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# How does monetary policy affect real sector of Papua New Guinea?

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## ABSTRACT

*Amongst the 14 independent Pacific island Countries (PICs), Papua New Guinea (PNG) is unique in several aspects. It is the largest island country in terms of both geographical area and population. Unlike other PICs, it is richly endowed with mineral and non-mineral resources and hence its exports are much more diversified. Mineral and non mineral tree exports since the mid 1990s have helped the country to emerge with trade surpluses and build up international reserves. Prudent monetary and fiscal policies especially have helped PNG to create sufficient fiscal space to fight the adverse effects of the ongoing global recession since 2008. PNG is the only PIC with a floating exchange rate regime unlike the other five PICs which have currencies of their own. The amended Central Bank Act of 2000, which set price stability as primary macroeconomic goal of the Bank of PNG, the country's central bank has further empowered it with greater autonomy than ever before. This chapter examines the effectiveness of monetary policies pursued so far under different elected governments and under different economic conditions with specific focus on transmission mechanism of monetary policy during the last 31 years (1979-2009).*

## I. INTRODUCTION

Amongst the 14 Pacific island countries (PICs)[1], eight are dollarized economies[2]. The dollarized countries, having adopted one of the currencies of three major economies in the region as legal tender since their political independence, do not have the luxury of pursuing independent exchange rate policies and monetary policies of their own. The other six PICs, which have independent currencies, are Fiji, Papua New Guinea (PNG), Samoa, Solomon Islands, Tonga and Vanuatu. Amongst the six, PNG is the only PIC with a floating exchange rate arrangement, while all the other five have fixed exchange rate regimes.

In economies under pure flexible exchange rate regime, adjustment to reach equilibrium automatically falls on exchange rate. Such an exchange rate regime is also expected to eliminate the need for keeping any level of official reserves to defend the exchange rate. With greater autonomy bestowed by the amended Central Banking Act of 2000[3], PNG's central bank, the Bank of PNG (BPNG) was expected to pursue a more effective monetary policy without interference from the government.

The major objectives of BPNG are: (i) price stability; (ii) stability of financial sector; (iii) an efficient national and international payments system; and (iv) economic growth. The BPNG has pursued its mandated objectives during the last four decades with mixed success. Its monetary policy measures include direct instruments such as statutory reserve requirement ratio and credit control measures, and indirect instruments such as open market operations in its own securities to influence the short term interest rate.

There are only two studies available on the effectiveness of PNG's monetary policy, with special focus on transmission mechanism. The study by Faal and Isnawangsih (2008) covered a period of 6 years (2001-2006), employing 72 monthly observations on monetary variables. As PNG's national income accounts data are reported only on annual basis, the aforementioned two authors generated monthly real gross domestic output (RGDP) data from annual figures and monthly price index from quarterly

[1] The 14 independent Pacific island countries (PICs), which are the members of the formal inter-governmental organization, known as Pacific Islands Forum (the Forum) are: Cook Islands, Fiji, Kiribati, Federated States of Micronesia, Marshall Islands, Nauru, Niue, Palau, Papua New Guinea, Samoa, Solomon Islands, Tonga, Tuvalu and Vanuatu. The Forum also includes the two advanced countries, Australia and New Zealand.

[2] The legal tender of Cook Islands and Niue is the New Zealand dollar; of Kiribati, Nauru and Tuvalu, the Australian dollar; and of Palau, Federated States of Micronesia and Marshall Islands, the United States dollar.

[3] The objectives of BPNG are laid down by the Central Banking Act 2000 in Section 4: (a) to formulate and implement monetary policy with a view to achieving and maintaining price stability; (b) to formulate financial regulation and prudential standards to ensure stability of the financial system in Papua New Guinea; and (c) to promote an efficient national and international payments system; and (d) subject to the above, to promote macro-economic stability and economic growth in Papua New Guinea.

consumer price index[4]. The other study by Ahmed (2003), which covered a longer period of 30 years (1974-2003), employed a quarterly model, utilizing 120 quarterly observations. Again in the absence of quarterly GDP data, quarterly figures of GDP were mathematically generated, utilizing the Gandolfo procedure (Gandolfo 1980).

The drawbacks of these two studies, which employed artificially created monthly or quarterly data time series, are apparent. They cannot be used for for forecasting purposes. Differing from such procedures, our study utilizes the annual data. Since the time series cover only a 40-year period (1970-2009), the bounds testing approach is used, which does not require a large sample size data, unlike the Johansen and Juslieus (1990) cointegration methodology. The objective of this chapter is to review the past monetary policy measures and assess the effectiveness of the monetary policy measures employed by BPNG to achieve its mandated objectives with specific focus on monetary policy transmission mechanism.

The chapter is organized as follows: Section 2 provides a brief background of the country's economy. Section 3 reviews monetary policy developments since the inception of BPNG. Section 4 outlines various transmission mechanisms as studied in advanced and developing economies and their limitations when applied to island economies. Section 5 deals with the methodology adopted for the empirical analysis. Section 6 reports the results and Section 7 presents some conclusions with policy implications.

## II. PAPUA NEW GUINEA: A BRIEF ECONOMIC REVIEW

Papua New Guinea, which attained independence in 1975, is the largest of all PICs in terms of both land area and population. Selected key indicators are given in Table 1. The country has abundant mineral resources which include copper, petroleum and natural gas.

[4] The annual GDP series is converted into a monthly series using quadratic match sum feature in Eviews and the quarterly CPI series is converted using the linear match last feature.

**Table 1: PNG: Selected key indicators**

| | |
|---|---|
| Land Area (Sq.km.'000) | 463 |
| Population (2009: million) | 6.4 |
| Per Capita GDP (US$) Current prices : 2009 | 1,235 |
| Human Development Ranking (2007) | 148 |
| Annual Average Growth Rate in percent (2005-2009) | 4.9 |
| Annual Average Inflation in percent (2005-2009) | 4.6 |
| Overall Budget Balance as percent of GDP (2005-2009 | 0.7 |
| Current Account Balance (% of GDP) (2005-2009) | 5.4 |
| Domestic Public Sector Debt (% of GDP):2009 | 19.6 |
| External Debt (% of GDP):2009 | 26.9 |
| Debt Service Ratio (% of XGS) :2009 | 7.0 |

**Source: World Bank (2011) ADB (2010), UNESCAP (2008, 2009).**

PNG is prone to natural disasters. Notable among them in recent years, which severely affected the lives of people, were a major volcanic eruption and two cyclones in the mid 1990s and and *El-Nino* drought in the late 1990s. Besides, there were manmade disasters as well, which included closure of Bougainville copper mine in 1989 following domestic unrest associated with Bougainville crisis and other inter-provincial rivalries and periodical land disputes[5].

***Commodity exports based growth***

PNG's economic growth since independence in 1975 has been powered by mineral and tree crop exports performance. Thus, its export base is well diversified: mineral exports, including copper, petroleum and natural gas; and tree crops including coffee, cocoa, copra and tea. The government for its revenues is dependent on levies on and royalty incomes. Earnings from copper exports in the 1980s and petroleum boom in the 1990s were however frittered away soon by expansionary fiscal policies, which consisted of wasteful government expenditures, ending in fiscal deterioration and external imbalances. As macroeconomic adjustments were needed, the government approached International Monetary Fund (IMF) for assistance. Two Stand-By arrangements during 1990-92 and a third in 1995 rescued the country from the brink. However, subsequent fall in mineral exploration activities, deterioration in physical infrastructure in rural areas, the 1997 drought and the closure of copper mines, and contraction in external demand for exports and law and order problems put the economy in poor shape. As

[5] Land disputes arise from the country's unique customary land tenure system, which is the common feature of Pacific island countries. Under this system, ownership of land is vested in communities. Land can be held on lease and its ownership cannot be transferred to any one individual or a group. The property rights under lease are often challenged by members of the community and the terms of contract are changed. Poor enforcement of contracts by legal system has often disrupted land based economic activities, including factories and hotels.

private capital outflows increased, the domestic currency, kina, depreciated despite central bank intervention (Marciniak 2006).

***Expansionary policies of the 1990s***

However, as the pick-up of the economy was too slow, the government decided in the second half of 1990s to launch expansionary policies. These included tax reductions, agricultural export subsidies and regular transfers to unviable state owned enterprises, which all led to persistent expenditure excesses,. As a result there were massive annual budget deficits in a row. Further, PNG's public debt rose to 60 percent of GDP in 1996 from 45 percent in 1990. Balance of payments crises ensued and the international reserves dwindled at one point to a half-month of non-mineral imports. Events forced PNG to resort to a floating exchange rates regime in 1994 which brought in a measure of external stability, though only for a short period. Sharp contraction in exports due to drought in 1997 and Asian financial crisis caused another current account crisis. Budgetary reforms introduced in 1999 restored some stability. However, in the months leading up to the 2002 elections, the familiar fiscal excesses were again indulged in by the incumbent government to re-capture power, which led to deterioration of both budget and current account balances.

Reviewing PNG's economic developments during a twenty five-year period, Marciniak (2006) noted that economic performance since independence in 1975 has fallen short of potential with per capita income in 2004, hardly above its 1975 level. There were three years of negative growth following the assumption of a new government in 2002. PNG's economy began to pick up in 2005, as growth was aided this time by more sensible fiscal and monetary policies as well as by export boom. Budget deficits were brought under control and monetary tightening measures followed. Higher mineral export revenue receipts following the international commodity boom and lower non-mineral imports contributed to rise in international reserves by 2005 and helped the turnaround in the economy to materialize. Massive rise in mineral revenue boosted government revenues from 28 percent of GDP in 2002 to 36 percent of GDP in 2006 and debt was reduced to 35 percent of GDP. Inflation fell to 5 percent.

***Effects of commodity price boom-bust cycle***

In 2007, aside from mineral boom, strong growth was also seen in non-mineral sectors, including construction, telecommunication and agriculture. After decades of stagnation, formal sector employment grew by a quarter in 2005-2007. The commodity boom continued in 2008 and PNG's growth rate rose from 6.7 percent to 7.3 percent in 2008. The fall in global commodity prices in 2008 and 2009, following the financial crisis since late 2007, affected all the commodity export based economies including PNG. The resilience of the commodity based economies is evaluated whether during the prosperity phase the governments invested the boom revenues in physical infrastructure and human capital or frittered away the valuable resources on

unproductive and wasteful projects including giving a huge rise in salaries and wages to civil servants.

Past experiences in the boom-bust cycle have shown the economy of PNG grew when the commodity boom contributed to the prosperity all around: government expenditures increased, including wages and salaries of civil servants and other recurrent expenditures, leaving less for capital expenditures. When the boom busted due to worldwide recessionary conditions, the large downturn in the prices of exports of PNG, mineral and non- mineral commodities, including coffee, tea and, cocoa affected the government revenues and GDP, as government did not have resources to maintain the earlier levels of expenditures. One such boom-bust phase was the 1990s, which is called 'the lost decade" of PNG. During the boom phase of the 1990s, mineral and non-mineral export receipts grew but the government poorly managed its revenues. As a former PNG Governor noted remarked, the nation was deprived of "an opportunity to set the stage for progress and growth" (Kamit 2009).

In the next phase of boom-bust episode (2004-2009), unlike in the previous decade, PNG was careful. It set aside the windfall gains from high commodity prices in 2007 and the first half of 2008 in various trust accounts (Kamit 2009). Further, sensible fiscal policies pursued since 2004 have put the government finances in good shape. The government was also successful succeeded in reducing its debt. The debt ratio which in 2001 was 71 percent of GDP was reduced to 30 percent in 2008. Debt servicing expenditure was also reduced leaving greater savings for investment. Using these carefully saved resources, PNG was ready to handle the recessionary conditions by maintaining the boom levels of expenditures. Further, as the kina appreciated against the US dollar as well as the Australian and New Zealand currencies, inflation was also be kept down.

***Prudent policies***

Thanks to the prudent fiscal policies pursued during 2004-2007, PNG was able to face the challenges posed by global economic downturn since 2008. Although lower export income reduced government revenues in 2009, the government decided to increase the public expenditures to meet the fall in aggregate demand. Consequently, the budget deficit widened. Public expenditures rose which were funded by heavy a drawdown from trust funds, which were generated and kept away during the boom period. Monetary conditions were also made favorable as the policy rate at 8 percent was kept unchanged. Economic growth in 2009 was at a healthy 5.5 percent.

As commodity prices improved in late 2009, and export volumes picked up aided by a faster than expected economic recovery in Australia and a steady Chinese demand for mineral resources, PNG's *kina* began to appreciate against the US dollar. BPNG intervened in the foreign exchange market by buying foreign currency for preventing the kina from appreciating. In 2009, the international reserves rose to US$ 2.2 billion,

equal to 14 months of non-mineral import cover and equal to 6.2 months of all imports cover.

***Massive investment in natural gas project***

Economic growth picked up in 2010 to around 7 percent in 2010, which was supported by a much stronger rise in commodity prices than in 2009 as well as by new project investments. The latter included activities in the mineral sectors, notably by a US$15 billion million ExxonMobil-led liquefied natural gas (LNG) project, the investment cost of which was estimated to be around 190 percent of country's GDP. The LNG project is expected to be completed by 2015. Other private investment and business activities have also risen due to the emergence of large spill over opportunities offered by LNG project. The current account deficit increased to about 30 percent of GDP, due to a big spurt in imports, mainly for LNG project construction. However, foreign exchange reserves in 2010 were at US$ 2.7 billion equivalent to about 16 months of non-mineral imports of goods and services and about 5 months of all imports. As a result of rise in demand for domestic inputs, including labour services and rental properties, inflation rate rose to reach 7.2 percent in 2010.

The latest assessment by IMF (2011a) of PNG's growth prospects ( the projected growth rate for 2011 is 9 percent as against 7 percent in 2010), mainly driven by LNG project and mineral exports, strikes a note of caution by recognizing the inherent risks associated with mineral resource endowed economy embarking on ambitious path to growth primarily based on exports. The LNG project has already pushed up demand for limited non-tradable domestic inputs including labor, giving rise to an unprecedented rise in inflationary pressures. Added to these domestic pressures on price level, steady increase in world food prices have also been contributing to rise in inflation since early 2011. The predicted inflation for 2011 is above 8 percent as against 6 percent in 2011 (Table 3).

***Emergence of strong kina***

Large capital inflows associated with LNG project and receipts of mineral exports have led to appreciation of kina in early 2011. An appreciating kina would help to reduce imported inflation and overheating pressures. The urban sector, which consumes imported consumer goods to a much larger extent than the rural sector, would welcome a strong kina. However, it is the rural poor, which would be adversely affected. A strong kina would hurt traditional exports and incomes in rural areas, which centre around non-mineral, tree crop exports such as coffee, cocoa, copra and tea, would be severely curtailed. As IMF (2011b) notes, the authorities are not targeting any specific exchange rate. With rise in inflation, real exchange rate would also rise, hurting competitiveness of exports. If exchange rate is defended and not left to market forces, despite being under a floating regime, macroeconomic adjustment measures are needed to curtail fiscal side of aggregate demand. In circumstances, formulation of fiscal policies need

close consultation with central bank and there should be coordination of monetary and fiscal policies at their implementation.

## III. A REVIEW OF BPNG'S MONETARY POLICY MEASURES DEVELOPMENTS

### *PNG's financial sector*

The financial sector of PNG comprises a central bank, four urban- oriented commercial banks (one domestic bank, subsidiaries of two Australian banks and one Malaysian bank), one state owned and non-deposit taking, national development bank, which is primarily focused on provision of credit to productive enterprises in rural sector and a number of non-bank financial institutions, and insurance companies (Table 2). The non-bank financial sector is dominated by the authorized superannuation funds, which own nearly 70 percent of the financial assets in non-bank sector. However, it is the commercial banks which dominate the financial sector, owning 68 percent of total financial sector assets. All the institutions are licensed, regulated and supervised by the central bank.

The financial sector is at a nascent stage of development, as only about 10 percent of population and 17 percent of adults have access to financial services offered by financial sector institutions. In the rural sector, only 15 percent of adults are covered. The overall financial deepening is, thus, seriously constrained by poor status of access to financial services. The three large banks (two Australian and one domestic bank) were largely, domestically funded with minimal exposure to overseas held assets.

**Table 2: PNG's Financial Sector (2010)**

| Sector Institutions | Assets in billion kina | Assets as percent of Total |
|---|---|---|
| Commercial Banks | 16.7 | 68.3 |
| National Dev Bank | 0.2 | 0.8 |
| Superannuation Funds | 5.5 | 22.3 |
| Other Non-banks | 2.1 | 7.9 |
| **Total** | **24.5** | **100** |

**Source: IMF (2011b)**

The indicator of financial deepening (the ratio of broad money to GDP) is around 45 percent to 47 percent of GDP during last five years (2005-2009). Financial assets comprise bonds and treasury bills issued by government and government agencies, which are held by a small number of participants in the capital markets. The stock market is at an infant stage. There is no active, secondary market of significance, in which the financial securities could be easily traded. The money and capital markets are thus shallow. Although, the central bank has been issuing its own bills for absorbing the excess liquidity in the system, its impact on short term interest rate is negligible, with the

result the traditional measures controlling money supply such as reserve requirements are increasingly relied upon.

***Objectives of central banking***

The Bank of Papua New Guinea (BPNG), the country's central bank was established in 1973 under the Central Banking Act 1973, two years prior to country's political independence. The Act was amended by the Central Banking Act 2000, empowering BPNG with greater autonomy, laid down the following objectives: (a) to formulate and implement monetary policy with a view to achieving and maintaining price stability; (b) to formulate financial regulation and prudential standards to ensure stability of the financial system in PNG; (c) to promote an efficient national and international payments system; and (d) subject to the above, to promote macro-economic stability and economic growth in PNG.

Until 1976, PNG was using the Australian dollar as legal tender. In 1976, PNG attained full monetary independence and the Australian dollar was discontinued as legal tender. The country's own currency, the *kina* was pegged at one to one Australian dollar. The objectives of BPNG were maintenance of both domestic price stability and external stability along with promoting conditions for economic growth[6]. For maintaining a stable domestic price level, since inflation was mostly imported, a fixed exchange rate regime was then considered appropriate by BPNG until 1994, when it decided to float the domestic currency. Further, it was even felt necessary to have an appreciating exchange rate (known then, as hard kina) for controlling inflation.

***Not a pure float***

Although PNG follows a floating exchange rate regime since 1994, it is not a pure float. Under a pure float, any deviation is corrected by an automatic adjustment mechanism falling on exchange rate. Such an exchange rate regime would even eliminate the need for any keeping any level of official reserves to defend the exchange rate. With the amended Central Banking Act of 2000, it was expected that with greater autonomy bestowed on it by the new legislation, BPNG under the flexible exchange rate regime would be able to pursue an unrestricted monetary policy unlike under the fixed exchange rate regime. Price stability was specifically mentioned, as external stability was expected to be taken care of by the floating exchange rate regime.

However, experiences of twenty years indicate that BPNG has been aiming at some comfortable level of reserves so that the domestic currency is not allowed to depreciate below a preferable level with a view to keeping inflationary pressures under control. BPNG formulates its monetary policy stance by considering the level of its international

[6] As PNG's currency was pegged to Australian dollar, external stability was primarily dedicated to the stability of exchange rate. With PNG switching on to a floating exchange rate regime the objectives had to be revised. The Central Banking Act of 2000 lays down "maintaining the PNG international payments" as one of the objectives.

reserves, as one of the key macroeconomic indicators. BPNG is not targeting any specific exchange rate. Intervention in exchange market is guided by its price stability objective. It is designed to provide liquidity, especially to smaller institutions given that there are a few participants. In fact, BPNG can intervene by selling foreign currency for domestic currency to arrest any decline in the value of the Kina. Two-way movement of kina is facilitated and often BPNG is the net seller of foreign reserves (IMF 2011).

In recent times, thanks to the commodity boom during 2005-2007, the accumulated foreign exchange reserves provided an import cover of about 6 months in 2005, 8.6 months in 2006 and 9.1 months in 2007. In a policy speech in April 2009, dealing with the likely impact of world recession on PNG, the central bank's the then Deputy Governor Bakani (2009) made it clear that (i) the link between monetary aggregates (money supply) and inflation in PNG was weak and not as strong as in other economies under flexible exchange rate regime; and (ii) the most influential factors of inflation have been the exchange rate and imported (foreign) inflation of PNG's major trading partners[7]. In fact, PNG's preference for appreciation of the Kina against the US and Australian dollars during the worldwide surge in oil and food prices in late 2007 until mid 2008 is understandable. The prices of fuel are by convention usually quoted in US dollars and food is mostly sourced from Australia. Appreciation of the Kina acted as a buffer against inflation.

In these circumstances, it is obvious that the monetary policy strategies in the five PICs under fixed exchange rate regime as well as in PNG, whose exchange rate regime is a managed float, are not very different. Monetary stability, as mandated by legislatures for the five PICs and price stability for BPNG as laid down in the Central Banking Act 2000, as the objectives for their central banks are intertwined with exchange rate stability and hence the monetary policy strategy for all of them has been to maintain a stable external value of domestic currency.

***Monetary Policy Instruments***

The first instrument of monetary policy was formally introduced in 1974, which was Minimum Liquid Asset Ratio (MLAR). The MLAR was set at 15 percent of deposits of commercial banks. The BPNG regulated bank credit flows through various quantitative measures, which included interest rate directives to commercial banks and issue of lending guidelines. In 1980, the lender of last resort facility was announced. Also in 1980, Treasury-bills were auctioned, which also served the purpose of absorbing excess liquidity. In 1983, discount facility began to be provided to commercial banks with additional flexibility. Thus, until 1984, BPNG targeted at growth in credit and broad

[7] The then Deputy Governor Bakani (2009) observed that while monetary expansion in the form of credit growth contributed to an extent to aggregate demand and therefore to inflation, the most influential factors on inflation in 2008 were the increases in food and fuel prices in 2007 and the first half of 2008 and their lag effect, and strong domestic demand.

money through MLAR and auction of T-bills, and lending guidelines and interest rate directives (BPNG 2007). Box 1 presents various monetary policy instruments employed by BPNG.

In 1984/85, as part of financial sector reforms, BPNG discontinued regulation of all interest rates, including rates on passbook savings accounts. However, BPNG continued to issue lending guidelines, directing banks to give priority to developing projects and government enterprises. As a reversal of deregulation policies, in June 1986, interest rate ceilings were re-imposed only to be revoked in late 1986. In 1992, 28-day and 60-day T-bills were introduced by government, which were used by BPNG for liquidity management purposes. In 1994, the discount facility was suspended (BPNG 2007).

***Confusing signals***

Thus, there were confusing signals from BPNG, which were understandable as the central bank was under severe pressure from the government. For example, PNG's large budget deficits of 1980 and mid 1990s, which were incurred due to increased military expenditures on Bougainville, tax reductions, agricultural subsidies, and persistent expenditure overruns, were all monetized by its central bank. On one hand BPNG had to act as an agent of government to finance spending; on the other hand, BPNG had to fight inflationary pressures arising out of fiscal excesses.

Earlier, when the kina came under pressure in 1978, PNG discontinued the peg to Australian dollar but linked the kina to a basket of currencies of major trading partners. Despite the basket pegged exchange regime during the next five-year period, there were steep devaluations that were resorted to in response to external shocks. Fall in export prices and closure of the Bougainville copper mines and rising prices for oil and other imports, necessitated a downward adjustment of the kina for diversifying non-mineral exports (Marciniak 2006).

Budget deficits of the early 1990s and consequent deterioration in balance of payments and easing of regulations on capital flows resulted in the depletion of reserves, which went down to a precarious level of less than one month equivalent of imports in 1994. The currency was devalued in early 1994 by 12 percent and the kina was floated from October 10, 1994. Within a few months after floating the currency, the kina in nominal terms declined further by 35 percent. In subsequent years, with improved finances and better fiscal management as well as better performance on the balance of payments front, the kina stabilized (Marciniak 2006).

***Short-term Liquidity Management***

In 1995, towards short-term liquidity management, the Kina Auction Facility (KAF) was introduced replacing discount facility. Under this BPNG was enabled to respond quickly to fluctuations in liquidity by buying or selling kina in auction on a weekly basis. It was

the first step towards the adoption of more market oriented monetary instruments. The KAF interest rate became the key official rate as it determined the price of liquidity at the margin. The KAF provided short-term liquidity when required (selling kina) or when necessary absorbing liquidity through acceptance of deposits (buying) kina.

In 1998, BPNG introduced a 10 percent non-interest bearing instrument known as Cash Reserve Requirement (CRR) calculated on total deposits and prescribed liabilities of each bank. Because of the introduction of CRR, MLAR was reduced from 20 percent to 10 percent. In 1999, BPNG introduced yet another new monetary policy instrument, known as Kina Deposit Facility with the rate set at 2 percent below KAF rate.

***Monetary Policy Statement***

Under the amended Central Banking Act of 2000, BPNG is required to publish a six monthly monetary policy statement (MPS) indicating the stance over a six-month period. In February 2001, BPNG announced its intention to announce on the first Monday of each month a rate signaling the stance of monetary policy for the whole month. The rate is known as Kina Facility Rate (KFR) and any change in KFR, based on economic fundamentals in the economy is expected influence short term interest rates in the market, In the same year, BPNG introduced the Repurchase Agreement (REPO) under which the central bank is allowed to sell (repurchase) to (from) the commercial banks a government security at the discretion of BPNG as and when the need arises for liquidity management. The BPNG sells at a margin above the KFR to inject liquidity and buys at a margin below KFR to absorb excess liquidity, on an uncollateralized basis, for overnight to 14 days.

In 2004, BPNG started conducting open market operations through auction procedure in its own paper known as Central Bank Bill (CBB), separating the Treasury bill auction from its own CBB auction. Thus, as of May 2011, BPNG uses the following instruments: MLAR, CRR, KFR, Repurchase Agreement as part of monetary policy, the intermediate target being short term interest rates in the money market (Box 1).

## Box 1. PNG: Monetary Policy Instruments[8]

**Direct Instruments**

*Minimum Liquidity Assets Ratio (MLAR)*

Introduced on 1 March 1974, the Minimum Liquidity Assets Ratio (MLAR) was 15% of total deposits and other specified liabilities in the form of liquid assets, namely cash deposits with the BPNG or government securities of up to three years to maturity. The MLAR was reduced from 25% to 0% on the 1 October 2010.

As of June 2011, MLAR is 0%

*Special Deposits- Cash Reserve Requirements (CRR)*

Introduced on 17 August 1998 as a cash deposit requirement, CRR specifies a fraction (initially at 10%) of commercial banks' deposits and specified liabilities that should be kept as deposits with the bank at zero rate of interest for liquidity management purposes. CRR was increased to 4.0% on 1 October 2010.

As of June 2011, CRR is 4%

*Standing (Kina deposit) Facility*

Introduced on 8 June 1999, enabled commercial banks to deposit surplus funds for three days earning interest set at 2% below the Kina Auction Rate (KAR).

**Indirect Instruments**

Money market operations

*Discount Facility*

Introduced on 2 May 1983 to provide commercial banks with additional flexibility in managing liquidity. Facility suspended in November 1985 and re-introduced on February 28, 1986 at an initial rate of 17.5%.

As of June 2011, there is no Discount Facility rate, as it is replaced by KFR

*Kina Auction Facility (KAF)*

Introduced on 1 May 1995, replacing the Discount Facility. KAF was designed for short-term liquidity management. The kina auction interest rate became the key official interest rate, as it determined the price of liquidity at a margin. The facility operated on both sides of the market, providing short-term liquidity when required (selling kina) and or, when necessary, absorbing liquidity through the acceptance of deposits (buying kina). The facility was discontinued in April 2003 following the introduction of the repurchase agreement.

[8] The authors are indebted to Mr. Tanu Irau of Research Department, BPNG for the updated information

*Kina Facility Rate (KFR)*

Introduced on 5 February 2001, KFR signals BPNG's stance on monetary policy. The KFR is a monthly rate announced on the first Monday of each month. It is based on an assessment of economic fundamentals in the economy. Changes in the KFR are expected to influence short term interest rates in the economy.

As of June 2011, KFR is 7.25%.

*Repurchase Agreement (repos)*

Introduced in 2001, Repurchase Agreements between the BPNG and commercial banks allow BPNG to sell (repurchase) to (from) the commercial banks a government security at the discretion of BPNG, as and when the need arises for liquidity management. The BPNG sells at a set margin which changes from time to time above KFR to inject liquidity and buys at a margin below the KFR to diffuse liquidity currently on an uncollateralized basis. The repos when introduced in 2001, were initially only on an overnight basis until 2003 when term repos (up to 14 days) were introduced.

As of June 2011, Repos/Reverse Repos:

100 basis points on both sides of the KFR since Jan 2010 (Reverse repo @ 6% and Repos @ 8%): The margins were maintained in June at 100 basis on both sides of the KFR.

*Central Bank Bill (CBB)*

Introduced on 3 August 2004, to support BPNG's monetary policy operations. The CBB is a liability of the Bank and has the same features (such as maturity structure) as the government Treasury bills and is offered at the weekly auctions.
As of June 2011, the rates are:

a. 28 days: 3.04%
b. 63 days: 3.28%
c. 91 days: 3.92%
d. 182 days: 4.59%

*Lender of Last Resort*

Introduced on 1 January 1980, interest charged was based on commercial banks' lending rate. From 1986, the rate has become more punitive and stands at 36.5 % per annum.

As of June 2011, the rate is 36.5%

***Impact of Global Crisis***

The commodity boom during 2005-08 benefited the country immensely. The windfall gains in terms of high export earnings from mineral exports including petroleum and gas and non-mineral exports such as tree crops, including coffee, cocoa and tea have been wisely saved and kept in trust accounts so that they can be utilized for critical expenditures during the bust period. A former Governor Kamit felt confident that the history of the "lost decade" would not repeat itself: "In the 1990s when in spite of high earnings from our mineral wealth and steady economic growth, because of gross fiscal mismanagement PNG was deprived of the opportunity to set the stage for progress and growth" (Kamit 2009).

The Monetary Policy Statement (MPS) released in March 2009 for the next six months was more concerned with fighting inflationary pressures generated by high international food and fuel prices and very strong domestic demand. Accordingly, BPNG tightened monetary policy by increasing KFR from 6.00 percent in June 2007 to 8.00 percent in December 2008. The KFR was kept unchanged at 8.00 percent until November 2009.

As inflationary pressures decreased in late 2009, with fall in commodity prices and consequent fall in export earnings, BPNG reduced KFR to 7 percent in December 2009 to signal further easing of monetary conditions. The reduced rate of KFR 7 percent was maintained throughout 2010. A combination of pick–up in mineral sector, facilitated by newly opened mines, increased lending by banks to non-mineral sector and rise in construction activities which were related to the start of LNG project, all contributed to growth. At the same time the capacity constraints were developing and were seen to fuel inflation once again. Inflation touched 7 percent in late 2010.

As rise in export earnings were adding to money supply, BPNG had to take tightening measures towards reducing inflationary pressures and for absorbing excess liquidity in the system. It issued central bank bills to absorb liquidity. Further, BPNG successfully got the trust funds hitherto held by commercial banks in which export earnings were deposited by government shifted to central bank. Furthermore, BPNG permitted the contractors involved in LNG project to hold their accounts in offshore banks and allowed them to use funds held abroad to pay for their project related imports

However, BPNG did not see any need to increase the policy rate, KFR from 7 percent since December 2009, which remained unchanged throughout 2010 and until May 2011(Table 3). It appears that BPNG did not want to use KFR as it might be looked upon as change in monetary policy stance[9]. The monetary authorities are also aware that the interest pass-through (defined as the percentage point change in commercial banks'

[9] IMF in its Article IV Consultation Mission Report of May 2011 recommended an increase in KFR by 3 to 4 percentage points above the core inflation for combating inflationary pressure being built up during late 2010. However, BPNG responded in June 2011 with a modest rise from 7 percent to 7.25 percent.

lending rate divided by the percentage point in BPNG's KFR, the policy rate) is low[10]. For these reasons, BPNG has been placing greater reliance on cash reserve requirement ratios in recent months (Table 4). It raised cash reserve requirement ratio in October 2010 from 3 percent to 4 percent.

**Table 3: PNG: KFR Rates: 2001 - 2011**

| Period | KFR Rate (%) | | Period | KFR Rate (%) |
|---|---|---|---|---|
| 2001: Feb | 15.5 | | 2004:Sep | 9.00 |
| 2001: April | 14.75 | | 2004: Oct-Dec | 7.00 |
| 2001: May-June | 14.00 | | 2005: Jan-Aug | 7.00 |
| 2001: July-Aug | 13.00 | | 2005:Sep-Dec | 6.00 |
| 2001: Sept-Dec | 12.00 | | 2006:Jan-Dec | 6.00 |
| 2002: Jan-July | 12.00 | | 2007:Jan-Dec | 6.00 |
| 2002: Aug-Oct | 12.50 | | 2008: Jan-May | 6.00 |
| 2002: Nov-Dec | 14.00 | | 2008: Jun-Jul | 6.25 |
| 2003: Jan | 14.50 | | 2008: Aug | 6.50 |
| 2003: Feb-May | 15.00 | | 2008: Sep-Nov | 7.00 |
| 2003: June-July | 16.00 | | 2008: Dec | 8.00 |
| 2003: Aug—Sep | 15.00 | | 2009: Jan-Nov | 8.00 |
| 2003: Oct-Dec | 14.00 | | 2009: Dec | 7.00 |
| 2004: Jan-Feb | 13.00 | | 2010: Jan-Dec | 7.00 |
| 2004: Mar | 12.00 | | 2011:Jan-May | 7.00 |
| 2004: Apr | 11.00 | | 2011:Jun | 7.25 |
| 2004: May-Aug | 10.00 | | | |

**Source: BPNG (2011)**

The challenges before BPNG are formidable. It does not want to leave exchange rate to the market forces, although it follows a flexible exchange rate regime. The only way it can prevent the real exchange rate from rising and reducing the competitiveness of PNG's exports is to take more effective macroeconomic adjustment measures including greater coordination between Ministry of Finance and central bank (IMF 2011)

In the meanwhile, if BPNG has to rely on more direct monetary policy tools. The next chapter examines in details the monetary policy transmission mechanism in PNG.

[10] IMF (2010) has estimated the pass-through in PNG at 0.3, as compared to 0.6 in Australia and 1.2 in Australia. IMF (2010) also cautions us that the econometric exercise undertaken in this regard that policy rate changes are accompanied by other policy moves (such as changes in reserve requirements) and hence the figure of 0.3 might be on higher side.

**Table 4: PNG: Reserve Requirement Ratios**

| Period | Cash Reserve Requirement (%) | Minimum Liquid Assets Requirement (%) | Total Requirement (%) |
|---|---|---|---|
| 1997 March - 1998 July | 0 | 20 | 20 |
| 1998 Aug - Nov | 0 | 20 | 20 |
| 1998 Dec -1999 Jan | 0 | 20 | 20 |
| 1999 Jan – Feb | 10 | 0 | 10 |
| 1999 March - May | 5 | 15 | 20 |
| *1999 June - Aug | 5 | 20 | 25 |
| 1999 Sep - 2002 Dec | 5 | 25 | 30 |
| 2003 Jan - Sep | 5 | 25 | 30 |
| 2003 Oct - April | 3 | 25 | 25 |
| 2010 May - Sep | 3 | 25 | 28 |
| 2010 Oct – Dec | 4 | 0 | 4 |

**Source: IMF (2010). Selected Issues Paper and Statistical Appendix, IMF Country Report. No.10/163, June 2010, page 15 of Statistical Appendix Table 13.**

*** From June 1999, CRR deposits at BPNG are excluded from definition of liquid deposits.**

## IV. MONETARY POLICY TRANSMISSION MECHANISM AND LIMITATIONS IN PICS[11]

Monetary policy transmission is described as a process through which how changes in monetary policy tools employed by a central bank influence the aggregate demand, output and price level in economy (Metzler 1995). The impact of monetary policy decision on the country's GDP domestic product is through its influences on consumption and investment decisions of households, business and financial intermediaries. At least six channels through which monetary policy impacts economic activities have been identified. These include: (i) interest rate channel; (ii) money supply channel; (iii) credit channel; (iv) the balance sheet channel; (v) asset price channel; (vi) exchange rate channel; and (vii) expectations channel (Mishkin 2006, 2001, 1996, 1995). A stylized representation of transmission mechanism by IMF (2004) is shown in Fig 1.

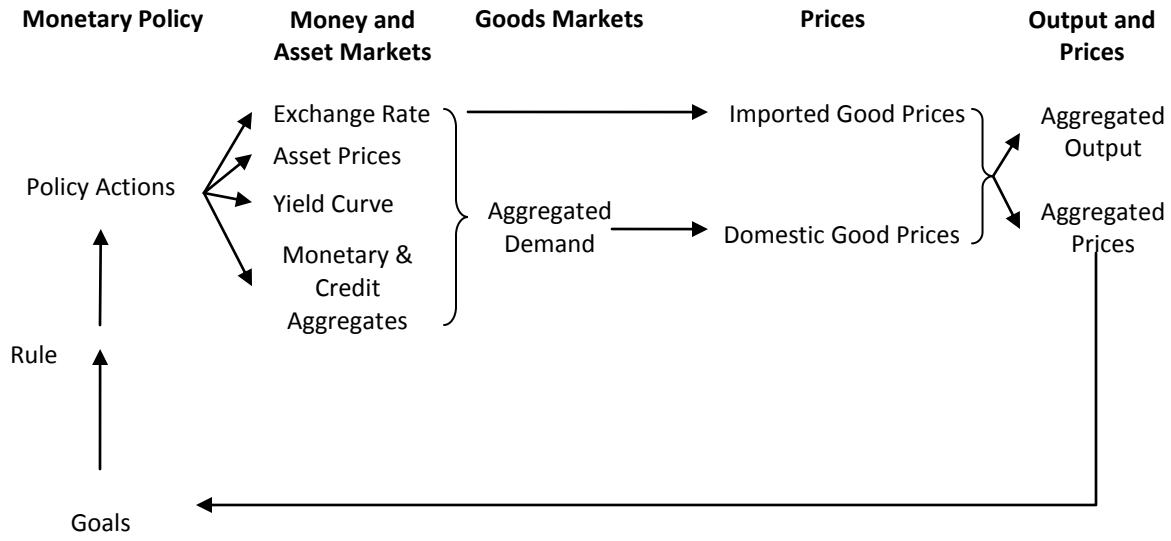
### *Interest Rate Channel*

The traditional view is that a fall in nominal interest rate, following a rise in nominal money stock, given the unchanged price level in the short run due to market rigidities, and hence a fall in real interest rate, would cause rise in investment spending, thereby increasing aggregate demand and rise in output. The key here is that it is fall in the real cost of borrowing that would promote investment. Taylor (1995) in his survey on

[11] This section heavily draws from Jayaraman (2011) and Jayaraman and Choong (2009).

empirical research studies on interest rate channel concluded that there is strong empirical evidence for substantial effects on consumer spending on semi-durables and investment spending, making the interest rate monetary transmission mechanism a strong one.

**Figure 1. A Stylized Monetary Policy Transmission Mechanism**




**Source: IMF (2004)**

### *Money Supply Channel*

The money supply channel view is that an expansionary monetary policy increases bank reserves and relaxes the constraints to banks' ability to create more loans and as a result short-term interest rate falls (King 1986; Ramey 1993; Romer and Romer 1990; Thornton 1994). Here, money supply expansion would mean increases either in M1, narrow money (comprising currency outside the banks and demand deposits) or M2, broad money (consisting of narrow money and savings and time deposits).

### *Credit Channel*

Increase in money supply through rise in bank reserves would raise the ability of banks to expand lending. Banks would make available loans to new borrowers, most of whom are dependent exclusively on bank loans. This will encourage further consumption spending in terms of purchases of semi-durables and business investment. The bank credit channel has assumed greater importance in recent years, not only in advanced but also in developing economies as documented in studies by Bernanke (1986), Bernanke and Blinder (1988), Kashyap *et al*. (1993) and Kashyap and Stein (1994).

***Balance Sheet Channel***

The balance sheet channel view lays emphasis on the role of collateral in reducing moral hazards. An expansionary monetary policy causes increases in financial and physical asset prices, thereby raising the market net worth of firms and the value of collateral, company cash flow and ultimately the firms' credit worthiness. Further, a rise in asset prices increases the ratio of liquid financial assets to household debt, thereby reducing the probability of financial distress and therefore increases consumption and housing investment (Mishkin 2001).

***Asset Price Channel***

This particular transmission channel rests on Tobin's *q* theory, which is applied to business investment (Mishkin 1995, 2001, 2006). An expansionary monetary policy raises price level of equities. Increase in its stock prices enables the firm to raise additional equity capital by issuing less number of stocks. Transmission mechanism through asset price increases is further strengthened by Modigliani's life cycle model, according to which increases in financial wealth raises consumption by households (Mishkin 1995, 2001, 2006).

***Exchange Rate Channel***

Monetary policy influences the exchange rate through interest rates. An expansionary monetary policy would increase money supply, leading to a fall in interest rate. Under conditions of perfect capital mobility and perfect substitutability of financial assets, capital would flow out and domestic currency would depreciate. Depreciation would make the country's exports more attractive to foreigners; an increase in net exports would result in greater aggregate demand leading to rise in output (Mishkin 2006).

***Expectations Channel***

Monetary policy decisions have an impact on the economy through their influence on the expectations of economic agents about the future outlook of the economy. In particular, expectation effects may improve monetary policy transmission channels by shortening reaction lags (Mayes 2004). The expectation channel is likely to be more effective, if the central bank has already acquired a high degree of credibility through its past performance.

***Limitations in the island economies***

There are constraints limiting the efficiency of transmission mechanisms acting through various channels. One of the constraints faced by PNG and other PICs is that in the

absence of a well-developed and deep financial sector and a vibrant secondary market, in which financial assets could be traded with considerable ease and speed, interest rate channel does not effectively operate (Worrell 2000, Fairbairn and Worrell 1996**)**.

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

With reference to asset price channel mechanism and its variants of Tobin's *q* theory (valuation of equities), the required pre-condition, namely the presence of financial assets including equities, a key component of borrowers' and wealth holders' portfolios, does not exist in PICs, including PNG. Commercial banks dominate the financial sector, since the non-bank financial sector institutions (stock, debt securities and mortgage market, insurance industry) are still in their infancy. Thus, market financing does not matter, which largely precludes the asset price channel's working through wealth and income effects (Dabla-Norris and Floerkemeir 2006).

The exchange rate channel transmission mechanism for its full efficiency presupposes a freely floating system, which adjusts to capital flows. Since PNG has a managed float, this particular channel is not fully effective. 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 money channel rather than through interest rate channel.

## V. VARIABLES, DATA, AND METHODOLOGY

For the empirical study on PNG's monetary policy transmission mechanism, the choice of variables is severely constrained by data availability on a consistent basis. Further, the modeling methodology has to remain simple, given the limited number of annual observations (1979-2009), affording a small number of degrees of freedom. For the analysis, two policy variables are chosen, the monetary aggregate and the interest rate. The monetary aggregate is represented by broad money (M2), comprising currency and demand deposits as well as saving and time deposits. The kina facility rate (KFR), was introduced in February 2001. As the KFR data series cover only a short period, the chapter employs use the weighted average lending rate, which is available on consistent basis for a 30-year period, as reported by *International Financial Statistics* of IMF (2010).

The target variables are real output, which is represented by real gross domestic product (*RGDP*), and the price level, which is represented by the consumer price index (*P*). Besides these variables, nominal exchange rate is used to check whether it could be a transmission channel. The nominal exchange rate is expressed as units of domestic currency, Kina per unit of US[12]. 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 (2010) and output data from ADB (2010) and UN ESCAP (2010). Table 5 presents a summary of GDP growth rate and monetary statistics for the period under study (1979-2009).

**Table 5: PNG: Key Monetary Statistics**

| Average | Growth Rate (%) | Inflation (%) | Broad Money (M2) (% of GDP) | Average Lending Rate (%) | Treasury Bill Rate (%) | Exchange Rate (Kina/US$) |
|---|---|---|---|---|---|---|
| 1980-89 | 1.4 | 5.6 | 32.0 | 12.3 | 10.7 | 0.84 |
| 1990-99 | 4.3 | 8.7 | 32.6 | 13.8 | 13.0 | 1.35 |
| 2000-04 | 0.4 | 10.8 | 29.8 | 14.8 | 13.6 | 3.37 |
| 2005 | 3.6 | 2.0 | 29.6 | 11.5 | 3.8 | 3.10 |
| 2006 | 2.6 | 2.0 | 35.3 | 10.6 | 4.0 | 3.06 |
| 2007 | 7.2 | 1.0 | 42.7 | 9.8 | 4.7 | 2.97 |
| 2008 | 6.7 | 10.7 | 43.9 | 9.2 | 6.2 | 2.70 |
| 2009 | 5.5 | 6.9 | 45.2 | 10.1 | 7.1 | 2.76 |
| 2010 | 7.0 | 6.0 | 47.2 | 10.46 | 4.7 | 2.67 |
| 2011 (est.) | 9.0 | 8.4 | .- | .- | .- | .- |

**Source: IMF (2011b).**

***Bounds testing approach***

Since the number of annual observations being only 31 (1979-2009) is not large enough for estimating a long-run money and output model, autoregressive distributed lag (ARDL) procedure developed by Pesaran *et al.* (2001) is used. 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 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). Pesaran and Shin

[12] 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; and 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).

(1999) established that the estimators of the short-run parameters are consistent and that the estimators of long-run parameters are 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, except lending rate (LR). To examine for cointegration by the bounds test proposed by *Pesaran et al.*, the following models are constructed for estimation purposes:

$$\Delta LRGDP_t = \delta_1 + \beta_{11} LRGDP_{t-1} + \beta_{21} LP_{t-1} + \beta_{31} LM2_{t-1} + \beta_{41} LR_{t-1} + \beta_{51} LER_{t-1} + \sum_{i=1}^{p} \alpha_{11i} \Delta LRGDP_{t-i} + \sum_{i=0}^{p} \alpha_{21i} \Delta LP_{t-i} + \sum_{i=0}^{p} \alpha_{31i} \Delta LM2_{t-i} + \sum_{i=0}^{p} \alpha_{41i} \Delta LR_{t-i} + \sum_{i=0}^{p} \alpha_{51i} \Delta LER_{t-i} + \varepsilon_{1t} \quad (1)$$

$$\Delta LP_t = \delta_2 + \beta_{12} LRGDP_{t-1} + \beta_{22} LP_{t-1} + \beta_{32} LM2_{t-1} + \beta_{42} LR_{t-1} + \beta_{52} LER_{t-1} + \sum_{i=1}^{p} \alpha_{12i} \Delta LRGDP_{t-i} + \sum_{i=0}^{p} \alpha_{22i} \Delta LP_{t-i} + \sum_{i=0}^{p} \alpha_{32i} \Delta LM2_{t-i} + \sum_{i=0}^{p} \alpha_{42i} \Delta LR_{t-i} + \sum_{i=0}^{p} \alpha_{52i} \Delta LER_{t-i} + \varepsilon_{2t} \quad (2)$$

$$\Delta LM2_t = \delta_3 + \beta_{13} LRGDP_{t-1} + \beta_{23} LP_{t-1} + \beta_{33} LM2_{t-1} + \beta_{43} LR_{t-1} + \beta_{53} LER_{t-1} + \sum_{i=1}^{p} \alpha_{13i} \Delta LRGDP_{t-i} + \sum_{i=0}^{p} \alpha_{23i} \Delta LP_{t-i} + \sum_{i=0}^{p} \alpha_{33i} \Delta LM2_{t-i} + \sum_{i=0}^{p} \alpha_{43i} \Delta LR_{t-i} + \sum_{i=0}^{p} \alpha_{53i} \Delta LER_{t-i} + \varepsilon_{3t} \quad (3)$$

$$\Delta LR_t = \delta_4 + \beta_{14} LRGDP_{t-1} + \beta_{24} LP_{t-1} + \beta_{34} LM2_{t-1} + \beta_{44} LR_{t-1} + \beta_{54} LER_{t-1} + \sum_{i=1}^{p} \alpha_{14i} \Delta LRGDP_{t-i} + \sum_{i=0}^{p} \alpha_{24i} \Delta LP_{t-i} + \sum_{i=0}^{p} \alpha_{34i} \Delta LM2_{t-i} + \sum_{i=0}^{p} \alpha_{44i} \Delta LR_{t-i} + \sum_{i=0}^{p} \alpha_{54i} \Delta LER_{t-i} + \varepsilon_{4t} \quad (4)$$

$$\Delta LER_t = \delta_5 + \beta_{15} LRGDP_{t-1} + \beta_{25} LP_{t-1} + \beta_{35} LM2_{t-1} + \beta_{45} LR_{t-1} + \beta_{55} LER_{t-1} + \sum_{i=1}^{p} \alpha_{15i} \Delta LRGDP_{t-i} + \sum_{i=0}^{p} \alpha_{25i} \Delta LP_{t-i} + \sum_{i=0}^{p} \alpha_{35i} \Delta LM2_{t-i} + \sum_{i=0}^{p} \alpha_{45i} \Delta LR_{t-i} + \sum_{i=0}^{p} \alpha_{55i} \Delta LER_{t-i} + \varepsilon_{5t} \quad (5)$$

**Where**

RGDP = real GDP
M2 = broad money
P = consumer price index
R= average lending rate
ER = exchange rate
$\Delta$ is the first difference operator, and
the $\varepsilon_{it}$ are white noise error terms.

The joint significance of the lagged levels in these equations is examined using the F-test, where the null and alternative hypotheses are expressed as follows:

For Equations (1) to (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)

where $i = 1,2,...,5$

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 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 it is concluded that there is no long-run level relationship between the variables under study. However, if 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.

## VI. RESULTS AND DISCUSSION

### *Unit root test*

Before examining the presence of a long-run relationship among variables, the stationarity properties of each series is examined by using two unit root tests, namely

augmented Dickey-Fuller (ADF) and Ng-Perron (NP) tests. In Table 6, it is shown that the series are non-stationary at levels, but stationary after first-differencing. After confirming the series are of I(1), cointegration analysis by adopting bounds test procedure is used.

**Table 6: Results of Unit Root Tests**

| Variable | ADF | | Ng and Perron | |
|---|---|---|---|---|
| | Level | First Difference | Level | First Difference |
| LRGDP | -2.394 | -3.328** | -13.421 | -11.402** |
| LM2 | -2.391 | -3.677** | -4.650 | -12.600** |
| LP | -1.859 | -3.809** | -2.787 | -12.831** |
| LER | -1.798 | -3.127** | -2.468 | -10.894** |
| LR | -2.341 | -5.817** | -8.367 | -13.321** |
| **Critical Value** | | | | |
| 1 per cent | -4.310 | -3.689 | -23.800 | -13.800 |
| 5 per cent | -3.574 | -2.972 | -17.300 | -8.100 |
| 10 per cent | -3.222 | -2.625 | -14.200 | -5.700 |

**Notes: The ADF critical values are based on Mckinnon. The optimal lag is chosen on the basis of Akaike Information Criterion (AIC). The null hypothesis for both ADF and Ng-Perron 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.**

***Bounds testing results***

The results of the bounds tests are reported in Table 7. The computed F-statistics for the real output equation suggests rejection of the null hypothesis of no cointegration. However, the null hypothesis is 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.[13]

[13] Narayan and Smyth (2006) 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, the analysis of trend variable has been omitted.

**Table 7: Bounds Test Results**

| **Dependent Variable** | | | **Computed F-statistic** |
|---|---|---|---|
| LRGDP | | | 64.660*** |
| LM2 | | | 1.751 |
| LP | | | 0.324 |
| LER | | | 1.061 |
| LR | | | 2.242 |
| **Pesaran *et al.* (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 *et al*. (2001), Table CI(iii) Case III: Unrestricted intercept and no trend, p. 300.**

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

**Table 8: ARDL Model for Real Output (LRGDP) Equation**

**I. Results**

| Variable | Coefficient | t-Statistic | Prob. |
|---|---|---|---|
| $LRGDP_{t-1}$ | -0.615 | -14.326 | 0.0000 |
| $LM2_{t-1}$ | 0.445 | 5.505 | 0.0009 |
| $LP_{t-1}$ | -0.722 | -17.595 | 0.0000 |
| $LER_{t-1}$ | 0.567 | 17.122 | 0.0000 |
| $LR_{t-1}$ | 0.001 | 0.711 | 0.5003 |
| C | 2.045 | 6.379 | 0.0004 |
| $\Delta LRGDP_{t-1}$ | 0.696 | 8.190 | 0.0001 |
| $\Delta LRGDP_{t-2}$ | 0.420 | 5.615 | 0.0008 |
| $\Delta LM2_{t-1}$ | 0.431 | 5.963 | 0.0006 |
| $\Delta LM2_{t-2}$ | 0.174 | 2.393 | 0.0480 |
| $\Delta LM2_{t-3}$ | 0.411 | 7.196 | 0.0002 |
| **$\Delta LM2_{t-4}$** | -0.033 | -0.689 | 0.5129 |
| $\Delta LP_{t}$ | -0.196 | -2.012 | 0.0842 |
| $\Delta LER_{t}$ | 0.380 | 10.565 | 0.0000 |
| $\Delta LER_{t-1}$ | -0.831 | -18.706 | 0.0000 |
| $\Delta LER_{t-3}$ | -0.383 | -12.066 | 0.0000 |
| $\Delta LR_{t-1}$ | -0.005 | -2.626 | 0.0341 |
| $\Delta LR_{t-3}$ | 0.004 | 2.160 | 0.0676 |

**II. Model Criteria/Goodness of Fit**

| | | | |
|---|---|---|---|
| R-squared | 0.9913 | Akaike info criterion | -6.4558 |
| Adjusted R-squared | 0.9704 | Schwarz criterion | -5.5782 |
| S.E. of regression | 0.0088 | F-statistic | 47.3509*** |
| Durbin-Watson stat | 2.8545 | Prob(F-statistic) | 0.0001 |

**III. Diagnostic Checking**

**i) Autocorrelation (Breusch-Godfrey Serial Correlation LM Test):**
F(3) = 3.5279 [0.1274]
**ii) ARCH Test:**
F(1) = 0.0110 [0.9174]
**iii) Jarque-Bera Normality Test:**
$\chi^2$ =1.4916 [0.4743]
**iv) Ramsey RESET Specification Test:**
F-statistic = 0.0091 [0.9272]

---

**Note:** **Lag length given in () and probability value stated in [].**
***, ** and *** indicate significance at the 0.1, 0.05 and 0.01 marginal levels, respectively.**
$C$ **represents the intercept term,** $\Delta$ **is the first difference operator.**

The results of estimation of an unrestricted error correction model (UECM) for real output are reported in Table 9. The short- and long -run elasticity estimates are presented in Table 10. 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 8, Panel III). Moreover, the CUSUM and CUSUM of squares plot show that the parameters of the model are stable over time (Figures 2 and 3).

**Figure 2: Plot of CUSUM Test for the LRGDP Equation**

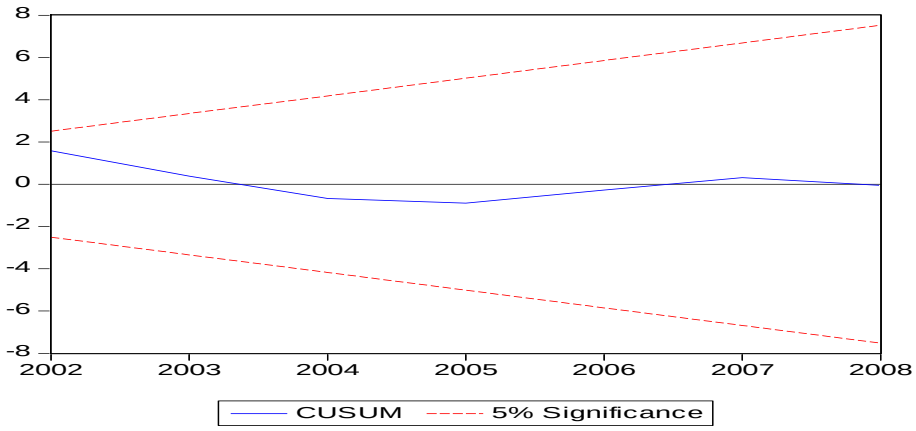
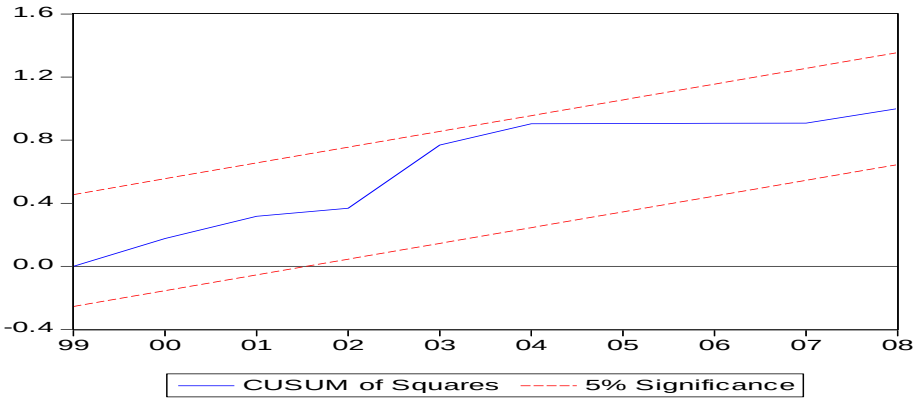


**Figure 3: Plot of CUSUM of Squares Test for the LRGDP Equation**




As shown in Table 9 the estimated long-run coefficient of 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 long run and a negative sign in the short run, indicating that a devaluation strategy would not be effective in stimulating economic growth in the short run.

**Table 9: Short-run and Long-run Elasticities**

| Variable | Short-run | Long-run |
|---|---|---|
| LM2 | 1.0157*** | 0.7240*** |
| LP | -0.1960** | -1.1742*** |
| LER | -0.8342*** | 0.9224*** |
| LR | -0.0013* | 0.0022 |
| Intercept | - | 3.3265*** |

**Note: *, ** and *** indicate significance at the 0.1, 0.05 and 0.01 marginal levels, respectively.**

***Variance decomposition analysis***

Since the variables are I(1), the VAR model in first differences for conducting the variance decomposition analysis is used.[14] The ordering of variables as follows: monetary aggregate (*LM2*), the lending rate (*LR*), and the exchange rate (*LER*), followed by the target variables, namely, prices (*LP*) and real output (*LRGDP).*[15] The results of the decomposition analysis of real output are shown in Table 10.

[14] The authors are grateful to Professor Koops for advice on this point through personal correspondence.
[15] Different orderings of the variables have been examined. With a view to evaluating the robustness of the VAR results, which vary 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

**Table 10: Variance Decomposition Analysis for Real Output (LRGDP)**

| Period | S.E. | LRGDP | LM2 | LP | LER | LR |
|---|---|---|---|---|---|---|
| 1 | 0.039 | 64.928 | 24.582 | 1.672 | 7.956 | 0.862 |
| 2 | 0.065 | 65.152 | 26.201 | 2.280 | 5.472 | 0.895 |
| 3 | 0.076 | 56.262 | 28.339 | 6.960 | 7.623 | 0.816 |
| 4 | 0.087 | 43.537 | 25.626 | 11.081 | 19.075 | 0.680 |
| 5 | 0.100 | 31.259 | 21.788 | 13.908 | 32.450 | 0.594 |
| 6 | 0.112 | 22.957 | 19.448 | 16.808 | 40.228 | 0.559 |
| 7 | 0.124 | 16.978 | 18.353 | 19.448 | 43.398 | 1.822 |
| 8 | 0.136 | 12.568 | 18.041 | 21.717 | 43.397 | 4.276 |
| 9 | 0.146 | 9.515 | 18.012 | 23.687 | 41.372 | 7.413 |
| 10 | 0.156 | 7.602 | 18.088 | 25.072 | 38.460 | 10.778 |

**Cholesky Ordering: LM2 LER LR LP LRGDP**

Real output in PNG is very sensitive to its own shocks and the money variable. It is found that substantial variability in output, about 65 per cent is explained by its own shock in the first year, which slowly decreases in the medium term (fifth year) to 31 per cent, and to around 8 per cent in the long run (at a 10-year horizon). The monetary aggregate explains 25 per cent of the variability in output in the short run, increasing to 28 per cent in the third year, and thereafter steadying at around 18 per cent in the long-run. Although exchange rate explains the variability in the real output to a small extent, less than 10 percent in the short-term, it is responsible for a larger extent, 19 percent of variability in output in the fourth year and around 40 percent in the long run.

**Table 11: Correlation Matrix of the Reduced Form of the VAR Residuals**

| | LRGDP | LM2 | LP | ER | LR |
|---|---|---|---|---|---|
| **LRGDP** | 1 | 0.382 | 0.045 | -0.302 | 0.039 |
| **LM2** | 0.382 | 1 | -0.064 | -0.052 | 0.024 |
| **LP** | 0.045 | -0.064 | 1 | 0.174 | -0.061 |
| **ER** | -0.302 | -0.052 | 0.174 | 1 | 0.212 |
| **LR** | 0.039 | 0.024 | -0.061 | 0.212 | 1 |

of the correlation matrix between M2 and the rest of the variables are low, indicating 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 11).

## VII. CONCLUSIONS

The monetary policy transmission mechanism in both developed and developing countries has been well documented in a growing body of empirical literature. This chapter makes yet another contribution by undertaking an investigation as to how changes in monetary policy in PNG have been influencing its real sector. PNG's financial sector is small. Its money market, which is shallow with few participants, is dominated by Treasury-bills, just as its capital market is saturated with long-term government bonds. Further, there are no secondary markets for short- and long-term debt securities.

Employing a simple bounds testing ARDL procedure, the study utilized annual data covering a 31-year period (1979-2009). The findings of the study are: (i) there is a long-run relationship between real output, prices, monetary aggregates, the interest rate, and the exchange rate; (ii) in the long-run relationship, the interest rate has had no significant influence; and (iii) monetary aggregate has been playing a major role.

The bounds test results confirm that the relationship runs in only one direction: changes in money supply affect the output; and changes in interest rate do not have any influence; and changes in the exchange rate under the managed float arrangements do have an impact. Thus the transmission mechanism operates only through monetary aggregate and interest rate has no role.

Further, variance decomposition analysis shows that the monetary aggregate is the most significant variable in explaining the changes in real output in the short- and medium terms while the exchange rate is the most significant variable in explaining the changes in real output in the long-run in PNG.

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. Only policy changes aiming at monetary aggregate have impact on real output. The findings should be useful for policy makers in PNG who are involved in the design and implementation of monetary policy. With the development of financial markets, the channels of transmission will continue to evolve. As such, the question of how monetary policy is transmitted to the real sector in PNG will be of continuing interest to researchers and policy makers.

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