the monetary expansion is "anticipated" or "unanticipated". Based on the theory of "rational expectations" and equilibrium "efficient market" hypothesis, they argued that only the unanticipated monetary expansion would result in an increase in output, but the anticipated increase in money would be dissipated in inflation; that is, according to them, the expectation-augmented supply curve is vertical both in the short as well as in the long term.

The New Keynesian School, however, based on the hypotheses of rational expectations but disequilibrium inefficient market, postulated non-neutrality of money at least in the short run because of rigidities in prices and wages, and market failures and imperfections. In sharp contrast to these theories, the RBC theory is based on the Classical position that monetary expansion cannot increase real output.

The RBC school takes the view that historical association between money and output is one of money supply endogenously responding (rather than leading) to an increase in output. According to RBC school, the observed money-output correlations are in fact due to "reverse causation", since the banking sector responds to increased demand for transactions by creating more inside money. To them, monetary expansion, whether short or long run, and anticipated or unanticipated, will have no positive effect on output; it will only raise interest rates and the price level. The RBC school, therefore, views money supply as endogenous and it is a function of output that is determined exogenously by factors such as technology or other real "stochastic" shocks.

Empirical studies have focused on the direction of causation on between money and output, which is an important issue for policy makers. Sophisticated empirical models have been devised to examine the implication of anticipated and unanticipated (Barro, 1977), and positive and negative monetary shocks (Cover, 1992; Thoma, 1994) on output fluctuations. While some studies have supported unidirectional causality, running from money to income (Sims, 1972; Devan and Rangazar, 1987), other studies have provided evidence on unidirectional causality, running from income to money (Cuddington, 1981; King and Plosser, 1984). There is also empirical evidence of bi-directional causality between money and output for a number of countries (Hayo, 1999). However, the existing empirical evidence based on testing of causality between money growth and output growth is, at best, mixed and contradictory (Ahmad, 1993; Hayo, 1999).

Further, results vary depending (i) whether the variables are modelled as (log-) level variables or growth rates (Christiano and Ljungquist, 1988) and (ii) whether they are modeled as trend- or difference stationary (Hafer and Kutan, 1997). Christiano and Ljungquist (1988) argue in favour of using level variables, since they find that power of the tests on growth variables is very low. Hafer and Kutan (1997) assert that the variables, which are assumed to be trend stationary, money Granger causes output and if the variables are assumed to be difference stationary, output Granger causes money.

While there has been a large number of empirical studies on linkages between money and economic activity in industrialised countries, there have been a few analyses for Pacific island countries. The main reason appears to be lack of consistent database for meaningful quantitative analyses. Empirical studies have been more concentrated on Fiji, which has a longer time series of data on national accounts[7]. For Fiji, Joynson (1997) examined whether there was any stable relationship between money, income and interest rates. The findings cast doubts on the effectiveness of monetary aggregates. Joynson (1997) also found that a change in income is quickly translated into a change in the demand for money. Katafono (2000) examined the relationship between selected monetary aggregates and inflation and output using simple correlation and Granger causality tests under a VAR framework to examine the leading or lagging role of the monetary aggregates. The results indicated lack of robustness in the relationship between the monetary aggregates and the economic activity variables. More recently, Gokul and Hanif (2004) used Granger causality tests under a VAR framework and found that a weak negative correlation exists between inflation and growth, while the change in output has a significant influence on inflation. The causality between the two variables ran only one-way, from GDP to inflation.

4. Methodology, Variables and Data

Following the procedure adopted by Starr (2005) for examining the role of money, we devise two models: one with output as the target variable and the other with price level as

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[7] Consistency by itself does not ensure quality. As the series are often revised and announced from time to time, their quality and reliability are questioned by researchers from academic institutions (Hughes 2003) and major users, including the Reserve Bank of Fiji (Morling and Williams, 2000).

the target variable. In both models, as we are not sure about the relationship between two target variables and policy variables, we employ all three policy instrument variables in the two models: money, interest rate and nominal exchange rate. To characterize the relationships between monetary-policy variables and both output and prices, we use methodology employed by Sims (1972) and resort to Granger causality tests, which indicate whether lagged values of policy variables are informative for predicting future movements in output and prices.

While the relationships are clear between changes in money and interest rate; between changes in money and price level; and the relationship between changes in money and nominal exchange rate in fixed exchange rate regimes and consequent impact on output and prices deserve some discussion.

If a country adopts a monetary tightening approach, domestic interest rate would rise. Under a floating exchange rate regime, an increase in interest rate would attract an increase in inflows of capital from overseas, which in turn would lead to appreciation of domestic currency and there would be a fall in net exports and output. In a fixed exchange regime, an increase in capital inflows in response to rise in interest rate would lead to rise in money supply and rise in prices, unless the central bank conducts open market operations to absorb the increased money supply to minimize exchange rate fluctuations. Such open market operations aiming at liquidity management would make the initial expansion in money supply redundant and the impact of monetary policy change would not be transmitted to exchange rate in a fixed exchange rate system. If no sterilization takes place, increase in money supply would result in lower interest and higher aggregate domestic demand would spill over into demand for foreign goods and assets, reducing foreign reserves. The adjustment would therefore be through changes in domestic incomes and prices rather than through changes in exchange rate. Exchange rate stability has however been found justified and also considered essential for price stability in Pacific island countries, given the high pass-through of the exchange rate to the price level since more than half of the items on the CPI basket is composed of imported goods.

The exchange rate channel of monetary policy transmission mechanism does not exist under a fixed exchange rate regime. Among the fixed exchange rate regimes, the exchange rate channel will work more strongly the higher the degree of exchange rate variability that the regime would allow. For example, Tonga allows a larger band of nominal exchange rate fluctuation than other four PICs.

Specifically, the variables utilized in our empirical study are real gross domestic product (*RGDP*), either of the two monetary aggregate measures *(M1* or *M2*)[8], consumer price index (*P*), average nominal lending rate (*IR*); and nominal exchange rate (units of US dollar per unit of domestic currency). The annual data for the empirical study are drawn from two sources: the monetary and exchange rate data published by International Monetary Fund (2008) and output data from Asian Development Bank (2008) and UN ESCAP (2008). For the empirical investigation, all the data are expressed in natural logs.

Bounds testing approach

While Fiji's data series cover a longer period (1970- 2007), the data series for other four countries cover a shorter period as their national accounts are available only from the 1980s: Samoa (1982-2007); Solomon Island (1983-2007); Tonga (1980-2007); and Vanuatu (1980-2007). For econometric analysis, all variables are duly transformed into their natural logs. We also add a trend variable[9].

Since the number of observations is not large enough for estimating a long-run money and output model, we resort to the autoregressive distributed lag (ARDL) procedure, developed by Pesaran, *et al*. (2001). The ARDL bounds testing model is a general dynamic specification, which applies lags of the dependent variable and the lagged and contemporaneous values of the explanatory variables, through which the short-run

[8] M1 is the sum of currency in circulation plus demand deposits held with commercial banks by the rest of the domestic economy other than the central bank. M2 is M1 plus savings and time deposits. we tried both M1 and M2 (broad money), alternately representing the monetary aggregate.

[9] Narayan and Smyth (2006) have extensively discussed the inclusion of time trend variable in the estimation.

impacts can be directly estimated, and the long-run relationship can be indirectly estimated.

The conventional cointegration procedures proposed by both the Engle and Granger (1987) residual-based procedure and the Johansen (1988) and Johansen and Juselius (1990) maximum likelihood approach require a testing of unit root to ensure that all series are integrated of order one. Same order of integration is necessary because in the presence of a mixture of I(0) and I(1) regressors, Harris (1995) shows that both trace and maximum eigenvalue tests from the Johansen procedure will be difficult to interpret and generate nuisance parameters. Besides, Rahbek and Mosconi (1999) also demonstrate how I(0) regressors in a Johansen-type framework would generate spurious cointegrating relations with other variables in the model[10].

Bound test with ARDL framework has several advantages: (i) it allows testing for the existence of a cointegrating relationship between variables in levels irrespective of whether the underlying regressors are I(0) or I(1) (Pesaran and Shin, 1999; Pesaran et al., 2001); (ii) it is considered more appropriate than the Johansen-Juselius multivariate approach for testing the long run relationship amongst variables when the data are of a small sample size (Mah, 2000; Tang and Nair, 2002)[11]; (iii) Pesaran and Shin (1999) show that estimators of the short-run parameters are consistent and the estimators of long-run parameters are super-consistent in small sample sizes. Therefore, ARDL model has become increasingly popular in recent years and we begin the empirical analysis with this procedure.

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

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[10] Hassler (1996) provides extensive discussion on the problems of stationary variables in cointegrating regressions.

[11] Some previous studies have used ARDL model to relatively small sample sizes with as few as 20 observations in their research. For example, Pattichis (1999) adapted the ARDL model to estimate an import demand function for Cyprus from 1975 to 1994 (20 observations). Tang (2001) applied ARDL framework to study inflation in Malaysia for the period of 1973-1997 (25 observations) while Tang and Nair (2002) followed the ARDL technique to estimate an import demand function for Malaysia from 1970 to 1998 (29 observations).

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 cointegration by the bounds test proposed by Pesaran et al., the following models are constructed for each country:

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

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

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

For Equation (1):
$H_0 : \beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$ (There is no long run level relationship)
$H_1 : \beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq 0$ (There is a long run level relationship)

For Equation (2):
$H_0 : \delta_1 = \delta_2 = \delta_3 = \delta_4 = 0$ (There is no long run level relationship)
$H_1 : \delta_1 \neq \delta_2 \neq \delta_3 \neq \delta_4 \neq 0$ (There is a long run level relationship)

The distribution of the F-statistics is non-standard under the null and is derived and provided by Pesaran *et al*. (2001). Two sets of critical values are given based on Pesaran, et al. (2001) and Narayan (2005). Narayan and Narayan (2005) and Narayan (2005) show that the use of Pesaran, *et al*. (2001) critical values for small sample study may lead to misleading inferences as the computed critical values are generally lower than those generated by Narayan who used similar GAUSS code provided by Pesaran, *et al.* (2001). Narayan (2005) has generated a set of critical values for small sample size ranging from 30 to 80 observations. Since the sample size in our study is small for PICs and as the critical values provided by Pesaran, *et al.* (2001) are calculated on the basis of large sample sizes of 500 and 1000 observations and 2000 and 40000 replications respectively, we use the critical values generated by Narayan (2005) [12].

If the computed F-statistic is greater than the upper critical bound value, the null hypothesis of no cointegration 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. However, if the computed F-statistic lies inside the lower and upper critical bound values, there is inconclusive inference unless the order of integration of the series under consideration is clearly examined.

Granger causality test

If the variables are cointegrated, 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 re-formulated into a vector error-correction model (VECM) framework in order to capture the short- and long-run effect of the cointegrating vector. Let Z_t as the vector of a set of endogenous variables, we can model Z_t as an unrestricted vector autoregression (VAR) model with optimum lag-length[13]:

$$Z_t = A_1 Z_{t-1} + A_2 Z_{t-2} + ... + A_k Z_{t-k} + U_t \quad where\ U_t \sim IN(0, \sigma) \qquad (3)$$

where Z_t is (4 x 1) vector comprised of *LRGDP (*or *LP), LM2, LIR* and *LER*. Each of the A_i is (4 x 4) matrix of parameters. The 4-variable VAR model as shown in Equation (3) is used if there is no long run relationship in the bound testing approach. Nevertheless, if

[12] See Table 4 for these critical values.
[13] The optimum lag length is chosen based on the Akaike's information criterion.

there is a cointegration vector, then the following VECM will be used to examine the long- and short-run causality relationship between variables under study.

$$\Delta Z_t = \Gamma_1 \Delta Z_{t-1} + \Gamma_2 \Delta Z_{t-2} + ... + \Pi Z_{t-k} + U_t \tag{4}$$

where ΔZ_t = [*LRGDP (*or *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_i reflects the short-run relationship of the changes in Z_t. The (4 x 4) matrix of Π $(=\alpha\beta')$ contains both speed of adjustment to disequilibrium (α) and the long-run information (β) such that the term $\beta' Z_{t-3}$ embedded in Equation (4) represents the *(n-1)* cointegrating relationship in the model.

5. Results and Discussions

Unit root tests

We use three testing procedures for examining the order of integration of each series. The first test relates to the one developed by Dickey and Fuller (1979, ADF) with the null hypothesis of a unit root process. However, one of the problems with the ADF tests is that the test has low power in examining the properties of the series. According to Pantula, *et al*. (1994), the unit root tests based on the ordinary least squares (OLS) estimator such as ADF tests, are the least powerful among the test statistics they examined. Hence, we also apply tests developed by Elliott, et al. (ERS, 1996) and by Kwiatkowski, *et al*. (KPSS, 1992).

Table 3 reports the results of three unit root tests for the five PICs.. Looking at the ADF test statistics for all PICs, we conclude that all variables except prices (LP) in Fiji are I(1). However, ERS test results show that monetary measure (LM2) in Solomon Islands and interest rate in Tonga are I(0) while prices in Samoa and Vanuatu, and exchange rate in Vanuatu are I(2). On the other hand, KPSS test show that all series in PICs are either I(0) or I(1). For example, the null hypothesis of stationary cannot be rejected for exchange rate (LER) in Fiji, monetary measure (LM2) in Samoa and Solomon Islands, all variables in Tonga and interest rate (LIR) in Vanuatu. Obviously, only in a few cases do the unit root tests confirm stationarity or non-stationarity consistently in some PICs.

Hence, the use of conventional cointegration procedures such as Johansen and Juselius (1990) multivariate cointgeration framework may not be appropriate as they require the same order of integration of each variable.

Bounds testing results

The next step is to examine the long-run relationship between output, money, interest rate and exchange rate using the bounds test developed by Pesaran, *et al*. (2001). The results of bounds tests are reported in Table 4. The computed F-statistics indicate rejection of the null hypothesis of no cointegration for all PICs. This finding shows that there is a long-run equilibrium relationship between output (or prices), monetary aggregate (M2), interest rate, and exchange rate in all PICs.

The estimated coefficients of M2, interest rate and exchange rate for both Equations (1) and 2 are shown in Tables 5 (effect on output) and 6 (effect on prices), respectively. Based on Table 5, we find for all PICs the coefficient of the monetary variable (M2) is positive as well as significant. Based on the values of the coefficient, it is found that while there is a relatively large response of output to changes in monetary aggregate for Samoa (0.3), Solomon Islands (0.7) and Vanuatu (0.4), the response is fairly small for Fiji (0.1) and Tonga (0.1). The coefficient of interest rate is negative for all PICs. However, it is only statistically significant for Fiji, Tonga and Vanuatu. Besides, while exchange rate (units of US dollar per unit of domestic currency) exhibits a negative effect in all PICs, except Vanuatu, the coefficient is significant only in Fiji, Solomon Islands and Tonga.

Table 3: The results of unit root tests

Country / Variable	ADF		ERS		KPSS	
	Level	**First Difference**	**Level**	**First Difference**	**Level**	**First Difference**
Fiji						
LRGDP	-2.7103	-7.0857**	17.2146	1.6229**	0.0942**	0.1598
LP	-2.6733	-2.7904	349.2003	2.5533**	0.1992**	0.7144
LM2	-2.1230	-5.7382**	58.3675	1.5185**	0.1763**	0.3836
LIR	-2.4302	-7.6340**	19.4068	1.7426**	0.1883**	0.2759
LER	-1.4338	-4.3631**	17.7899	1.6236**	0.0879	0.1317
Samoa						
LRGDP	-1.2377	-4.1753**	27.8062	2.1268**	0.1680**	0.2365
LP	-3.4609	-6.4594**	38.0664	0.4158**	0.1762**	4.7857
LM2	-2.4415	-5.3757**	10.9073	0.3187**	0.0786	0.0564
LIR	0.2524	-6.3262**	60.2085	2.5085**	0.1878**	0.4530
LER	-2.2521	-3.1794**	25.6885	0.2322**	0.1471**	0.4174
Solomon Islands						
LRGDP	-1.6895	-3.8188**	33.7947	2.0427**	0.1601**	0.2886
LP	-0.0198	-4.6688**	128.3159	4.8134	0.1557**	0.4455
LM2	-2.3758	-4.6234**	4.7193**	7.6397	0.1366	0.0923
LIR	-2.0578	-3.4941**	71.5092	1.9910**	0.1557**	0.4129
LER	-1.3039	-4.3461**	32.6075	2.0825**	0.1563**	0.3487
Tonga						
LRGDP	-2.5101	-4.5885**	9.4827	2.6801**	0.0694	0.0854
LP	-3.4180	-3.4468**	133.0252	2.3034**	0.1069	0.1601
LM2	-2.1031	-4.7478**	19.6802	2.5756**	0.1070	0.1378
LIR	-3.3778	-4.3883**	0.7341**	1.8993**	0.0784	0.0542
LER	-2.4572	-3.3057**	6.4833	1.4720**	0.1011	0.0834
Vanuatu						
LRGDP	-2.5243	-3.9553**	15.2735	1.8601**	0.1954**	0.0900
LP	-0.5065	-3.0126**	114.5609	30.1555	0.1811**	0.4382
LM2	-2.4077	-5.2102**	111.0838	2.0705**	0.1887**	0.3679
LIR	-2.2171	-5.2852**	15.1180	1.7900**	0.1407	0.0953
LER	-2.7599	-4.6573**	47.1089	14.6349	0.1526**	0.4362

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 of the test for both ADF and ERS tests is a series has a unit root (non-stationary) while the null hypothesis of the KPSS test is does not contain unit root (stationary).

The asterisk ** denotes the rejection of the null hypothesis at the 5% level of significance.

Table 4: Bound Test for Five PICs

Country	Dependent Variable		Computed F-statistic	
Fiji	LRGDP		7.68***	
	LP		4.12*	
Samoa	LRGDP		14.35***	
	LP		6.33**	
Solomon Islands	LRGDP		6.26**	
	LP		13.21***	
Tonga	LRGDP		13.04***	
	LP		16.39***	
Vanuatu	LRGDP		22.75***	
	LP		25.32***	
	Pesaran et al. (2001)[a]		**Narayan (2005)[b]**	
Critical Value	Lower bound value	Upper bound value	Lower bound value	Upper bound value
1 per cent	3.75	5.06	4.76	6.67
5 per cent	2.86	4.01	3.35	4.77
10 per cent	2.45	3.52	2.75	3.99

[a] Critical values are obtained from Pesaran *et al*. (2001), Table CI(iii) Case III: Unrestricted intercept and no trend, p. 300.
[b] Critical values are obtained from Narayan (2005), Table case III: unrestricted intercept and no trend, p. 10.
*, ** and *** indicate significance at 10%, 5% and 1% levels, respectively.

Equations (1) and (2) are adequate as revealed in the diagnostic checking. The models have the desired properties of OLS technique. Moreover, the CUSUM and CUSUM of Squares plot show that the parameters of the model are stable over time[14].

Granger causality test

Table 7 presents the results of the Granger tests. The error-correction term in the equation with output as dependent variable are negative and statistically significant for all PICs, confirming the long run relationship running from money, interest rate and exchange rate to output. The speed of adjustment of any disequilibrium towards a long-run equilibrium ranges from 31% to 79% within a year for output regressions. We also observe that the error correction terms in the equations with price as dependent variables for all countries are negative and significant, confirming the long run relationship running from money,

[14] In order to conserve space, we do not show the plots of both CUSUM and CUSUM squares tests. However, the results will be made available upon request.

interest rate and exchange rate to price and the speed of adjustment ranges from 17% to 86% within a year for price regressions.

In the short run, changes in monetary aggregate (M2) have significant effects on output and prices in all PICs. On the other hand, we find mixed evidence in regard to Granger-causality relationship between interest rate and exchange rate and output and prices in these five countries. For example, both interest and exchange rates Granger cause output in Samoa and Tonga while these variables do not Granger cause output in Fiji and Solomon Islands. In Vanuatu, it seems that exchange rate variable plays a larger part than interest rate.

Table 5: Long-run estimates for Output in Five PICs

Country	LM2	LIR	LER	Diagnostic Tests
Fiji	0.1036** (2.7142)	-0.4598*** (-4.8019)	-0.1179* (-1.9926)	JB = 0.3964 [0.8202]; AR(1) = 1.7839 [0.2041]; ARCH(1) = 0.8695 [0.3591]; RESET= 0.0010 [0.9751]
Samoa	0.2912*** (6.6585)	-0.1089 (-1.6406)	-0.0467 (-1.1954)	JB = 1.3426 [0.5110]; AR(1) = 0.1256 [0.7334]; ARCH(1) = 0.4278 [0.5237]; RESET= 0.9601 [0.3598]
Solomon Islands	0.6684*** (3.8444)	-0.0384 (-1.0954)	-0.3773*** (-3.8530)	JB = 1.0207 [0.6003]; AR(1) = 0.4975 [0.5121]; ARCH(1) = 0.1243 [0.7279]; RESET= 0.2341 [0.6489]
Tonga	0.1346*** (3.9698)	-0.2366*** (-4.9898)	-0.2708*** (-6.1110)	JB = 0.4809 [0.7863]; AR(1) = 2.5492 [0.1580]; ARCH(1) = 0.1128 [0.7409]; RESET= 1.3292 [0.2868]
Vanuatu	0.3585*** (2.9172)	-0.2052** (-2.3940)	0.1486 (0.6816)	JB = 0.5869 [0.7457]; AR(1) = 0.0063 [0.9394]; ARCH(1) = 0.0114 [0.9160]; RESET= 1.1605 [0.3228]

Notes: Values in bracket [ ] are probability value of the test statistics. Values in parentheses ( ) are *t* value of the test statistics. JB is Jarque-Bera test, null hypothesis: normal residuals; AR(1) is Breusch-Godfrey serial correlation LM test with lag 1, null hypothesis: no autocorrelation; and ARCH(1) is heteroskedasticity test with lag 1, null hypothesis: no heteroskedasticity; RESET is Ramsey RESET test, null hypothesis: the model is correctly specified.
*, ** and *** indicate significance at the 10, 5 and 1 percent levels, respectively.

Table 6: Long-run estimates for Price in Five PICs

Country	LM2	LIR	LER	**Diagnostic Tests**
Fiji	0.5027*** (3.7081)	-0.2000** (-2.2241)	-0.1662 (-0.9650)	JB = 0.3233 [0.8507]; AR(1) = 0.0055 [0.9416]; ARCH(1) = 0.1798 [0.6744]; RESET= 2.2249 [0.1507]
Samoa	0.2989** (2.6864)	-0.4485** (-2.2921)	0.0280 (0.2191)	JB = 1.2801 [0.5273]; AR(1) = 2.9568 [0.1462]; ARCH(1) = 0.0016 [0.9689]; RESET= 2.4266 [0.1800]
Solomon Islands	0.3112** (4.5652)	-0.0979 (-1.4258)	-0.7371*** (4.5652)	JB = 1.4115 [0.4937]; AR(1) = 1.1644 [0.3120]; ARCH(1) = 0.1641 [0.6895]; RESET= 0.1506 [0.7081]
Tonga	0.5306** (2.3228)	0.0882 (0.7786)	-0.3342** (-2.8890)	JB = 1.8851 [0.3896]; AR(1) = 0.1838 [0.6902]; ARCH(1) = 0.0008 [0.9992]; RESET= 0.0342 [0.8622]
Vanuatu	0.3825*** (3.9522)	-0.1804*** (-2.4517)	-0.0785 (-0.7080)	JB = 0.7701 [0.6804]; AR(1) = 0.7510 [0.4195]; ARCH(1) = 0.0316 [0.8607]; RESET= 2.7291 [0.1580]

Notes: Refer to Table 5.

Table 7: Granger causality test for output and prices in five PICs

Country	**F-statistics**			**ECT (t-statistics)**
	LM2	**LIR**	**LER**	
Effects on output				
Fiji	3.0885**	1.3549	2.3001	-0.4580*** (-4.3267)
Samoa	2.7555*	8.7874***	7.7713**	-0.7882** (-2.2336)
Solomon Islands	9.0514***	0.6648	0.9266	-0.6083*** (-3.3863)
Tonga	82.9205***	12.2290***	18.1392***	-0.4471* (-2.1406)
Vanuatu	5.9157**	1.0179	5.1306**	-0.3097** (-2.6914)
Effects on prices				
Fiji	6.2312***	7.9939***	7.2179***	-0.1698*** (-4.5961)
Samoa	3.1333*	4.8109**	8.3432**	-0.8586** (-2.7078)
Solomon Islands	3.2787*	1.7108	2.6068*	-0.8416** (-2.6482)

Tonga	13.2537***	17.4136***	6.4131**	-0.3750** (-2.8421)
Vanuatu	3.4580**	0.0329	4.5399*	-0.6007*** (-5.2818)

Note: *, ** and *** indicate significance at 10%, 5% and 1% levels, respectively. Figures in parentheses representing t-statistics.

Variance decomposition analysis

The Granger causality tests within vector error correction model (VECM) provide frameworks to investigate within-sample causality, that is, indicate short-run causality between the variables within the sample period. However, they do not allow researchers to examine the relative strength of the Granger causal chain amongst the variables out-of-sample period. Hence, with a view to determining the degree of exogeneity of the variables,, the study employs variance decomposition analysis. This analysis shows a relative strength amongst variables by decomposing the variance of the forecast error of a variable into proportions attributable to shocks (or innovations) in every variable in the model including its own (Masih and Masih, 2002).

The variance decomposition results of real output for five PICs are presented in Table 8. Obviously, focusing on the own shock being explained, real output in Fiji, Solomon Islands, Tonga and Vanuatu exhibits its relative exogeneity with over 30% of own variances being explained by its own innovations in the first 3 years. Vanuatu's real output appears to be the most explained by its own innovation: more than 70% in the first 3 years, but decreasing over the remaining years until 54% in 10^{th} year. Consistent with the cointegration and Granger causality tests, monetary measure (M2) is responsible for a substantial proportion of variation in real output in all PICs, except in Samoa (about 8% over the whole period).

Table 8: Variance Decomposition of Real Output (LRGDP)

Period	S.E.	LRGDP	LM2	LIR	LER
Fiji					
1	0.0418	58.2968	28.2577	13.3661	0.0794
2	0.0511	42.8140	23.7650	27.6364	5.7847
3	0.0586	32.5002	19.1228	26.5478	21.8292
4	0.0708	22.3359	31.7664	29.3472	16.5505
5	0.0765	20.4758	37.1608	25.7516	16.6118

6	0.0943	17.4345	50.8048	17.1392	14.6216
7	0.1059	13.8480	55.9679	14.1770	16.0071
8	0.1298	9.7030	57.6770	9.5548	23.0653
9	0.1477	8.0951	64.8742	7.3906	19.6402
10	0.1641	7.7956	67.1881	6.2779	18.7384
Samoa					
1	0.0293	29.8017	1.8963	50.4622	17.8398
2	0.0374	31.3770	8.2942	47.5131	12.8157
3	0.0413	33.3493	12.6862	41.5285	12.4361
4	0.0474	42.7596	9.7608	33.1322	14.3473
5	0.0527	45.6030	8.1703	30.5540	15.6727
6	0.0549	44.0581	9.2216	28.2329	18.4874
7	0.0595	38.8577	8.8845	25.5844	26.6734
8	0.0639	34.6043	9.3381	22.2328	33.8249
9	0.0664	32.2184	9.7757	21.8071	36.1988
10	0.0693	30.4560	8.9777	23.5190	37.0473
Period	**S.E.**	**LRGDP**	**LM2**	**LIR**	**LER**
Solomon Islands					
1	0.0600	48.9656	32.3436	0.2085	18.4823
2	0.0892	27.2082	44.0659	6.6952	22.0307
3	0.0949	24.0189	45.2305	10.8842	19.8665
4	0.0998	21.9204	43.0147	15.5510	19.5139
5	0.1064	19.3355	39.0644	22.9298	18.6704
6	0.1108	18.9227	36.1271	26.0978	18.8525
7	0.1121	19.6928	35.3181	26.3670	18.6221
8	0.1162	22.0969	35.8157	24.5560	17.5314
9	0.1250	24.1761	39.0041	21.2382	15.5816
10	0.1337	24.0408	43.3572	18.8012	13.8009
Tonga					
1	0.0260	55.5365	15.9908	18.4112	10.0616
2	0.0326	39.9225	29.4709	20.2028	10.4038
3	0.0375	32.3580	37.4831	17.9267	12.2323
4	0.0415	27.2711	43.2426	15.4873	13.9989
5	0.0450	23.5868	47.4905	13.4365	15.4862
6	0.0482	20.8153	50.6975	11.8179	16.6694
7	0.0510	18.6767	53.1760	10.5572	17.5901
8	0.0536	16.9912	55.1371	9.5694	18.3024
9	0.0559	15.6374	56.7235	8.7846	18.8546
10	0.0581	14.5311	58.0324	8.1505	19.2859
Vanuatu					
1	0.0574	90.4610	5.5782	0.2650	3.6959
2	0.0801	82.1151	9.2205	0.1360	8.5284
3	0.0967	74.3679	12.7564	0.2749	12.6008
4	0.1099	68.1023	15.7965	0.7225	15.3788
5	0.1207	63.4081	18.2243	1.3606	17.0070

6	0.1298	60.0479	20.0798	2.0442	17.8281
7	0.1376	57.7098	21.4643	2.6694	18.1566
8	0.1446	56.1085	22.4886	3.1871	18.2158
9	0.1509	55.0132	23.2511	3.5899	18.1458
10	0.1568	54.2496	23.8301	3.8929	18.0274

Notes: Cholesky Ordering: LM2, LER, LIR, LP. (See Footnote 15)

While interest rate appears to have a greater effect on real output in Fiji, Samoa, Solomon Islands and Tonga, either in the short- or long-run, the results show that real output is not much responsive to interest rate in Vanuatu (with less than 5% of its forecast error variance explained by interest rate). Real output in all PICs is quite sensitive to exchange rate variable (that is, over 10% of the variance explained by exchange rate), with Samoa being most responsive (between 17% and 37% over the period), followed by Solomon Islands (between 13% and 22%) and Tonga (between 10% and 19%).

Referring to the variance decomposition of prices (Table 9), a few findings are worth noting. First, consistent with the findings of Granger causality test variance decomposition of real output, monetary measure (M2) plays a pivotal role in explaining the variation of prices in most PICs either in the short-run (Samoa and Tonga) or long-run (all PICs). Second, it seems that price itself in all PICs exhibits its relative exogeneity with over 44% of own variances being explained by its own innovations in the short-run, and especially in Vanuatu with a close 100%.

Third, while interest rate is an influential variable in explaining prices in Fiji and Tonga, the variable has less influence on prices in Samoa, Solomon Islands and Vanuatu, either in the short- or long-run. Finally, the exchange rate variable consistently explains a large proportion of variation in prices (ranging from 19% to 31%) for Fiji, Samoa and Solomon Islands. This result indicates that change in exchange rate is the critical driving force for prices in these countries.

Table 9: Variance Decomposition of Prices (LP)

Period	S.E.	LP	LM2	LIR	LER
Fiji					
1	0.0225	44.3715	0.8795	27.6335	27.1156
2	0.0353	43.3167	6.5009	22.8124	27.3701
3	0.0442	37.4419	20.7506	22.1960	19.6115
4	0.0495	30.5312	29.2945	21.2855	18.8888
5	0.0540	25.8102	37.6157	18.4543	18.1198
6	0.0584	22.1884	42.9916	15.7899	19.0301
7	0.0622	19.6925	44.7121	14.7061	20.8894
8	0.0668	18.4151	42.5496	16.1967	22.8386
9	0.0716	17.8064	38.3521	18.4350	25.4065
10	0.0761	16.9090	34.0669	19.6653	29.3588
Samoa					
1	0.0356	45.1114	18.2578	16.4083	20.2225
2	0.0378	40.5609	22.9930	17.3335	19.1126
3	0.0509	26.6444	36.8760	10.9382	25.5414
4	0.0521	26.0935	36.0000	13.0056	24.9008
5	0.0527	25.7396	36.0397	12.7990	25.4217
6	0.0602	19.9587	40.8019	11.3839	27.8554
7	0.0638	18.0125	39.0236	13.6056	29.3584
8	0.0676	17.3861	43.0759	12.3481	27.1899
9	0.0740	14.7564	43.2325	14.7704	27.2406
10	0.0771	15.9505	42.2023	15.6608	26.1864
Solomon Islands					
1	0.0134	66.9995	0.7313	12.5518	19.7174
2	0.0159	49.1804	24.4025	10.4848	15.9323
3	0.0180	38.6888	34.9896	8.1937	18.1280
4	0.0210	28.9375	25.7237	14.6709	30.6679
5	0.0259	18.9176	47.0589	10.7270	23.2966
6	0.0276	17.9011	45.2680	9.5287	27.3023
7	0.0281	17.2603	44.5996	9.2485	28.8916
8	0.0291	16.2249	43.8494	9.3858	30.5399
9	0.0294	15.9694	42.9786	9.2638	31.7881
10	0.0298	15.5835	43.1140	9.3325	31.9700
Tonga					
1	0.0230	77.3351	14.7842	0.1813	7.6994
2	0.0374	33.8362	46.1761	16.0172	3.9705
3	0.0485	20.4369	41.2953	35.8951	2.3727
4	0.0546	16.6236	42.4534	37.7173	3.2057
5	0.0640	13.6383	54.4187	29.1977	2.7453
6	0.0765	10.7622	64.9629	21.4097	2.8653
7	0.0890	8.4372	69.0432	19.3470	3.1725
8	0.1045	6.3281	69.9821	19.6524	4.0374
9	0.1202	4.8432	68.7224	20.7890	5.6454
10	0.1336	3.9213	66.9412	22.3169	6.8207

Vanuatu					
1	0.0230	99.7572	0.0315	0.1559	0.0554
2	0.0309	88.6616	8.6118	1.2862	1.4404
3	0.0392	64.4391	33.7980	0.8007	0.9622
4	0.0478	43.7312	54.9879	0.5590	0.7220
5	0.0531	35.3539	63.1541	0.5206	0.9713
6	0.0582	29.6907	67.5278	0.7606	2.0209
7	0.0618	26.4711	69.7371	1.3162	2.4756
8	0.0643	24.6409	71.0529	1.9540	2.3522
9	0.0658	23.5898	71.3035	2.6134	2.4934
10	0.0671	22.6994	70.3463	3.1883	3.7660

Notes: Cholesky Ordering: LM2, LER, LIR, LP.. (See Footnote 15).

Impulse response function analysis

Figure 1 shows the results of impulse response function analysis based on VECM models, which enable us to trace out the response of output to a shock in policy variable. The shock is represented by one standard deviation of the error term in the underlying structural model for the variable. Since all variables are measured in log forms, the impulse response functions trace out a growth rate relative to the base period when the shock occurred. Compared to Granger causality tests, IRF has an additional advantage, as it indicates whether the whether the effect is positive or negative, and whether a transitory jump or otherwise.

For investigating IRF in regard to the output model by Choleski decomposition, we enter the variables in the following order: M2, exchange rate, interest rate, prices, and real output[15]. Figure 1 shows impulse response functions indicating how M2 and other variables affect output, with the dotted lines representing 95% confidence intervals. Overall, the results using impulse response functions of real output are consistent with the results reported by the Granger causality analysis, confirming the short-term non-neutrality between real output and monetary measure (M2). In all PICs, a one-standard

15 We used different orderings of the variables. With a view to evaluating the robustness of the VAR results which vary according to different orderings of the variables, we examined the correlation matrix of the reduced-form VAR residuals.The elements of the correlation matrix between the M2 and the rest of the variables are very low, indicating that contemporaneous feedback is not a problem. These correlations suggest that the ordering of the variables in a Choleski decomposition is not a major concern.

deviation shock to the monetary aggregate produces a positive impact on real output in the first 4 years. However, the impact converges to its long run equilibrium after 4th year.

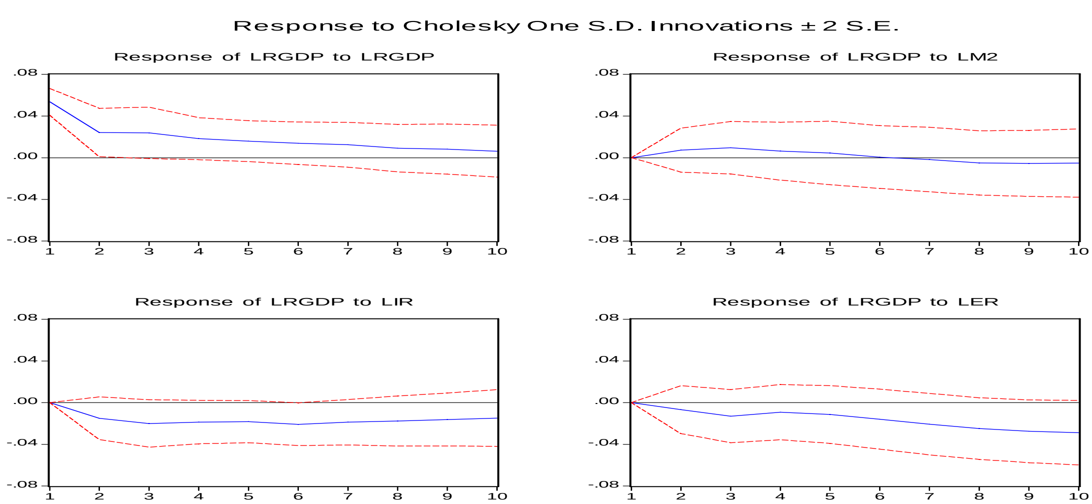
A one-standard deviation shock to interest rate has a negative impact on real output in Fiji and Tonga. Similarly, a shock to interest in Solomon Islands results in a modest increase in the real output for the first 6 years. In Samoa and Vanuatu, a similar shock to interest rate has a negligible impact on real output in the short-term, but the shock exhibits a negative effect after 3rd year.

However, response of output to a shock to exchange rate in PICs is mixed. For example, it is positive in Samoa and Vanuatu while there is no obvious impact of a one standard deviation shock to exchange rate on output in Solomon Islands. In line with theoretical expectations, the impact of shocks to exchange rate on real output in Fiji and Tonga are both negative and persistent in the long-run.

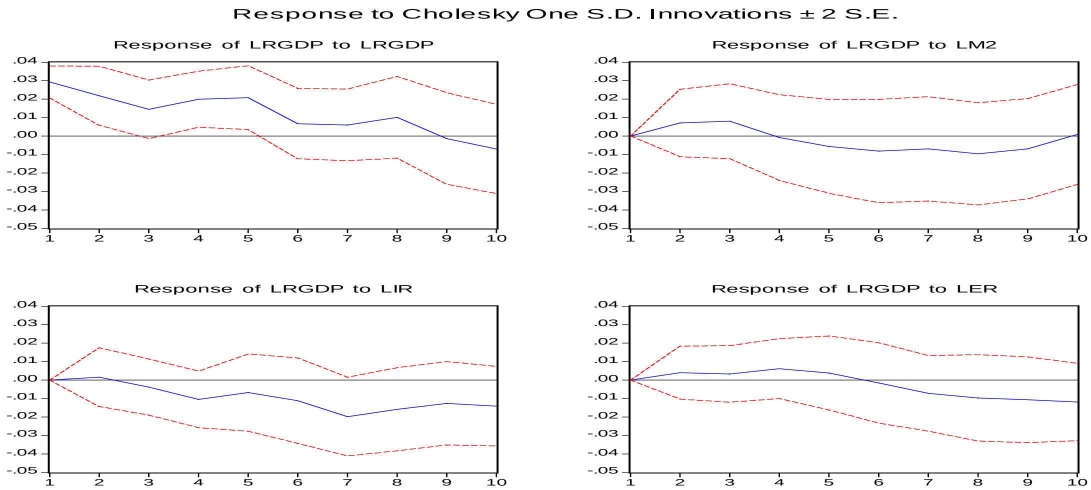
Response of prices to shocks in M2 and other variables differs greatly, as shown in Figure 2. In general, a shock to monetary aggregate (M2) has a positive effect on prices in the short-run in all PICs. Specifically, the impact increases over time and persistent in the long-run in Fiji, Tonga and Vanuatu. In Samoa and Solomon Islands, the effect of M2 on prices fluctuates in the long-run. This result is in line with the results of Granger causality test.

Figure 1: Impulse Response Function of Output (LRGDP) for PICs

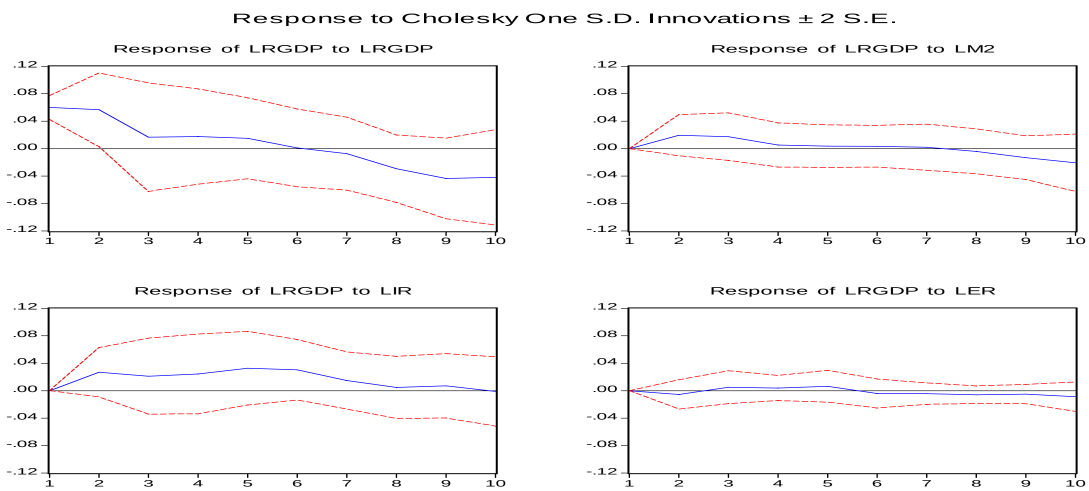
Fiji

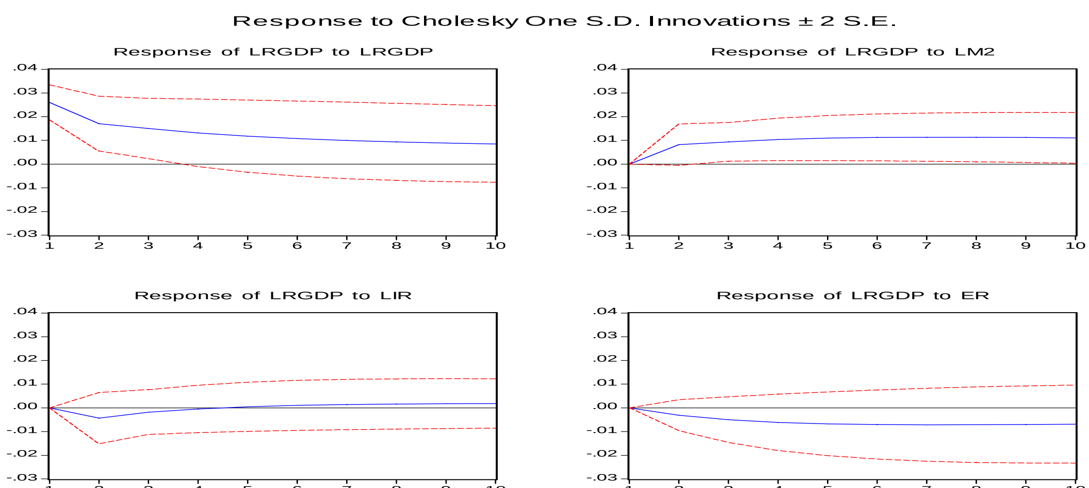


Samoa



Solomon Islands





Vanuatu

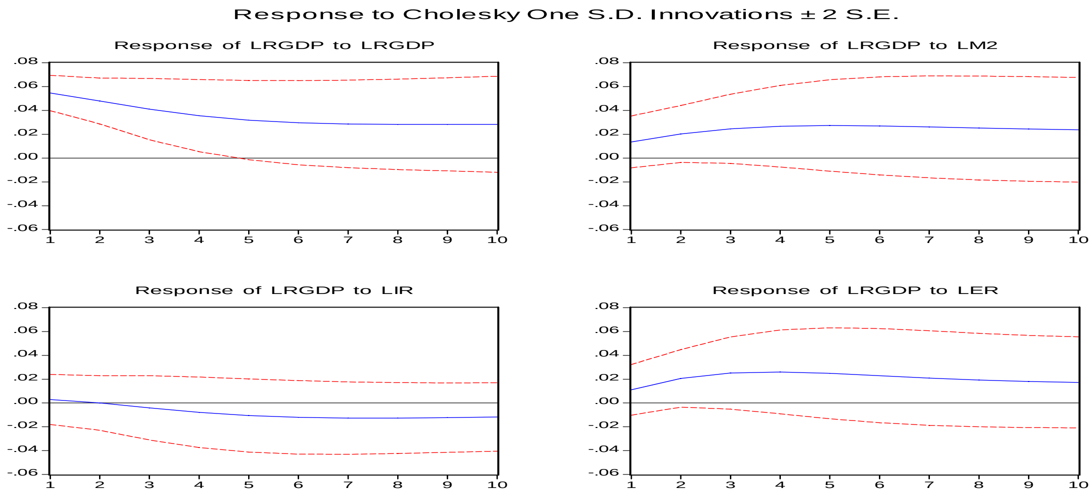
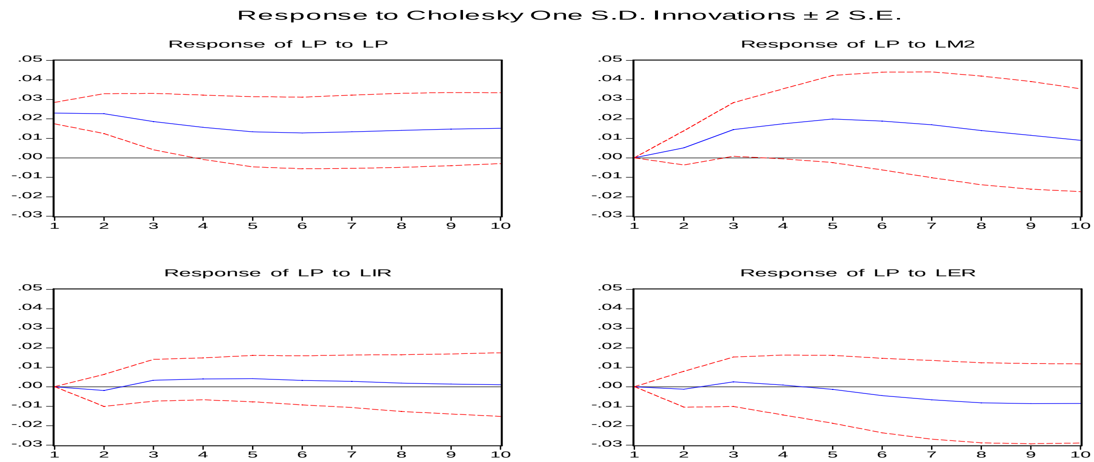
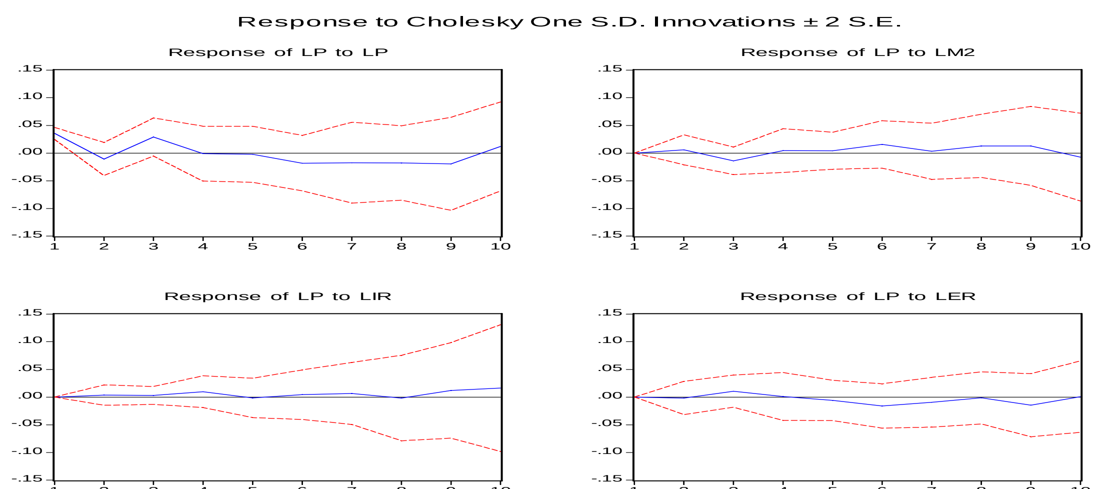


Figure 2: Impulse Response Function of Prices (LP) for PICs

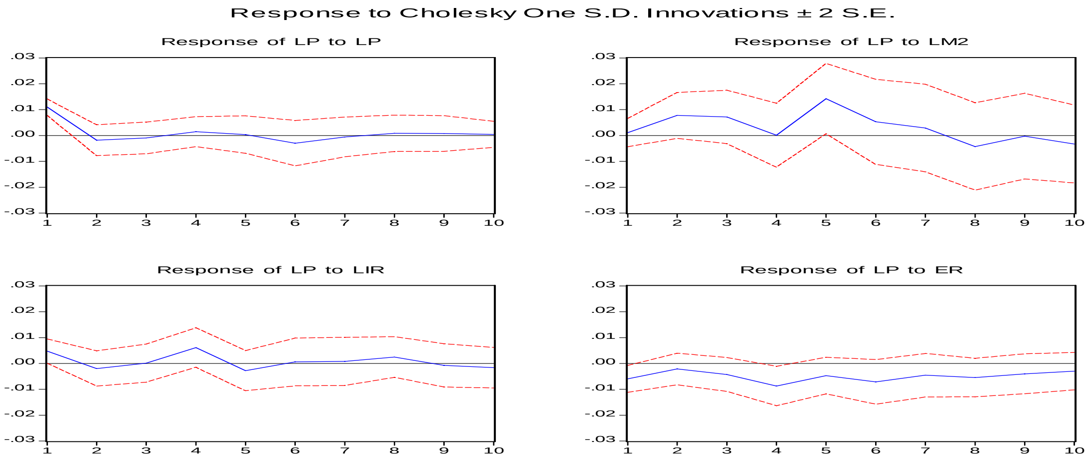
Fiji



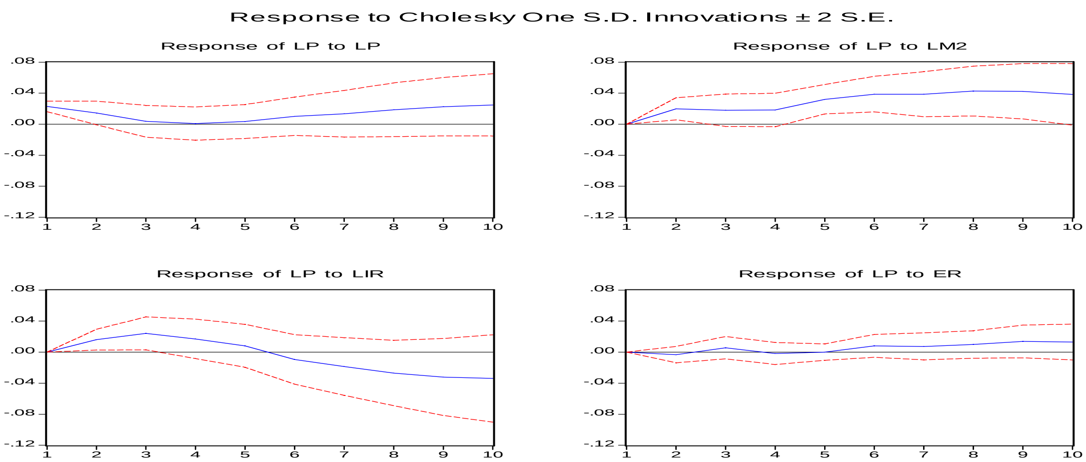
Samoa



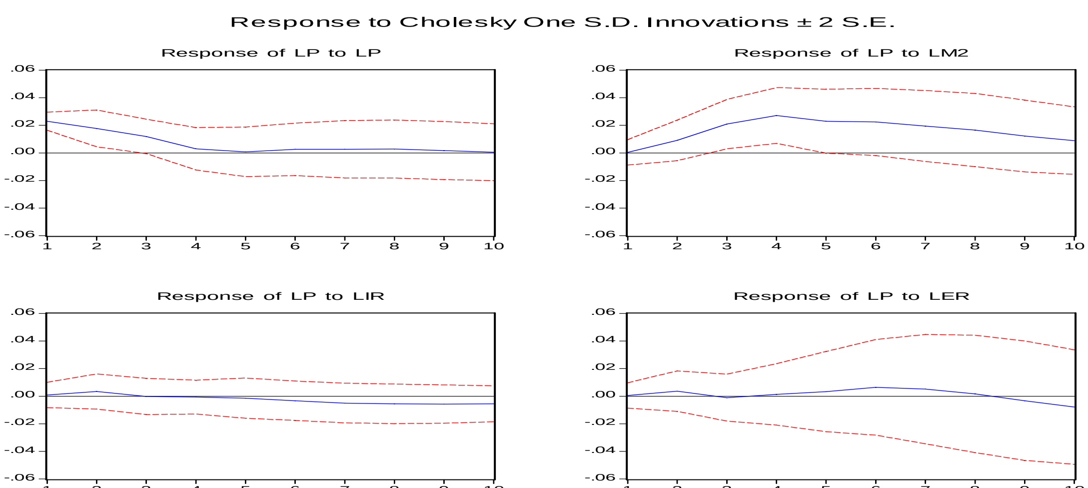
Solomon Islands



Tonga



Vanuatu



6. Summary and Conclusions

This paper undertook an empirical study on the role of money and its impact on output and prices in five PICs, which have independent currencies under fixed exchange rate regimes. Their financial sectors are relatively less developed with near absence of private sector securities. Further, they are dominated by the government issued bonds or the government agency issued bonds but backed by the government.. Furthermore, there are no secondary markets, in which the limited securities can be traded. .

The empirical results indicate that monetary aggregate plays a significant role in determining both output and prices in all PICs. The results also confirm that exchange rate variable has a more dominant effect on output and prices in most PICs.

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