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Research Article

Role of Money in Smaller Pacific Island Countries

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Pacific island countries (PICs), which attained political independence, are open economies with very small manufacturing base and narrow range of exports of copra and tuna. They are highly dependent on imports ranging from food and mineral fuels to intermediate and capital goods and transport machinery. Four of the 14 PICs, namely Samoa, Solomon Islands, Tonga, and Vanuatu, have independent currencies with usual paraphernalia of central banks under fixed exchange rate regimes. Their financial sectors are small and with undeveloped money and capital markets. The nominal exchange rate as an anchor has served the four PICs well by keeping inflation low. 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 PICs. The findings are that broad money (M2) and exchange rate have a long run as well as short-run casual relationship with both output and prices in all PICs.

1. Introduction

The role of money in promoting economic growth in the developed and developing countries has sparked renewed interest in recent years by various studies spanning over a three-decade period [1–7]. While there has been substantial much empirical work on the linkages between money and economic activity in other parts of the world, there have been only a few analyses relating to Pacific Island Countries (PICs). (Among the 14 Pacific Island Countries, only six of them have independent currencies with central banks of their own. They, are Fiji, Papua New Guinea, Samoa, Solomon Islands, Tong and Vanuatu. The other eight are dollarized economies. They are Cook Islands and Niue with New Zealand dollar as legal tender; Kiribati, Nauru, and Tuvalu with Australian dollar; Republic of Marshall Islands, Federated States of Micronesia, and Palau with United States dollar.)

The available studies have only concentrated on Fiji (e.g., in regard to Fiji, Joynson [8] in her study on relationship between money, income, and interest rates casts doubts on the effectiveness of monetary aggregates. Katafono [9] studied 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.) and Papua New Guinea (See Jayaraman and Choong [10–12] and Jayaraman et al. [13]) and there are no similar studies devoted to smaller PICs.

This paper, therefore, focuses on four PICs, namely, Samoa, Solomon Islands, Tonga, and Vanuatu, which are the other four countries with independent currencies of their own under fixed exchange rate regimes (while the currencies of 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 [14]) and examines the effect of money on price and output by undertaking quantitative analyses. 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 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.

2. A Background

The four PICs, whose selected key indicators are given in Table 1, share many commonalities amongst themselves. 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.

All the four PICs 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 primary products, namely, banana, copra, fish, and timber. In these circumstances, their fixed exchange rate regimes have served them well. Since most of 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 four PICs comprise 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); commercial banks, 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; three in Vanuatu: a government-owned bank, the other two being foreign owned; 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 precolonial 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. (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.)

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 three countries, namely, 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, since the 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. They all strive for a 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 but continue to employ statutory reserve deposit requirements of certain percentages of deposits, both demand and time and saving deposits.

The Reserve Bank of Fiji 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 and declaring the yield to maturity of 91-day paper as policy indicator rate. (The liquidity management by Fiji's central bank is described 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.) Other central banks followed suit, once Fiji's experiment proved successful. However, the Central Bank of Solomon Islands (CBSIS) 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

Table 1: Key economic and social indicators of Pacific Island Countries.

PIC	Population ('000) 2009	Area ('000) Sq.km	Per capita GDP (US$) 2008	Human Dev. Index Ranking 2006
Samoa	183	2.8	2,776	96
Solomon Is.	523	28.9	1256	134
Tonga	104	0.7	2991	85
Vanuatu	240	12.2	2072	123

Source: ADB [24], UN ESCAP [25].

Table 2: Output and monetary statistics in selected PICs.

	Output growth (%)	Inflation (%)	Interest rate (%)	Exchange rate US$/DC	M2 (% of GDP)
Samoa					
1983–89 (Ave)	2.00	9.00	36.20	0.379	25.30
1990–99 (Ave)	1.40	4.80	12.40	0.38	34.90
2000–04 (Ave)	3.30	5.90	11.30	0.38	45.40
2005	5.20	1.80	11.40	0.37	42.27
2006	0.50	3.80	11.70	0.36	43.82
2007	−6.80	5.50	12.70	0.38	42.32
2008	−3.40	11.50	12.66	0.38	44.76
2009	−1.70	6.30	12.08	0.37	49.23
2010	1.50	0.80	10.72	0.40	50.69
Solomon Islands					
1980–89 (Ave)	7.40	12.50	13.30	0.79	30.10
1990–99 (Ave)	2.90	10.70	16.20	0.33	28.50
2000–04 (Ave)	−2.10	8.20	14.50	0.14	26.60
2005	5.00	7.30	14.10	0.13	38.50
2006	6.08	11.23	13.90	0.13	43.38
2007	10.72	7.64	14.10	0.13	44.27
2008	7.33	17.34	14.44	0.13	38.07
2009	−1.23	7.11	15.26	0.12	39.85
2010	7.07	0.95	14.43	0.12	39.44
Tonga					
1980–89 (Ave)	2.30	9.60	10.20	0.08	31.20
1990–99 (Ave)	2.00	4.50	11.60	0.07	35.90
2000–04 (Ave)	2.90	9.50	11.40	0.49	45.90
2005	−0.96	8.30	11.40	0.51	39.78
2006	0.26	6.40	12.00	0.49	38.63
2007	−0.90	5.80	12.20	0.51	42.72
2008	2.59	10.40	12.46	0.51	42.75
2009	−0.99	1.40	12.47	0.49	42.65
2010	0.32	3.60	11.54	0.52	43.38
Vanuatu					
1980–89 (Ave)	8.80	8.80	16.70	0.01	109.80
1990–99 (Ave)	5.10	3.20	13.60	0.01	102.70
2000–04 (Ave)	0.60	2.80	7.90	0.07	92.60
2005	5.13	1.15	7.50	0.01	95.85
2006	7.19	2.63	8.30	0.01	91.30
2007	6.74	4.11	8.20	0.01	94.84
2008	6.33	5.83	5.30	0.01	95.41
2009	0.04	2.80	5.50	0.01	95.43
2010	3.00	2.57	5.80	0.01	98.00

Source: International Monetary Fund [14].

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. (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.) 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 [15].

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 [7]. 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 [15].

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 nonneutrality 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 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 [1], and positive and negative monetary shocks [3, 4] on output fluctuations. While some studies have supported unidirectional causality, running from money to income [16, 17], other studies have provided evidence on unidirectional causality, running from income to money [2, 18]. There is also empirical evidence of bidirectional causality between money and output for a number of countries [19]. However, the existing empirical evidence based on testing of causality between money growth and output growth is, at best, mixed and contradictory [19, 20].

Further, results vary depending on (i) whether the variables are modelled as (log-) level variables or growth rates [21] and (ii) whether they are modeled as trend or difference stationary [5]. Christiano and Ljungquist [21] argue in favour of using level variables, since they find 1998 that power of the tests on growth variables is very low. Hafer and Kutan [5] 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.

4. Methodology, Variables, and Data

Following the procedure adopted by Starr [22] for examining the role of money, we devise two models: one with output as the target variable and the other with price level as the target variable. In both models, as we are not sure about

Table 3: Results of Johansen and Juselius multivariate procedure for output in four PICs.

	Maximum Eigenvalue		Trace	
Ho : rank = p	Test statistic	95%	Test statistic	95%
Samoa				
$p = 0$	27.318*	27.584	55.051**	47.856
$p \leq 1$	17.461	21.132	27.733	29.797
$p \leq 2$	9.063	14.265	10.272	15.495
$p \leq 3$	1.208	3.841	1.208	3.841
Solomon Islands				
$p = 0$	33.424**	32.118	68.564**	63.876
$p \leq 1$	16.622	25.823	35.140	42.915
$p \leq 2$	10.645	19.387	18.518	25.872
$p \leq 3$	7.873	12.518	7.873	12.518
Tonga				
$p = 0$	70.651**	27.584	118.147**	47.856
$p \leq 1$	39.138**	21.132	47.496**	29.797
$p \leq 2$	5.897	14.265	8.359	15.495
$p \leq 3$	2.462	3.841	2.462	3.841
Vanuatu				
$p = 0$	26.005*	27.584	56.889**	47.856
$p \leq 1$	16.131	21.132	30.884**	29.797
$p \leq 2$	13.652	14.265	14.752	15.495
$p \leq 3$	1.100	3.841	1.100	3.841

Notes: * and **indicate significant at 5% and 1% levels, respectively.

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 adopt Sims [16] and use Granger causality, which indicates whether lagged values of policy variables are informative for predicting future movements of output and prices.

While the relationships are straightforward and clear between changes in money and interest rate; between changes in money and price level; 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 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 change 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, M2) (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.), consumer price index (P), average nominal lending rate (IR); and nominal exchange rate (units of US dollar per unit of domestic currency). The data series for other four countries cover a shorter period as their national accounts are available only from the 1980s: Samoa (1982–2010); Solomon Islands (1983–2010); Tonga (1980–2010); and Vanuatu (1980–2010). For econometric

Table 4: Results of Johansen and Juselius multivariate procedure for price in four PICs.

	Maximum eigenvalue		Trace	
Ho : rank = p	Test statistic	95%	Test statistic	95%
Samoa				
$p = 0$	24.844*	27.584	48.173**	47.856
$p \leq 1$	13.141	21.132	23.329	29.797
$p \leq 2$	8.406	14.265	10.188	15.495
$p \leq 3$	1.781	3.841	1.781	3.841
Solomon Islands				
$p = 0$	31.814*	32.118	67.092**	63.876
$p \leq 1$	18.547	25.823	35.278	42.915
$p \leq 2$	12.676	19.387	16.731	25.872
$p \leq 3$	4.055	12.518	4.055	12.518
Tonga				
$p = 0$	36.991**	27.584	65.930**	47.856
$p \leq 1$	17.276	21.132	28.939	29.797
$p \leq 2$	10.655	14.265	11.663	15.495
$p \leq 3$	1.008	3.841	1.008	3.841
Vanuatu				
$p = 0$	30.288**	27.584	51.011**	47.856
$p \leq 1$	14.739	21.132	20.723	29.797
$p \leq 2$	5.592	14.265	5.984	15.495
$p \leq 3$	0.392	3.841	0.392	3.841

Notes: * and **indicate significant at 5% and 1% levels, respectively.

analysis, all variables are duly transformed into their natural logs. We also add a trend variable. (Narayan and Smyth [23] have extensively discussed the inclusion of time trend variable in the estimation.)

The annual data for the empirical study are drawn from two sources: the monetary and exchange rate data published by IMF [14] and output data from Asian Development Bank [24] and UN ESCAP [25]. For the empirical investigation, all the data are expressed in natural logs.

The conventional cointegration procedures proposed by both the Engle and Granger [26] residual-based procedure and the Johansen and Juselius [27] maximum likelihood approach require a testing of unit root to ensure that all series are integrated of order one.

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. The findings are consistent with findings of empirical studies obtained in other developing countries, which have no capital and stock markets.

4.1. 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 reformulated 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 (the optimum lag length is chosen based on the Akaike's information criterion),

$$Z_1 = A_1 Z_{t-1} + A_2 Z_{t-2} + \cdots + A_k Z_{t-k} + U_t, \quad \text{where } U_t \sim \text{IN}(0, \sigma), \tag{1}$$

where Z_t is (4×1) vector comprised of LRGDP (or LP), LM2, LIR, and LER. Each of the A_i is (4×4) matrix of parameters. The 4-variable VAR model as shown in (1) is used if no long run relationship in the bound testing approach. Nevertheless, if there appears a cointegration vector, then the following VECM will be used to examine the long- and short-run causality relationship between variables under study:

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

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 (4×4) matrix of $\Pi(= \alpha\beta')$ contains both speed of adjustment to disequilibrium (α) and the long-run information (β) such that the term $\beta' Z_{t-3}$ embedded in (2) represents the $(n-1)$ cointegrating relationship in the model.

5. Results and Discussions

5.1. Unit Root Tests. We employ two testing procedures for examining the order of integration of each series. The first test is proposed by Dickey and Fuller [28] with the null

Table 5: Long-run estimates for output in four PICs.

Country	LM2	LIR	LER	Diagnostic tests
Samoa	0.290*** (25.439)	−0.718*** (−12.528)	−0.281*** (−4.597)	JB = 10.631 [0.2235]; AR(1) = 8.336 [0.9382]; AR(2) = 10.771 [0.8233];
Solomon Islands	0.803*** (15.550)	−0.165* (−2.021)	−0.511*** (−4.774)	JB = 8.331 [0.4018]; AR(1) = 14.725 [0.5448]; AR(2) = 14.674 [0.5486];
Tonga	0.297*** (38.547)	−0.523*** (−10.826)	−0.267*** (−9.557)	JB = 10.195 [0.2516]; AR(1) = 16.454 [0.4217]; AR(2) = 12.329 [0.7210];
Vanuatu	0.204** (2.655)	−0.715*** (−8.373)	−0.413 (−1.236)	JB = 12.875 [0.2108]; AR(1) = 12.791 [0.6880]; AR(2) = 15.375 [0.4973];

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 *** indicate significance at the 10, 5, and 1 percent levels, respectively.

Table 6: Long-run estimates for price in four PICs.

Country	LM2	LIR	LER	Diagnostic tests
Samoa	0.438*** (17.869)	−0.550*** (−4.404)	−0.556*** (−4.531)	JB = 9.808 [0.2787]; AR(1) = 8.336 [0.9382]; AR(2) = 10.771 [0.8233];
Solomon Islands	0.299*** (5.182)	−0.323*** (−3.579)	−0.641*** (−5.382)	JB = 7.519 [0.4818]; AR(1) = 11.390 [0.7848]; AR(2) = 12.970 [0.6749];
Tonga	0.679*** (33.350)	−0.346*** (4.546)	−0.488*** (6.919)	JB = 7.937 [0.4396]; AR(1) = 15.929 [0.4579]; AR(2) = 15.632 [0.4789];
Vanuatu	0.527*** (15.429)	−0.033 (−0.746)	−0.237* (−1.98)	JB = 12.088 [0.1473]; AR(1) = 12.314 [0.7221]; AR(2) = 13.986 [0.5997];

Notes: Refer to Table 5.

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. [29], 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 the test developed by Elliott et al. [30]. Looking at both ADF and ERS test statistics for all PICs, we conclude that all variables are I(1). (The results are available upon request.) Hence, the next step is to examine the long-run relationship between output, money, interest rate, and exchange rate by using Johansen and Juselius [27] multivariate cointegration framework.

The results of cointegration tests are reported in Tables 3 and 4 for both output and price in four PICs. The statistics for both maximum eigenvalue and trace tests suggest that there is at least one cointegrating vector in 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 these PICs.

The estimated coefficients of M2, interest rate, and exchange rate for both output and price equations 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 Solomon Islands (0.80), the response is fairly small for Samoa (0.29), Tonga (0.29), and Vanuatu (0.20). The coefficient of interest rate is negative and statistically significant for all PICs. Besides, while exchange rate (units of US dollar per unit of domestic currency) exhibits a negative effect in all PICs, the coefficient is significant in Samoa, Solomon Islands, and Tonga, except Vanuatu.

Results in Table 6 show that monetary variable has a positive and significant impact on prices in all PICs. The effects of both interest rate and exchange rate on prices are negative. While interest rate is seen as significantly influencing price in Samoa, Solomon Islands, and Tonga, it is not significant in Vanuatu. On the other hand, exchange rate (units of US dollar per unit of domestic currency) has a negative and significant impact on prices in all PICs. The equations for both output and price are adequate as revealed in the diagnostic checking. The models have the desired properties of OLS technique.

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

Country	F-statistics			ECT
	LM2	LIR	LER	(t statistics)
Effects on output				
Samoa	17.583***	14.189***	4.228*	−0.6458** (−2.697)
Solomon Islands	7.671***	1.759	3.492*	−0.3801*** (−3.056)
Tonga	7.097***	1.342	5.081**	−0.4181*** (−3.306)
Vanuatu	8.732***	0.148	3.768*	−0.3495** (−2.540)
Effects on prices				
Samoa	5.079***	0.371	3.767**	−0.5965** (−2.249)
Solomon Islands	8.131***	4.876**	11.947***	−0.3159** (−2.757)
Tonga	16.609***	14.007***	5.984**	−0.9035*** (−4.176)
Vanuatu	4.093**	0.633	3.816*	−0.6684*** (−5.743)

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

5.2. Granger Causality Test. Table 7 presents the results of the Granger causality 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 35 perecent to 64 percent 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, interest rate and exchange rate to price and the speed of adjustment ranges from 31 percent to 90 percent within a year for price regressions.

In the short run, changes in monetary aggregate (M2) and exchange rate 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 output and prices in these four countries. For example, interest rate Granger causes output in Samoa while this variable does not Granger cause output in Solomon Islands, Tonga, and Vanuatu. Besides, interest rate Granger causes price in Solomon Islands and Tonga while does not have any causality relationship in Samoa and Vanuatu.

6. Summary and Conclusions

This paper undertook an empirical study on the role of money and its impact on output and prices in four 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 bonds or bonds issued by government agencies, guaranteed by government. Furthermore, there are no secondary markets, in which the limited securities can be traded.

The empirical results indicate that monetary aggregate and exchange rate play a significant role in determining both output and prices in all PICs. The results also confirm that monetary aggregate variable has a more dominant effect on output and prices in most PICs. The findings are consistent with findings of empirical studies obtained in other developing countries, which have no capital and stock markets. Nevertheless, it is suggested for future research to investigate the robustness of the present paper's findings by using panel data models that can be modified to allow for the structural break(s). As suggested by P. K. Narayan and S. Narayan [31] and Narayan [32, 33], there is evidence of the structural break(s) in some transactional economies including Fiji Islands.

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