How does monetary policy work in Solomon Islands?

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This article examines how the monetary policy tools employed by the Central Bank of Solomon Islands worked to achieve its mandated objectives of maintaining price and exchange rate stability during a 28-year period (1980–2007). The findings show that, given the current undeveloped status of the money market in Solomon Islands, monetary impulses are transmitted to the real sector predominantly through the money channel rather than through the interest rate channel. Until effective inter-bank activities develop and open market operations in central bank bills become regular enough to influence short-term market interest rates by injecting or mopping up excess liquidity, the central bank will have to depend on direct instruments aimed at monetary aggregates.

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Solomon Islands is one of the six Pacific island countries that have independent currencies. The other Pacific island countries have dollarised economies.[1] Of those Pacific island countries with independent currencies, Solomon Islands—along with Fiji, Samoa, Tonga and Vanuatu—has a fixed exchange rate regime, whereas Papua New Guinea has a floating exchange rate regime.

The country's monetary authority, the Central Bank of Solomon Islands (CBSI), is charged with the responsibilities of promoting monetary stability and a sound financial structure and fostering conditions conducive to orderly and balanced economic development. Monetary stability implies achieving price stability in terms of low inflation as well as the external stability of its currency, the SI dollar. In recent years, however, the CBSI has been called on to play the additional role of the government's agent for financing its budget deficits. In that situation, achieving its mandated objectives was a challenging task. As government borrowing from the central bank was inflationary, subsequent efforts towards fighting inflation and reducing pressures on external reserves often presented difficulties for the CBSI.

Similar to other Pacific island countries, Solomon Islands is highly dependent on

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imports—ranging from food and fuel to all intermediate and capital goods. The CBSI, which aims to maintain gross foreign reserves equivalent to a minimum of three months' total merchandise imports, is aware that foreign reserves stability is critical for maintaining exchange rate stability and price stability. There is a high pass-through of exchange rate changes to prices since more than two-thirds of the items in the basket for the determination of the consumer price index (CPI) are imported goods.

During the past two decades, the CBSI has pursued its mandated objectives with mixed success. Its monetary policy measures include direct instruments such as statutory reserve requirements and credit control measures and indirect instruments such as open market operations in its own securities.

No studies have been undertaken on monetary policy transmission in Solomon Islands. This article seeks to fill the gap. Since the data available cover a 28-year period (1980–2007), we employ the bounds testing time series approach, which does not require a large sample size of data or stringent requirements with regard to the order of integration of the variables employed.

The article is organised as follows: section two provides the background to the country's economy and the monetary policy instruments employed; section three reviews monetary policy developments since the establishment of the CBSI; section four outlines various transmission mechanisms as studied in industrialised and developing economies and their limitations when applied to small economies; section five deals with the methodology adopted for the empirical analysis; section six reports the results; and section seven presents some conclusions and policy implications.

Background

Solomon Islands (population 489,000), whose key economic indicators are presented (Table 1), shares many features with the other Pacific island countries. The manufacturing base is very small—confined to tuna canning, palm-oil and coconut-oil processing and the production of soaps, detergents, biscuits and bread. Solomon Islands is heavily subsistence oriented, with the informal sector providing livelihoods for 80 per cent of the population.

Table 1 **Solomon Islands: recent selected key indicators**

Land area ('000 sq km)	28
Population (2006: '000)	489
Per capita GDP (US$, 2006 current prices)	684
Aid per capita in US$ (2006)	418
Aid as percentage of GDP (2006)	47.8
Annual average growth rate (percentage, 2001–07)	3.6
Annual average inflation (percentage, 2001–07)	8.6
Budget balance as percentage of GDP (2001–07)	–2.1
Current account balance as percentage of GDP (2001–07)	–9.5

Sources: Asian Development Bank (ADB), 2006. *Key Indicators of Developing Asian and Pacific Countries 2006*, Asian Development Bank, Manila; United Nations Economic and Social Commission for Asia and Pacific (UNESCAP), 2008. *Economic and Social Survey 2008*, United Nations Economic and Social Commission for Asia and Pacific, Bangkok.

The country's fixed exchange rate regime has served it well. Since most of the imports are sourced from Australia and New Zealand, whose central banks have been targeting inflation, domestic inflation has been kept low in recent years despite expanding domestic fiscal deficits. Although much better endowed with large land and marine resources than other Pacific island countries—with the exception of Papua New Guinea—Solomon Islands' economic progress has been disrupted by frequent government changes as well as law and order problems.

The economic structure and growth have remained stagnant during the past three decades. The economic structure is characterised by a large public sector and a small private sector with modest activities. The country's main exports have been timber, tuna and palm-oil. Steady aid inflows and assistance under the auspices of the Regional Assistance Mission to Solomon Islands (RAMSI), which was mounted in 2005 to restore law and order, have been a great source of support to the country's current account balance, minimising pressure on the exchange rate.

Macroeconomic performance

The 1980s was a difficult period for Solomon Islands. Decline in the terms of trade and the withdrawal of annual budgetary support by the United Kingdom left the country's finances in poor shape, aside from the decline in international prices for copra, palm-oil and timber, which resulted in lower export earnings, Cyclone Namu in 1986 led to declines in export volumes as well, as it uprooted the country's copra and oil-palm plantations. The adverse impacts of the cyclone affected export earnings for the next three years. Solomon Islands had to seek help from the International Monetary Fund (IMF) to tide it over the shortage in foreign reserves. Two sets of stand-by arrangements—the first in 1981 and the second in 1983—came to the country's rescue. As the authorities could not fully meet the conditionality requirements, however, the full amount planned under the second stand-by arrangement of 1983 could not be disbursed (Ginting and Porter 2006).

The next decade saw a spurt in export earnings, thanks to controversial log export policies, which were questioned by international agencies from environmental protection points of view. There was an economic boom during the 1990s as timber exports to Japan, Korea and Malaysia reached new highs. Average annual economic growth during the first half of the 1990s was about 8 per cent. Exports to Asian countries, however, came to a sudden halt in the late 1990s as the East Asian financial crisis of 1997–1998 abruptly reduced the demand for logs. Further, in addition to the fall in export earnings, the ethnic crisis, which exploded in 1999, severely impacted Solomon Islands' economy, as physical infrastructure and private shops in the capital, Honiara, were destroyed in riots. GDP declined throughout the next six years. All export- oriented projects were closed and international reserves were at a minimum level until 2003 when RAMSI arrived to restore law and order. In the meantime, the SI dollar was allowed to depreciate by 30 per cent and inflation reached a peak of 16 per cent.

The end of ethnic conflict encouraged private sector activities. Export trade in timber resumed in earnest. Many of the suspended foreign investment projects were revived to put the economy on a growth path. The annual growth rate during 2003–2007 averaged 7 per cent. Substantial aid inflows averaging about 49 per cent of GDP helped the country to reduce the current account deficit—which was about 24 per cent of GDP in 2004—to a sustainable

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level of 3 per cent in 2007. The government's fiscal surpluses during 2003–2006 were also due to aid inflows, as well as growth in revenues coming mainly from export taxes and royalties from log exports.

In 2007, the economy grew at an impressive 10.3 per cent—the highest annual growth in 15 years. The growth was due to massive expansion in logging activities, with the forestry sector accounting for 16 per cent of GDP. Exports of round logs rose by 25 per cent. The expansion of logging at an unsustainable scale has brought closer the imminent decline of the forestry sector, which is now forecast to begin as early as 2010, with exports becoming negligible by 2014.

The volatility in fuel and food prices in the early months of 2008 had already exposed the government's weaknesses, especially its fiscal management and its inability to resist demands for increases in public sector wages. In 2008, the GDP growth rate fell to 7 per cent—still the second-highest in the region, after Papua New Guinea, — benefiting from the mineral boom. As fiscal expenditure rose and with continued increases in private sector lending, the budget balance and current account balance deteriorated (CBSI 2008). The continuing global economic recession has posed a challenge, as log exports have been declining. In the midst of calls for a fiscal stimulus package to fight recession, the CBSI's (2009) May 2009 *Monetary Policy Statement* rejected such a move as inadvisable.[2]

The annual fiscal deficits have been posing major problems for the CBSI, as their monetisation has led to excess liquidity. Further, inflows of aid money and a credit boom at a high annual growth rate of 60 per cent during 2005–2007 have compounded the problem. The CBSI and the finance ministry have to coordinate their efforts with a view to reducing inflationary pressures.

Monetary policy formulation and implementation

Structure of the financial system and market

As of December 2008, Solomon Islands' financial sector consisted of five institutions: the CBSI, three commercial banks comprising one domestic bank (National Bank of Solomon Islands) and two foreign commercial banks (Westpac and ANZ), and one state-owned pension fund, the Solomon Islands National Provident Fund (SINPF) (Table 2). A few credit unions and a small insurance sector complete the financial sector.

Table 2 **Solomon Islands financial structure, 2008**

Type of institution	Assets (SI$ million)	Assets (%)	Number of institutions	Percentage of 2008 GDP
Commercial banks	1,841.5	66	3	45
Credit unions	31.4	1	8	1
Insurance companies	74.2	3	3	2
Pension funds (SINPF)	856.6	30	1	29
Total	2803.7	100.0	15	68.5

Source: Central Bank of Solomon Islands (CBSI), 2008. *Monetary Policy Stance 2008*, Central Bank of Solomon Islands, Honiara.

As banking activities are confined largely to urban centres—where formal sector activities are concentrated—the deepening of the financial sector, as reflected in the ratios of narrow and broad money, has been slow. In the absence of vibrant bond and equity markets, there are no attractive financial assets other than saving and time deposits for savers to invest in. Following liberalisation of the economy, including the financial sector, with discontinuance of controls on lending and deposit rates from the late 1980s, the ratio of broad money to GDP has been on the rise.

Monetary framework

Solomon Islands' monetary policy is implemented in the context of a fixed exchange rate arrangement according to which the value of the domestic currency is linked to a trade-weighted basket of currencies comprising the Australian dollar, the Japanese yen, the New Zealand dollar and the US dollar. Two devaluations have taken place: one in the mid 1980s and another after the East Asian financial crisis of 1998. In 2002, soon after the law and order restoration efforts began, the SI dollar was further adjusted downwards—in all, a cumulative 30 per cent devaluation against the US dollar. These adjustments have contributed to keeping the real exchange rate more or less constant. Since 2003, however, the CBSI has maintained a *de facto* peg to the US dollar, effectively serving as a nominal anchor. As substantial aid inflows strengthened the reserves position, the CBSI was keen to maintain a stable bilateral US dollar/SI dollar rate rather than permitting an appreciation (IMF 2006).

In the initial years of their existence, central banks in the Pacific island countries, including Solomon Islands, relied on direct instruments.[3] Direct instruments, also known as rules-based instruments, include: 1) the liquid asset ratio (LAR), a requirement for a bank to hold a minimum amount of specified liquid assets, typically as a percentage of its liabilities; 2) the reserve ratio, a requirement for a bank to hold minimum balances with the central bank, typically as a percentage of its liabilities, known as a statutory reserve deposit (SRD) ratio; and 3) standing facilities, used at the initiative of banks and allowing banks to borrow from (refinance facility) or deposit funds with the central bank (deposit facility).

On the other hand, indirect instruments are linked to money market conditions. These are used at the discretion of the central bank and they bear an interest rate. They include open market operations conducted by the central bank as a participant in the money market. They involve: 1) buying/selling bonds issued by the government and government agencies in the secondary market, and buying/selling assets under a repurchase agreement in the repurchase agreement market, or foreign exchange swaps; and 2) open market-type operations, which are monetary operations based on auction techniques that are regulated by the central bank. They involve primary market issuance of the central bank's own securities or government securities issued exclusively for monetary policy purposes (IMF 2004).

Until 1989, the CBSI did not have any indirect instruments (Box 1). It relied on direct instruments, including LAR and direct controls on credit. In 1989, it launched open market operations (OMO) in its own 91-day paper, known as Bokolo bills, for mopping up excess liquidity. Fiscal dominance and sovereign defaults through the 1990s, however, led to the closure of domestic securities markets and, ultimately, discontinuance of Bokolo bills. They were reintroduced and discontinued between 1992 and 1996. During the interregnum, the CBSI conducted liquidity management operations by using separately issued treasury bills (T-bills). As the CBSI was undertaking OMO in T-bills, it was under

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Box 1 **Solomon Islands monetary policy instruments**

Liquid asset ratio (LAR)

Banks are required to maintain a balance of liquid assets for each working day amounting to not less than 7.5 per cent of deposit liabilities. Before November 2008, the qualified liquid assets were cash and deposits with the CBSI. In November 2008, cash was removed from the definition of liquid assets.

Liabilities qualifying for the purpose of the requirements include

1. demand deposits
2. savings deposits
3. time deposits
4. deposits by non-residents
5. foreign currency deposits by residents.

Standing facilities

Secured advanced facility (SAF): This facility is intended to assist banks with short-term liquidity problems or needs due to specific market situations. This is in accordance with the principal objectives under Section 4 of the *CBSI Act*. The maturity term of the facility is seven days and the interest rate is 2.5 per cent above the interest rate on earning assets as determined by the CBSI. The minimum advance is SI$1 million.

Open market operations

Treasury bills: The CBSI auctions treasury bills with maturities of 7, 14, 28 and 56 days. Originally introduced in the early 1980s, the sales were discontinued in mid 1995.

They were revived about 1999 and were continuing. A cap of SI$30 million was introduced by the CBSI for total T-bills sales. While the instrument remains with the CBSI, the government incurs the cost.

Bokolo deposit facility: This facility was introduced in late 2008 by the CBSI with fixed-term maturities of 12, 18 and 24 months. Interest rates on the facility are 4, 4.25 and 4.5 per cent. The deposit amount is negotiable. The purpose behind the facility is to absorb excess liquidity in the banking system.

pressure. Caution was needed to ensure that the issuance of new T-bills did not undermine budget discipline (IMF 2005).

Given these circumstances, Solomon Islands in recent years used LAR to the fullest extent to reduce liquidity in the banking system and for fighting potential inflationary pressures. The LAR, which was as high as 40 per cent until 1998, was reduced in 1999 to 7.5 per cent of deposit liabilities. Since the CBSI has used T-bills for liquidity management, LAR requirements now exclude T-bills as eligible assets. Currently for LAR calculations, the only eligible assets are the deposits by commercial banks with the central bank. Since there is limited scope for an inter-bank money market to develop in the near future, and there is no secondary market for T-bills, indirect instruments are not likely to emerge as a reliable monetary

policy instrument. Commercial banks have to look to standing facilities offered by the CBSI for meeting liquidity needs, which should eventually develop as a discount facility. Further, as a major departure from past practices, the CBSI has now allowed the Solomon Islands National Provident Fund to invest overseas up to 30 per cent of its investment portfolio (about US$20 million), which has considerably reduced domestic liquidity (IMF 2008).

Solomon Islands ran budget surpluses during 2003–06 thanks to substantial aid inflows, which helped meet recurrent and investment expenditure. In 2007 and 2008, however, the public sector wage bill rose as the opposition was pressing the government to accommodate the claims of the civil service to offset the rise in the fuel price. The rise in food prices in 2008 also led the government to eliminate the goods tax and import duty on rice. With the likely fall in revenues—including export taxes and royalty revenues in the light of the expected decline in timber exports—larger fiscal deficits are anticipated. Monetary conditions have been tightened since 2008, when there was a credit boom—especially growth in personal loans. Further tightening of monetary conditions will be needed if fiscal deficits cannot be prevented (CBSI 2008). Since the authorities are maintaining a *de facto* peg with the US dollar with a view to containing inflation, rather than allowing currency depreciation that would only contribute to increases in landed prices of imports, it is all the more necessary to absorb excess liquidity. Direct instruments are likely to play a more dominant role (IMF 2008).

In fact, the CBSI (2005) has indicated the possibility of a larger role for direct instruments in the near term. These include credit ceilings, changes in LAR and standing facilities if increases in money growth present problems preventing the realisation of the CBSI's objectives. No doubt each has drawbacks: increases in LAR, if unremunerated, would be a tax on intermediation. Bank-by-bank credit ceilings would also distort intermediation. The use of a deposit facility has quasi-implications. On the other hand, use of an indirect instrument, the Bokolo bills, runs the risk of fragmenting the sovereign debt and would also involve costs (Porter 2005).

In Pacific island economies, which have shallow financial markets with a small number of participants, mopping up structural excess liquidity is not easy. Absorbing excess liquidity through open markets, using either government-issued securities or the central bank's own paper, would result in overshooting of interest rates and market volatility (IMF 2004, 2005). In these circumstances, as the CBSI (2005) has indicated, employment of direct instruments including LAR and other quantitative measures such as credit ceilings would be more effective, as they directly affect the volume of liquidity.[4] The experiences of other Pacific island countries are also relevant here.[5]

Monetary policy transmission in Pacific island countries: some limitations

Monetary policy transmission is described as a process through which changes in monetary policy influence aggregate demand, output and the price level. The impact of monetary policy decisions on GDP is through its influences on consumption and investment decisions of households, businesses and financial intermediaries. At least six channels through which monetary policy has an impact on economic activities have been identified: 1) the interest rate channel; 2) the money supply channel; 3) the credit channel; 4) the balance sheet channel; 5) the asset price channel; 6) the exchange

rate channel; and 7) the expectations channel (Mishkin 1995, 1996, 2001, 2006).

Limitations in the island economies

There are constraints on the efficiency of transmission mechanisms acting through various channels. One of the constraints faced by all Pacific island countries, including Solomon Islands, and by countries in the Caribbean region is that in the absence of a well-developed financial sector and a vibrant secondary market, in which financial assets can be traded with ease and speed, the interest rate channel does not operate effectively (Worrell 2000; Fairbairn and Worrell 1996).

The balance sheet approach presupposes that financial assets are important constituents of firms' and consumers' portfolios and assumes the existence of convertibility between illiquid (consumer durables) and liquid (financial) assets. Empirical studies have shown that markets for assets in the Pacific island countries and the Caribbean region have not attained sufficient sophistication to function as an efficient conduit for monetary policy (Baksh and Craigwell 1997). A recent study (Dabla-Norris and Floerkemeir 2006) notes that the inability of banks in developing countries to assess credit risk properly, due to weak risk-management expertise and opaque corporate accounting practices, increases banking spreads and reduces the effectiveness of the balance sheet channel.

With reference to the asset price channel mechanism and its variants of Tobin's *q* theory (valuation of equities), the required precondition—namely, the presence of financial assets constituting a key component of borrowers' and wealth holders' portfolios—does not exist in any Pacific island country. Further, commercial banks dominate the financial sector, since the non-bank financial sector institutions (stock, debt securities and mortgage market, and insurance industry) are still in their infancy. Market financing therefore does not matter, largely precluding the asset price channel working through wealth and income effects (Dabla-Norris and Floerkemeir 2006).

For full efficiency, the exchange rate channel transmission mechanism presupposes a floating system, which adjusts to capital flows. Since Solomon Islands has adopted a fixed exchange rate regime, this particular channel does not operate. In view of the constraints discussed above, it is more likely that in small island economies with undeveloped money markets, monetary pulses are transmitted to the real sector through the money channel rather than through the interest rate channel. The next section undertakes an empirical investigation to test the hypothesis that changes in monetary aggregates are more important than changes in the interest rate.

Variables, data and methodology

For the empirical study, the choice of variables is constrained by data availability. Further, the modelling methodology has to remain simple, given the limited number of annual observations (1980–2007), affording a small number of degrees of freedom. For the analysis, we chose two policy variables — the monetary aggregate and the interest rate. The monetary aggregate is represented by broad money. The interest rate is proxied by the average lending rate, since there is not a consistent data series for the short-term interest rate in Solomon Islands.

The target variables are real output, which is represented by real GDP (*RGDP*), and the price level, which is represented by the CPI (*P*). Besides these variables, we include the nominal exchange rate, to check whether it could be a transmission channel. The nominal exchange rate is expressed as units of the US dollar per unit of domestic

currency.[6] The annual data for the empirical study are drawn from two sources: the monetary and exchange rate data from international financial statistics published by the IMF (2008) and output data from the Asian Development Bank (ADB 2008) and UNESCAP (2008). We can summarise output and monetary statistics during the period 1980–2007 (Table 3).

Bounds testing approach

Since the number of annual observations—only 28—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, Shin and Smith (2001). The ARDL bounds testing model is a general dynamic specification that applies lags of the dependent variable and the lagged and contemporaneous values of the explanatory variables through which short-run impacts can be directly assessed and long-run relationships indirectly estimated. Further, bounds testing allows tests for the existence of a co-integrating relationship between variables in levels, irrespective of whether the underlying regressors are I(0) or I(1) (Pesaran and Shin 1999; Pesaran, Shin and Smith 2001). Pesaran and Shin (1999) established that the estimators of the short-run parameters were consistent and that the estimators of long-run parameters were super-consistent in small sample sizes.

There are two steps involved in estimating the long-run relationship between money, output and other variables. The first step is to test for the existence of a long-run relationship among all variables in the equation. Once a long-run relationship is confirmed, the long-run coefficients are estimated using the associated ARDL model. For econometric analysis, all variables are duly transformed into their natural logs. To examine for co-integration by the bounds test proposed by Pesaran, Shin and Smith (2001), models are constructed for estimation purposes (Equations 1–5).

$$\begin{aligned}\Delta LRGDP_t = {} & \delta_1 + \beta_{11} LRGDP_{t-1} + \beta_{21} LP_{t-1} \\ & + \beta_{31} LM2_{t-1} + \beta_{41} LIR_{t-1} + \beta_{51} LER_{t-1} \\ & + \sum_{i=1}^{p} \alpha_{11i} \Delta LRGDP_{t-i} + \sum_{i=0}^{p} \alpha_{21i} \Delta LP_{t-i} \\ & + \sum_{i=0}^{p} \alpha_{31i} \Delta LM2_{t-i} + \sum_{i=0}^{p} \alpha_{41i} \Delta LIR_{t-i} \\ & + \sum_{i=0}^{p} \alpha_{51i} \Delta LER_{t-i} + \varepsilon_{1t}\end{aligned} \tag{1}$$

Table 3 **Solomon Islands output and monetary statistics**

Years/period	RGDP (%)	Inflation (%)	Interest rate (%)	Exchange rate US$/SI$	M1 (% of GDP)	M2 (% of GDP)
1980–89	7.4	12.5	13.3	0.77	12.2	30.1
1990–99	2.9	10.7	16.2	0.30	14.2	28.5
2000–04	–2.1	8.2	14.5	0.16	15.9	26.6
2005	5.0	7.3	14.1	0.13	24.0	38.5
2006	6.2	11.2	13.9	0.13	27.5	42.6
2007	5.4	7.7	14.1	0.13	32.9	49.0

Source: International Monetary Fund (IMF), 2008. *Staff Report of Art IV Mission*, International Monetary Fund, Washington, DC.

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$$\begin{aligned}\Delta LP_t &= \delta_2 + \beta_{12}LRGDP_{t-1} + \beta_{22}LP_{t-1} \\ &+ \beta_{32}LM2_{t-1} + \beta_{42}LIR_{t-1} + \beta_{52}LER_{t-1} \\ &+ \sum_{i=1}^{p}\alpha_{12i}\Delta LRGDP_{t-i} + \sum_{i=0}^{p}\alpha_{22i}\Delta LP_{t-i} \\ &+ \sum_{i=0}^{p}\alpha_{32i}\Delta LM2_{t-i} + \sum_{i=0}^{p}\alpha_{42i}\Delta LIR_{t-i} \\ &+ \sum_{i=0}^{p}\alpha_{52i}\Delta LER_{t-i} + \varepsilon_{2t}\end{aligned} \tag{2}$$

$$\begin{aligned}\Delta LM2_t &= \delta_3 + \beta_{13}LRGDP_{t-1} + \beta_{23}LP_{t-1} \\ &+ \beta_{33}LM2_{t-1} + \beta_{43}LIR_{t-1} + \beta_{53}LER_{t-1} \\ &+ \sum_{i=1}^{p}\alpha_{13i}\Delta LRGDP_{t-i} + \sum_{i=0}^{p}\alpha_{23i}\Delta LP_{t-i} \\ &+ \sum_{i=0}^{p}\alpha_{33i}\Delta LM2_{t-i} + \sum_{i=0}^{p}\alpha_{43i}\Delta LIR_{t-i} \\ &+ \sum_{i=0}^{p}\alpha_{53i}\Delta LER_{t-i} + \varepsilon_{3t}\end{aligned} \tag{3}$$

$$\begin{aligned}\Delta LIR_t &= \delta_4 + \beta_{14}LRGDP_{t-1} + \beta_{24}LP_{t-1} \\ &+ \beta_{34}LM2_{t-1} + \beta_{44}LIR_{t-1} + \beta_{54}LER_{t-1} \\ &+ \sum_{i=1}^{p}\alpha_{14i}\Delta LRGDP_{t-i} + \sum_{i=0}^{p}\alpha_{24i}\Delta LP_{t-i} \\ &+ \sum_{i=0}^{p}\alpha_{34i}\Delta LM2_{t-i} + \sum_{i=0}^{p}\alpha_{44i}\Delta LIR_{t-i} \\ &+ \sum_{i=0}^{p}\alpha_{54i}\Delta LER_{t-i} + \varepsilon_{4t}\end{aligned} \tag{4}$$

$$\begin{aligned}\Delta LER_t &= \delta_5 + \beta_{15}LRGDP_{t-1} + \beta_{25}LP_{t-1} \\ &+ \beta_{35}LM2_{t-1} + \beta_{45}LIR_{t-1} + \beta_{55}LER_{t-1} \\ &+ \sum_{i=1}^{p}\alpha_{15i}\Delta LRGDP_{t-i} + \sum_{i=0}^{p}\alpha_{25i}\Delta LP_{t-i} \\ &+ \sum_{i=0}^{p}\alpha_{35i}\Delta LM2_{t-i} + \sum_{i=0}^{p}\alpha_{45i}\Delta LIR_{t-i} \\ &+ \sum_{i=0}^{p}\alpha_{55i}\Delta LER_{t-i} + \varepsilon_{5t}\end{aligned} \tag{5}$$

In Equations 1–5, Δ is the first difference operator and the ε_{it} are white noise error terms. The joint significance of the lagged levels in these equations is examined using the F-test, in which the null and alternative hypotheses are expressed as follows.

For Equations 1–5

$H_0 : \beta_{1i} = \beta_{2i} = \beta_{3i} = \beta_{4i} = \beta_{5i} = 0$

(there is no long-run level relationship)

$H_1 : \beta_{1i} \neq \beta_{2i} \neq \beta_{3i} \neq \beta_{4i} \neq \beta_{5i} \neq 0$

(there is a long-run level relationship)

in which $i = 1,2,...,5$.

The distribution of the F-statistics is non-standard under the null hypothesis and testing the hypothesis. If the computed F-statistic is greater than the upper critical bound value, the null hypothesis of no co-integration is rejected, irrespective of whether the variable is I(0) or I(1). In contrast, when the F-statistic is smaller than the lower critical bound value, the null hypothesis is not rejected, and we conclude that there is no long-run level relationship between the variables under study. If, however, the computed F-statistic lies between the lower and upper critical bound values, there is inconclusive inference unless the order of integration of the series under consideration is clearly examined.

Results and discussion

Bounds testing results

The results of the bounds tests are reported (Table 4).[7] The computed F-statistics for the real output equation suggest rejection of the null hypothesis of no co-integration. The null hypothesis is, however, not rejected for other equations. This finding shows that there is a long-run equilibrium relationship between real output, prices, the money variable (M2), the interest rate and the exchange rate.[8]

Table 4 **Bounds test results**

Dependent variable	Computed F-statistic
LRGDP	8.877***
LP	1.3304
LM2	0.4546
LIR	1.1478
LER	1.7097

Pesaran, Shin and Smith (2001)[a]

Critical value	Lower bound value	Upper bound value
1 per cent	3.41	4.68
5 per cent	2.62	3.79
10 per cent	2.26	3.35

[a] Critical values are obtained from Pesaran, M.H., Shin, Y. and Smith R., 2001. 'Bounds testing approaches to the analysis of level relationships', *Journal of Applied Econometrics*, 16:Table CI(iii) Case III: Unrestricted intercept and no trend, p. 300.
* significant at 10 per cent
** significant at 5 per cent
*** significant at 1 per cent

The results of estimation of an unrestricted error correction model (UECM) for real output are reported (Table 5). The short and long-run elasticity estimates are presented (Table 6). The model is adequate since the results of a battery of tests indicate that the disturbance terms are normally distributed and are serially uncorrelated with the residuals, confirming the model has the correct functional form (Table 5: Panel III). Moreover, the CUSUM and CUSUM of squares plots show that the parameters of the model are stable over time.[9]

As shown in Table 6, the estimated long-run coefficient of the money variable (M2) has a positive sign, which is also found to be statistically significant. The estimated coefficient of price, which has the theoretically expected sign, is also significant. Although the coefficient on the interest rate variable has a positive sign, it is not statistically significant. The exchange rate coefficient has a positive sign in the short run and a negative sign in the long run, indicating that a devaluation strategy would not be effective in stimulating economic growth in the short run but would lead to an increase in the long run.

Variance decomposition analysis

Since the variables are all I(1), we resort to the VAR model in first differences for conducting the variance decomposition analysis.[10] We order the policy variables first—namely, the monetary aggregate (*LM2*), the interest rate (*LIR*) and the exchange rate (*LER*)—followed by the target variables: prices (*LP*) and real output (*LRGDP*).[11] The results of the decomposition analysis of real output are shown (Table 7).

Real output in Solomon Islands is very sensitive to its own shocks and the money variable. It is found that substantial variability in output—about 82 per cent—is explained by its own shock in the first year, and that this slowly decreases in the

Table 5 **ARDL model for real output (LRGDP) equation**

I. Results

Variable	Coefficient	t-statistic	Probability
$LRGDP_{t-1}$	–0.2689	–2.2743*	0.0525
LP_{t-1}	–0.9463	–5.4096***	0.0006
$LM2_{t-1}$	0.4892	5.7576***	0.0004
LIR_{t-1}	0.1518	1.0632	0.3187
LER_{t-1}	–0.5328	–3.4015***	0.0093
C	1.4037	2.0074*	0.0796
$\Delta LRGDP_{t-2}$	–0.7748	–4.3700***	0.0024
$\Delta LRGDP_{t-4}$	–0.4191	–2.7408**	0.0254
$\Delta LRGDP_{t-6}$	0.4080	2.1807*	0.0608
ΔLP_{t-2}	–0.9125	–2.0553*	0.0739
$\Delta LM2$	0.3908	5.8180***	0.0004
ΔLIR_{t}	0.1066	0.7807	0.4574
ΔLER_{t-2}	0.5493	3.9619***	0.0042

II. Model criteria/goodness of fit

R-squared	0.9327	Akaike info criterion	–4.4187
Adjusted R-squared	0.8317	Schwarz criterion	–3.7721
SE of regression	0.0232	F-statistic	9.2389***
Durbin-Watson statistic	1.9372	Probability(F-statistic)	0.0020

III. Diagnostic checking

a) Autocorrelation (Breusch-Godfrey serial correlation LM test):

F(1) = 0.0061 [0.9399] F(2) = 0.1579 [0.8574]

F(3) = 0.6404 [0.6211] F(4) = 0.8154 [0.5760]

b) ARCH test:

F(1) = 1.5038 [0.2359] F(2) = 2.1074 [0.1540]

F(3) = 2.0486 [0.1533] F(4) = 1.0607 [0.4175]

c) Ramsey RESET specification test:

F-statistic = 2.8593 [0.1342]

* significant at 0.1 marginal level
** significant at 0.05 marginal level
*** significant at 0.01 marginal level
Notes: Lag length given in parentheses and probability value stated in square brackets; *C* represents the intercept term, Δ is the first difference operator.

Table 6 **Short-run and long-run elasticities**

Variable	Short run	Long run
LP	–0.9125*	–3.5194***
LM2	0.3908***	1.8193***
LIR	0.1066	0.5644
LER	0.5493***	–1.9815***
Intercept	-	5.2203*

- zero
* significant at 0.1 marginal level
** significant at 0.05 marginal level
*** significant at 0.01 marginal level

Table 7 **Variance decomposition analysis for real output**

Period	SE	LRGDP	LP	LM2	LIR	LER
1	0.0567	82.4254	0.0000	14.2634	1.1933	2.1179
2	0.0803	60.8904	0.0152	29.0145	4.1351	5.9448
3	0.0980	45.8006	0.8971	36.4032	12.1980	4.7012
4	0.1142	35.0764	1.5263	41.5001	17.7048	4.1924
5	0.1261	29.2333	2.8088	43.2820	19.6528	5.0232
6	0.1341	25.8282	3.9443	44.0887	20.0011	6.1378
7	0.1387	24.5240	4.6719	44.0363	20.2426	6.5251
8	0.1410	25.0721	4.9017	43.2965	20.2062	6.5235
9	0.1427	26.6954	4.8763	42.2618	19.7600	6.4064
10	0.1450	28.2930	4.7235	41.4673	19.3091	6.2072

Notes: Cholesky ordering—LM2, LER, LIR, LP and LRGDP. We tried different orderings of the variables but the findings were robust to changes (see Note 12).

Table 8 **Variance decomposition analysis for prices**

Period	SE	LRGDP	LP	LM2	LIR	LER
1	0.0213	0.3876	67.9721	24.8599	0.1086	6.6718
2	0.0250	6.4640	60.2950	20.4680	1.9942	10.7789
3	0.0303	11.5993	46.4619	21.5488	3.5503	16.8397
4	0.0350	9.9921	35.8344	22.6296	6.3277	25.2162
5	0.0406	9.1061	27.2472	23.0266	9.1104	31.5098
6	0.0457	10.0115	21.6223	21.9673	12.5010	33.8979
7	0.0506	12.1981	17.7795	20.2227	14.8443	34.9555
8	0.0549	14.6638	15.1483	18.1360	15.7582	36.2937
9	0.0588	17.3018	13.2746	16.1377	15.6721	37.6138
10	0.0622	20.0716	11.9384	14.4329	15.2224	38.3347

Notes: Cholesky ordering—LM2, LER, LIR, LP and LRGDP. We tried different orderings of the variables but the findings were robust to changes (see Note 12).

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medium term (fifth year) to 29 per cent, and to about 25 per cent in the long run (at a 10-year horizon). The monetary aggregate explains 14 per cent of the variability in output in the short run, increasing to 43 per cent in the medium term, and thereafter steadying at about 42 per cent. In contrast, real output is not very responsive to the interest rate and the output response to the exchange rate is the least.

With regards to the price level (Table 8), the analysis shows that about 68 per cent of the variability in prices is explained by its own shock in the first year. The impact declines, however, over the rest of the time horizon. The money variable is the most important determinant in explaining the variability in prices—in the short and long run. Twenty-five per cent of the variability in prices is explained by the monetary aggregate in the first year, and the proportion steadies at about 23 per cent in the medium term and declines to 14 per cent in the long run. A shock to the interest rate has a negligible effect on prices in the short run as well as in the medium and long term. Only about 7 per cent of the variability in prices is explained by a shock of the exchange rate in the first year. Over time, however, the impact of the exchange rate on prices increases to 32 per cent in the fifth year and climbs to 38 per cent in the long run.

Impulse response analysis

The impulse response function (IRF) enables us to trace the response of output to a shock in the policy variable. The shock is represented by a one standard deviation of the error term in the underlying structural model for the variable. Since all variables are measured in log form, the impulse response functions trace a growth rate relative to the base period when the shock occurred. The IRF has an additional advantage— it indicates whether the effect is positive or negative. For investigating the IRF with regard to the output model by the Choleski decomposition, we adopt the same ordering of variables as for the variance decomposition analysis.

The response of output to shocks in the monetary policy variables and prices is shown (Figure 1). A shock to prices has a negative impact—although negligible—on output, which is also not significant. The response of real output to a shock in the monetary aggregate is not only positive, it increases significantly over the first two years, as the lower confidence interval (the two standard deviation band denoted by a dotted line) crosses the zero line. The response of real output to a shock in the interest rate is not significant as the lower two standard deviations are below the zero line for the entire time horizon. The response of real output to a shock in the exchange rate is negative and significant.

Table 9 **Correlation matrix of the reduced form of the VAR residuals**

	LRGDP	LP	LM2	LIR	LER
LRGDP	1	0.1730	0.3777	0.0892	–0.0629
LP	0.1730	1	0.4986	0.0297	–0.1477
LM2	0.3777	0.4986	1	–0.1433	0.2102
LIR	0.0892	0.0297	–0.1433	1	–0.2940
LER	–0.0629	–0.1477	0.2102	–0.2940	1

Note: See Note 11.

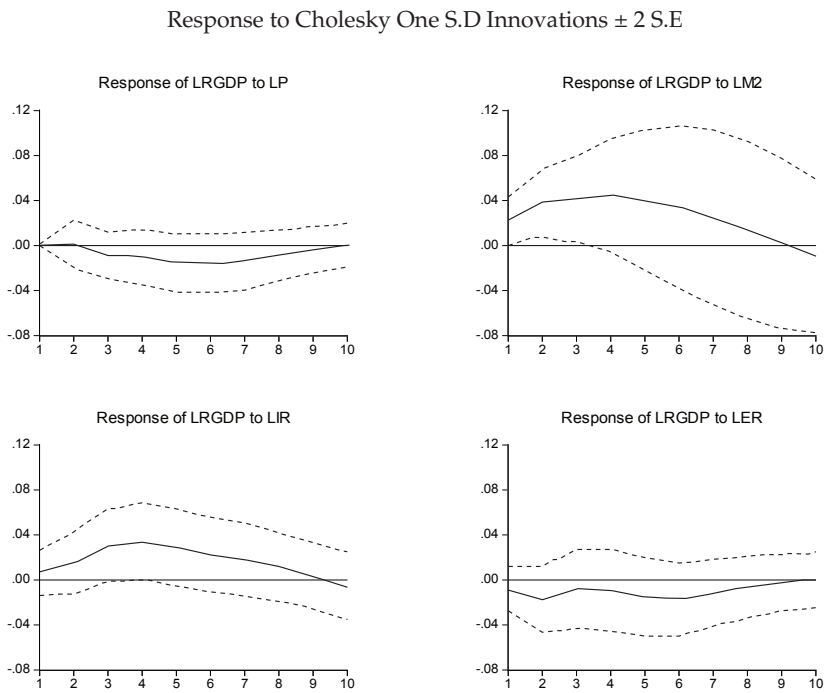
The responses of prices to shocks in M2, the interest rate, the exchange rate and real output are shown (Figure 2). Prices respond immediately and significantly to changes in real output—that is, prices decline sharply in the first two years and then slowly steady over the rest of the time horizon. Prices are seen to be very sensitive to monetary shocks in the first year as prices rise quickly and decline quickly, as the lower confidence interval line (dotted line) crosses the zero line just before the second year. Thereafter, the decline is not significant. The response of prices to shocks in interest rates is not significant throughout the period, as the confidence interval line is well below the zero line. Prices respond negatively and quickly to shocks in the exchange rate, and the response is significant.

The results of variance decomposition and the impulse response function analysis lead us to conclude that monetary aggregates play a significant role in explaining changes in output and the price level, whereas the effect of changes in the interest rate on output and price is not statistically significant.

Summary and conclusions

The monetary policy transmission mechanism in industrialised and developing countries has been well documented in a growing body of empirical literature. There is, however, no such study on Solomon Islands, which is one of the five Pacific island countries with an independent currency under a fixed exchange rate regime.

Figure 1 **The results of impulse response function analysis for real output**

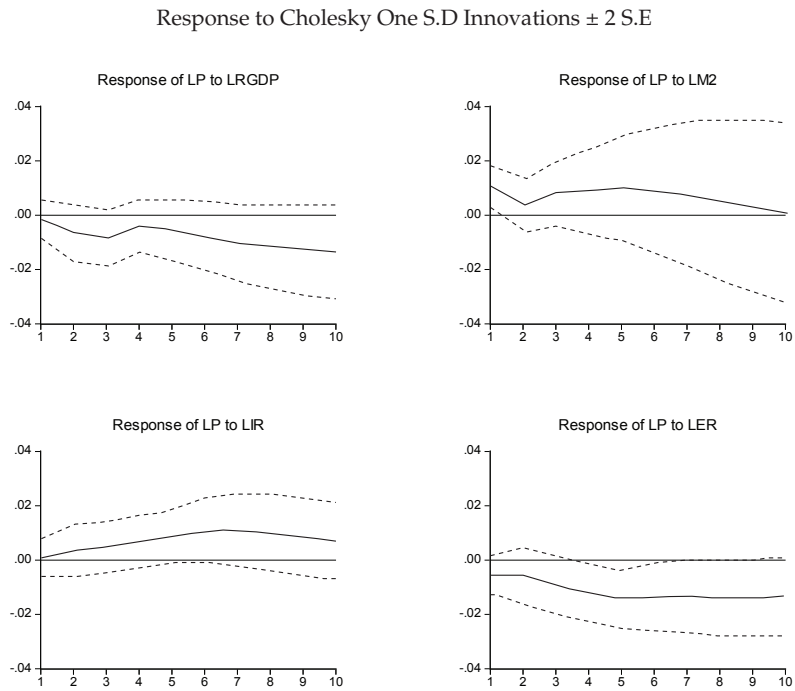


This article is an attempt to fill the gap by undertaking an investigation into how changes in monetary policy influence the real sector in Solomon Islands. The financial sector in Solomon Islands is small. Treasury bills dominate the money market, which is shallow with few participants, just as long-term government bonds saturate the capital market. Further, there are no secondary markets for short and long-term debt securities.

The findings of the study are: 1) there is a long-run relationship between real output, prices, monetary aggregates, the interest rate and the exchange rate; 2) in the long-run relationship between real output and the independent variables tested, the interest rate does not play a significant role; and 3) monetary aggregates play a major role. Further, variance decomposition and impulse responses function analysis show that the monetary aggregate is the most significant variable in explaining the changes in real output and the price level in Solomon Islands.

These conclusions are consistent with the findings of studies in most of the developing world that money markets are not the principal conduit of monetary policy shocks. The policy implications are that, given the current nature of the money market and the limited government debt instrument holdings, monetary easing can be resorted to only through foreign exchange operations. With a wider daily trading band, and with the exchange rate pegged to the US dollar, which has recently been depreciating against all major currencies, a depreciation of the SI

Figure 2 **The results of impulse response function analysis for prices**



dollar would enable the country to earn greater reserves. The banks are required to sell foreign exchange to the central bank under the existing limits, which will increase domestic liquidity. The IMF has been advising the CBSI to issue short-term bills of 28 days' maturity to manage liquidity, which will eventually facilitate development of greater inter-bank activity.

Until effective inter-bank activities develop and open market operations in CBSI bills become regular enough to influence short-term market interest rates by injecting or mopping up excess liquidity, the CBSI has to depend on direct instruments aimed at monetary aggregates.

Notes

1 The dollarised economies, which use one of the three major regional currencies as legal tender, are Kiribati, Nauru and Tuvalu (AU dollar); Cook Islands and Niue (NZ dollar); Marshall Islands, Federated States of Micronesia and Palau (US dollar).

2 The *Monetary Policy Statement* (CBSI 2009) issued in May 2009 says 'It would not however be appropriate for Solomon Islands to implement such a program at this juncture as the cost would be prohibitive, it would encumber the nation with further debts and provide very little boost to the economy given the supply constraints of the economy and the dependence on foreign demand.'

3 When the central bank uses direct instruments, its aim is to change the balance sheets of commercial banks. By so doing, there is a one-to-one correspondence between, say, the credit ceiling and commercial loans. On the other hand, when the central bank uses indirect instruments, the aim is to change its own balance sheet. For example, if the central bank undertakes sales of its own security, it acquires additional reserves, thereby absorbing funds from the economy. If there is a stable relationship between reserve money and aggregate demand, indirect instruments will be effective.

4 The IMF (2004) observed that there were insufficient market instruments for liquidity management, noting the existing excess reserves were almost six times the stock of T-bills and almost twice the T-bill issuance permitted under the then existing prospectus (SI$100 million).

5 The IMF (2005) reported that central banks in Tonga and Vanuatu had to rely eventually on imposing bank-by-bank credit ceilings and raising LAR for controlling liquidity. The IMF (2005) cites the experiences of industrialised countries in this regard: the use of reserve requirements (Spain), mandatory deposits (Mexico and The Netherlands) and moving deposits from commercial banks to the central bank (Malaysia and Thailand).

6 The reason for using the nominal exchange rate is that one can isolate changes in the nominal exchange rate on real economic activity separately from changes in prices. Since the real exchange rate is already adjusted for changes in prices, using the real exchange rate would make it difficult to isolate price changes (inflation) from exchange rate changes (Dabla-Norris and Floerkemeir 2006).

7 Although the bounds-testing procedure did not require testing for unit roots, we undertook the investigation and found all the variables were I(1). The test results will be made available on request.

8 Narayan and Smyth (2005) have extensively discussed the inclusion of a time trend variable in the estimation. Since the time trend variable was found to be insignificant in our first-stage estimations, we decided to omit it.

9 The figure is provided in the Appendix.

10 We are grateful to Professor Gary Koop for advice on this point through personal correspondence.

11 We tried different orderings of the variables. With a view to evaluating the robustness of the VAR results—which varied according to different orderings of the variables and different lag lengths—the correlation matrix of the reduced-form VAR residuals based on the ordering was examined. The elements of the correlation matrix between M2 and the rest of the variables are low, indicating

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that contemporaneous feedback is not a problem. These correlations suggest that the ordering of the variables in the Choleski decomposition is not of any major concern (see Table 9).

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Appendix

Figure A1 **Plot of CUSUM test for real GDP (LRGDP) equation**

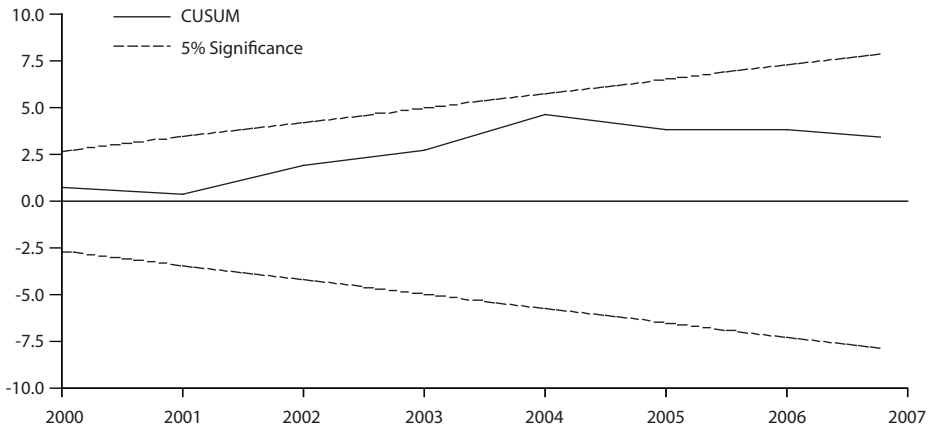
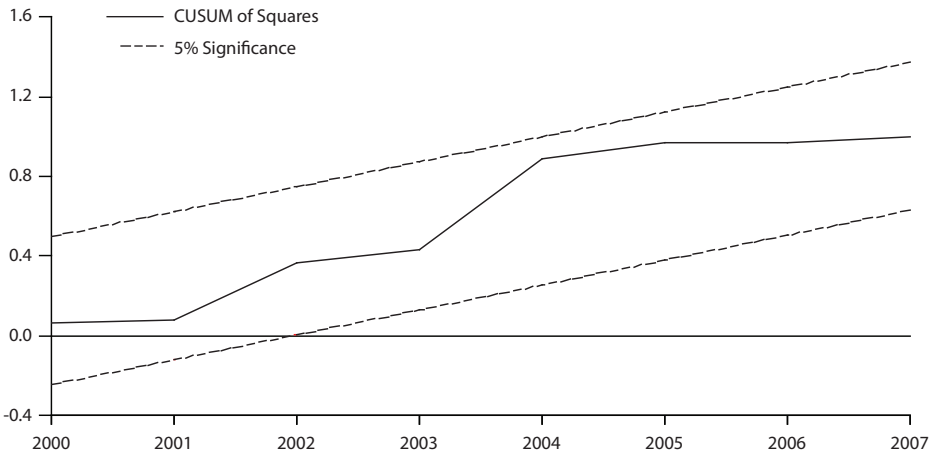
Figure A2 **Plot of CUSUM of squares test for real GDP (LRGDP) equation**