Impact of currency depreciation on trade balance

A case study on Papua New Guinea

Ravinder Rena[1]*, Muhammad Shahabz*[2] *and Muhammad Irfan Chani*[3]

Abstract

The article delves the comprehensive understanding between trade balance and currency depreciation by incorporating the absorption and monetary approaches, including the Marshal Lerner condition. In doing so, the Ng–Perron test is employed to find out the order of integration and the cointegration technique developed by Johansen and Juselius (1990) to examine the long-run relationship between currency depreciation and trade balance. Our results reveal that there is a long-run relationship among trade balance, currency depreciation, real income and money supply. Any depreciation in local currency worsens the trade balance. The reforms in trade policies improve the trade balance in the future but deterioration in the trade balance seems to reverse this impact due to currency depreciation. A fall in money supply plays a vital role in improving the trade balance in Papua New Guinea. A rise in domestic income seems to recover the trade deficit.

Keywords: Currency depreciation, Trade balance, Cointegration, monetary approach, Bank of Papua New Guinea

JEL codes: C51, E5, E52, F31

(Footnotes)

Introduction

The depreciation in local currency can affect the balance of trade of an economy either positively or negatively. Positive progress in the trade balance is considered one of the most significant and beneficial impacts of depreciation of local currency. This channel can increase the volume of exports and reduce the volume of imports, resulting in an improvement in the, trade balance of the economy. Exchange rate theory in international trade shows some major advantages of adopting flexible exchange rate policy. First, adoption of a flexible exchange rate policy enhances the capacity of an economy to adjust to external and real shocks. Secondly, in a flexible exchange rate regime, a country can operate what is virtually an independent monetary policy. Thirdly, a flexible exchange rate policy allows an economy to make use of foreign reserves to fulfil its demands (Bahmani-Oskooee & Kandil , 2007; Rena,2008).

The rationale for choosing the 1980–2008 time period for this case study is that for the most part, developing economies have shifted from fixed exchange rate policy to floating exchange rate policy since 1994. The International Monetary Fund (IMF) has required the government of Papua New Guinea too to change its exchange rate policy. So, despite its importance, this relationship between depreciation in local currency and trade balance has not been researched in the case of Papua New Guinea; a major objective of the present study is to fill this gap. The paper provides empirical evidence on both long- and short-run linkages between depreciation in local currency and trade balance over the period of 1980 up to 2008.

Balance of payments in Papua New Guinea

The overall deficit in the Papua New Guinea balance of payments in the March quarter of 2008 was K114 million, compared to a deficit of K106 million in the corresponding period of 2007. This outcome was due to a deficit in the capital and financial accounts, which more than offset a surplus in the current account mainly attributable to a higher trade surplus and lower net service payments that adversely affect the higher net income payments and lower net transfer receipts. The surplus recorded in the trade account in the March quarter of 2008 was higher at K1,567 million, an increase of 48.4 per cent from the corresponding quarter of 2007, reflecting an increase in the value of merchandise exports and a decline in the value of merchandise imports. The March 2008 quarter value of merchandise exports is shown as K3,496 million, an increase of 16.0 per cent from the corresponding period of 2007. This was attributed to higher values of coffee, cocoa, palm oil, copra, copra oil, marine products, gold, copper and other exports, more than offsetting declines in logs, tea, rubber, refined petroleum products and crude oil exports (Bank of PNG, 2008:16).

The value of merchandise imports in the March quarter of 2008 was K1,929 million, a decline of 1.5 per cent from the corresponding period of 2007. This was part and parcel of an overall decline in general imports, which did not counteract an increase in mining and oil sector imports. General imports were K1,325 million in the March quarter of 2008, 6.3 per cent below the figure for the corresponding period of 2007. Mining sector imports were K434 million in the March quarter of 2008, an increase of 4.8 per cent from the corresponding period of 2007, mainly reflecting the OkTedi mine's higher capital expenditure, which affects the decline of capital expenditure in all other mining projects in the country. Imports by the petroleum sector were K170 million in the March quarter of 2008, an increase of 30.8 per cent from the corresponding period of 2007. The

increase was due to higher capital expenditure mainly by the Kutubu oil project (Bank of PNG, 2008:16). The deficit in the services account was K829 million in the March quarter of 2008, a decline of 35.8 per cent from the corresponding period of 2007. The decline resulted from lower payments relating to travel, education, computer and information services, communication services, other business services and financial services, construction services, refining and smelting and other service payments, combined with lower service receipts by resident companies.

The deficit in the income account was K343 million in the March quarter of 2008, up by 3.3 per cent from the corresponding period of 2007. This climb in the deficit was a direct result of higher compensation of employees and lower income receipts by resident companies. The March quarter deficit in the transfers account in 2008 was K126 million, compared to a surplus of K273 million in the 2007 March quarter. The deficit was due to lower receipts from gifts and grants, tax and licensing fees, combined with higher transfer payments relating to family maintenance. As a result of these developments in the trade, services, income and transfers accounts, the current account recorded a surplus of K269 million in the March quarter of 2008, compared to a deficit of K294 million in the corresponding period of 2007.

The capital and financial account recorded a net outflow of K356 million in the March quarter of 2008, compared to a net inflow of K169 million in the corresponding period of 2007. This outcome was mainly attributed to net outflow in the financial account—reflecting equity withdrawal from direct investment, higher portfolio investments reflecting investments in short-term money market instruments; and build up in foreign currency account balances of the mineral companies, combined with higher loan repayments by the government. The level of gross foreign exchange reserves at the end of March 2008 was K5,805.0 (US$2,075.4) million, sufficient for 9.0 months of total and 13.1 months of non-mineral import covers (Bank of PNG, 2008).

Exchange rate in Papua New Guinea

In small open economies, depreciation in local currency influences both the prices and the volumes of exports and imports. Changes in the trade account can then have an impact on aggregate demand and final output. The extent of the movements in the domestic currency's foreign currency values depends on the exchange rate regime of the country. We discuss the exchange rate channel in the context of a floating exchange rate regime, as that is the current system in Papua New Guinea. (Sali & Nants, 2006). Under the floating exchange rate regime, changes in the kina exchange rates can come about from three main sources: a) the external appreciation or depreciation of the currencies of the key trading partners of Papua New Guinea; b) fluctuations in the volumes and values of exports and imports; and c) changes in both domestic monetary and fiscal policies. Papua New Guinea has no control over the first cause of change. It is in the second and third areas that authorities could make decisions to influence the variables involved to exert some level of influence on movements of the nominal kina exchange rates.

Table 1 Dependency ratio of Papua New Guinea, 1980–2008

Years	Export (a)	Import (b)	GDP (c)	Dependency Ratio [(a + b)/ c]
1980	2013804928	3699437312	1708099968	0.9640
1981	2122562688	3705155840	1681200000	0.9710
1982	2088044928	3661633280	1749200000	0.9740
1983	2124480000	3638124288	2145400064	0.8960
1984	2191323392	3572363520	2282200064	0.9320
1985	2459793664	3499613696	2402599936	0.9540
1986	2755112192	3428452352	2572300032	0.9490
1987	2727169280	3529794048	2854299904	0.9300
1988	2688268288	3873528576	3170099968	0.9530
1989	2664160768	3483729920	3045700096	0.9340
1990	2542527232	2900778496	3076199936	0.8960
1991	2944959488	3483411712	3605600000	0.9420
1992	3771465728	3377940480	4223000064	0.9360
1993	4778230784	2921745408	4867100160	0.8950
1994	5253259264	3162550528	5530299904	0.9330
1995	5082862592	3322981120	6194699776	1.0500
1996	4773573632	3676881920	6794699776	1.0800
1997	3992269056	3795060224	7079600128	0.9920
1998	4217181696	3809673984	7803599872	1.0300
1999	4883624448	4343340544	8828199936	1.1600
2000	5229702144	4137067520	9735799808	1.1500
2001	5775424512	4479209984	10396300288	1.1800
2002	5702845440	5264057856	11655499776	1.1800
2003	6516274176	4924766208	12567347200	1.2300
2004	6693283328	5349881856	12652124160	1.3100
2005	6377999872	5621000192	15265319936	1.3500
2006	5611700224	5743900160	17050792960	1.4400
2007	4860000256	5661499904	18550900736	1.5700
2008	6693283328	5349881856	20300000000	1.6400

Source: Bank of Papua New Guinea's Quarterly Economic Bulletins available at http://www.bankpng.gov.pg/

Table 2 Exchange rate of kina with other major currencies during 1990–2008

As at end of	A$	US$	EN	DM/ EURO(c)	STERLING	SDR	TWI (d)
1990	1.3616	1.0511	141.36	1.5690	0.5453	0.74371	108.08
1991	1.3818	1.0498	131.91	1.5983	0.5628	0.73464	108.12
1992	1.4708	1.0127	126.09	1.6358	0.6702	0.73658	108.15
1993	1.5077	1.0190	113.93	1.7675	0.6896	0.78783	108.29
1994	1.0927	0.8485	84.71	1.3178	0.5442	0.58280	93.49
1995	1.0176	0.7545	76.79	1.0866	0.4899	0.50790	73.25
1996	0.9653	0.7553	82.17	1.1369	0.4845	0.52030	74.01
1997	0.9365	0.6971	84.23	1.2073	0.4264	0.50650	69.51
1998	0.7708	0.4856	63.43	0.8564	0.2933	0.35830	53.33
1999	0.6086	0.3922	44.74	0.3666	0.2426	0.28980	40.80
2000	0.6256	0.3623	39.01	0.3931	0.2409	0.27590	43.32
2001	0.5476	0.2976	36.13	0.3321	0.2071	0.24000	38.07
2002	0.4740	0.2573	32.29	0.2738	0.1719	0.19910	31.50
2003	0.4326	0.2816	32.07	0.2490	0.1723	0.20100	31.09
2004	0.4222	0.3101	33.54	0.2496	0.1694	0.20940	31.79
2005	0.4229	0.3224	35.50	0.2594	0.1773	0.21820	32.06
2006	0.4342	0.3272	38.04	0.2606	0.1778	0.22230	32.78
2007	0.4027	0.3375	39.70	0.2464	0.1685	0.22040	31.44
2008	0 5328	0.3506	38.26	0.2354	0.1881	NA	NA

Source: Bank of Papua New Guinea's Quarterly Economic Bulletins available at http://www.bankpng.gov.pg/

Changes in the kina exchange rates can transmit influential changes in the economy. An appreciation (depreciation) of the kina against a key currency such as the US or Australian dollar due to external market forces would translate to a decline (an increase) in the prices of Papua New Guinea's imports. Lower (higher) import prices would lead to lower (higher) domestic prices, which in turn, ceteris paribus, will result in a fall (rise) in domestic inflation. On the other hand, foreign currency prices of Papua New Guinea's exports would rise (fall) leading to a decline (rise) in external demand, which in turn should induce a negative (positive) change in the balance of payments position (Sali & Nants, 2006). Papua New Guinea is a small, open economy with a high marginal propensity to import. A depreciation of the exchange rate can be expected to lead directly to higher prices for imports of both intermediate inputs and final goods. If firms choose to pass the import price increases on to consumers then domestic inflation will result. This inflation may in turn stimulate further price changes through 'second round' effects such as increases in inflation-indexed wages or demand shifts resulting from the initial price rises. One of the primary purposes of the 'hard kina' policy pursued by Papua New Guinea from the time of independence until the kina was floated in 1994 was to avoid imported inflation by maintaining the value of the kina (Garnaut & Baxter, 1983).

A comparison of exchange rate movements and inflation rates before and after the floating of the kina in October 1994 illustrates the perceived link. Between the start of 1989 and the end of 1993

the kina depreciated by 16 per cent against the United States (US) dollar. Average annual Consumer Price Index (CPI) inflation for this five-year period was 5.2 per cent. During the next five years, 1994–98, the kina depreciated by 53 per cent against the US dollar. Average annual inflation for this period was 11.5 per cent – double its level before the kina was floated (Sampson et al. 2006). Asafu-Adjaye (1998) and Choudhri and Hakura (2001) both estimate the pass-through of exchange rate movements to inflation to be in the 30–40 per cent range. Choudhri and Hakura, who undertake a cross-country analysis, also find that countries with lower average inflation have lower pass-through. However, both papers use datasets primarily covering the period prior to the floating of the kina.

Relevant literature review

The conventional theory of international trade assumes that trade balance of any economy is directly affected by nominal depreciation or appreciation of local currency for longer periods of time (see for instance Himarios, 1989; Rawlins & Praveen, 2000; Bahmani-Oskooee, 1992, 2001; Aftab & Aurangzeb, 2002; Musila & Newark, 2003; Bahmani-Oskooee & Ratha, 2004; Tochitskaya, 2005; and Shahbaz et al. 2010). In the literature, some empirical evidence supports this general consensus that currency devaluation tends to lead the improvements in balance of trade for the long run as well as the J-curve phenomenon in shorter periods of time (for example, Rincon, 2000; Baharumshah, 2001; Bahmani-Oskooee, 2001; Brahmasrene, 2002; Aftab & Aurangzeb, 2002; Lal & Lowinger, 2003; Onafowora, 2003; Stucka, 2003, 2004; and Tochitskaya, 2005).

Contrary to the above argument, some studies have also examined the weak empirical impact of currency depreciation on trade balance in long-run and J-curve significance in the short run as well (for details, see Greenwood, 1984; Rose & Yellen, 1989; Rose, 1991; Mahdavi & Sobrabian, 1993; Buluswar et al. 1996; Wilson, 2001; Wilson & Tat, 2001; Narayan & Narayan, 2004; and Dusasa, 2007). There is also evidence showing an adverse impact of currency devaluation on balance of trade (Bahmani-Oskooee, 1985, for Greece, India, Korea and Thailand; Upadhyaya & Dhakal, 1997, for eight developing courtiers (Colombia, Cyprus, Greece, Guatemala, Mexico, Morocco, Singapore and Thailand) of Asia, Europe, Africa and Latin America; Kale, 2001, for the case of Turkey; Aftab & Khan, 2008; Shahbaz et al. 2010 for the case of Pakistan). Halicioglu (2008) seems to conclude that depreciation in Turkish currency is positively linked with Turkish trade balance with an insignificant J-curve in a short span of time but in the long run, currency depreciation improves the balance of trade. For the case of Ghana and South Africa, Agbola, (2004), Bhattarai and Armah, (2005) and Damoense and Agbola (2004) document no J-curve existence and long-run positive impact of currency depreciation on trade balance. Similarly, Aftab and Aurangzeb (2002) confirm the existence of an ML condition in the long run and a J-curve for a short time-span for Pakistan. Recently, Aftab and Khan (2008) and Shahbaz et al. (2010) find no evidence for a standard J-phenomenon for Pakistan.

The empirical evidence about the existence of the J-curve phenomenon is controversial. For instance, Felmingham (1988) could not find evidence for the J-curve pervasiveness in the case of Australia. Marwah and Klein (1996) seem to introduce an S-curve for both Canada and the United States. This curve states that trade balance initially declines after depreciation, followed by a trade balance improvement, i.e. the typical J-curve effect. However, after several quarters, when trade balance improvement reaches its limits, it then starts to deteriorate. This S-curve finding is reminiscent of the S-shaped response of the trade balance to changes in terms of trade mentioned

in Backus et al. (1994). In the case of Turkey, Akbostanci (2002) favours an S-shaped trade balance response to devaluation in the short span of time that delays J-curve effect. Jung and Doroodian (1998) document the survival of the J-curve effect in the case of Japan. These examples justify the conclusion that the J-curve is an empirical but not inevitable phenomenon, i.e. it may or may not be found in a given country.

Theoretical background of model

The theoretical model developed in this study is based on the seminal work of Bickerdike (1920) and afterwards by Robinson (1947) and Metzler (1948) that is generally called the elasticity approach or the Bickerdike–Robinson–Metzler (BRM) model.[1] The foundation of this concept is the substitution effect in consumption (explicitly) and production (implicitly) seems to induce by the relative price changes that are caused by depreciation in currency. The *imperfect substitution model* or BRM model is a partial equilibrium version that provides sufficient condition for improving the trade balance through currency depreciation. For positive impact of currency depreciation on the trade balance, and implicitly for a stable exchange rate market, the absolute values of summation of demand elasticities of exports and imports must exceed unity that fulfils the Marshal Lerner condition.[2] The BRM and ML conditions are basic assumptions of one school of thought that supports the argument that nominal exchange rate devaluation has recovered the trade balance or stabilized the foreign market.

In the 1950s, a different approach to the balance of payments in international economics emerged. The focus of economic analysis of balance of payments has shifted from the seminal work of Harberger (1950) and later (Meade, 1951; Alexander, 1952, 1959; Krueger, 1983; and Kenen, 1985).[3] The analysis of this new body of literature is known as the *absorption approach* (AA) to the balance of payments.[4] The essence of this approach is the proposition that improvement in trade balance requires an increase in income over total domestic expenditures. According to the Keynesian approach, currency depreciation affects the relative prices of domestic goods in domestic currency. This reduction produces two forms of direct effects. First, there is a substitution effect that causes a shift in the composition of demand from foreign goods to domestic goods, that is the exchange rate change causes an *expenditure-substituting* effect. Second, there is an income effect, which would increase absorption and then reduce the trade balance.

The absorption approach explains that the devaluation process in a country causes deterioration in its terms of trade, and thus deterioration in its national income. The presumption is that devaluation will result in a decrease in the price of exports measured in foreign currency. Of course, the fact that terms of trade deteriorate does not necessarily imply that the trade balance is going to deteriorate. '*It can worsen the trade balance if the foreign currency price of exports sinks far enough relative to the price of imports to outweigh the trade balance improvement implied by the rise in export volumes and the drop in import volumes*' (Lindert & Kindleberger, 1982). In all, the net effect of currency depreciation on the trade balance will depend on the combined substitution and income effects. As predicted by the absorption approach, the trade balance will improve, but it would be smaller (because of the income effect on absorption) than that predicted by the BRM model.

The latter part of the 1950s saw the emergence of the monetary approach related to the balance of payments that is known as the 'modern' monetary view to the balance of payments.[5] The core of this

subsection of monetary approach reveals that balance of payments is a monetary phenomenon that is also called the global monetarist approach (Polak, 1957; Hahn, 1959; Pearce, 1961; Prais, 1961; Mundell, 1968, 1971; Dornbusch, 1973; Whitman, 1975; Frenkel & Johnson, 1977; and Corden, 1994).[6] The monetary approach has revealed that any excess demand for goods, services and assets creates a deficit in balance of payments that is also reflected in an excess supply or demand for stock of money. So, the analysis of balance of payment should be according to the demand for money and supply of money. In simple words, one may say that if people's demand for money outstrips the supply of money from the central bank, the excess demand would be fulfilled through the inflows of money from abroad to improve balance of payment and vice versa.[7]

Over the short span, the absorption approach predicts that the real value of money stock falls after an increase in prices, i.e. the drop is caused by currency depreciation and subsequently improves the trade balance.[8] The reason is that where there is an increase in prices due to devaluation, people will reduce their spending relative to income in order to restore their real balances and holdings of other financial assets. Similarly, people restored their desired financial holdings; real money balances '*expenditures will rise again … new surplus … (in the stock of money caused by trade balance surplus)* will be eliminated' (Cooper, 1971).[9]

Econometric model and data

Economic literature reveals that the log-linear specification is superior to the linear-specification (Shahbaz, 2010) for examining the relationship between depreciation in local currency and trade balance in the case of Papua New Guinea. The foregoing discussion leads us to combine the core elements of BRM, i.e. absorption and monetary approaches, to investigate the relationship between currency depreciation and trade balance. The empirical model has been borrowed from Dusasa (2007) and Shahbaz et al. (2010) as given below:

$$LTB = \alpha_1 + \alpha_2 LREER + \alpha_3 LRGDP + \alpha_4 LRM + \mu_t \quad \ldots (1)$$

Where, ***LTB*** = log of Trade Balance, ***LREER*** = Log of Currency Depreciation proxies by Real Effective Exchange Rate, ***LRGDP*** = Log of real GDP proxy for income, ***LRM*** = Log of Real Money Supply (M) and μ = Error Term

Correlation matrix and descriptive statistics are reported in Table 3. Table 1 indicates that depreciation in local currency is significant but negatively correlated with trade balance. Money supply and real gross domestic product are significantly and positively associated. Money supply and real gross domestic product are showing negative correlation with currency depreciation. Finally, depreciation in local currency and income move in opposite directions implying that income would be negatively affected by currency depreciation.

Table-3 Correlation matrix and descriptive statistics

Variables	LTB	LREER	LRM	LRGDP
Mean	0.0025	4.7814	16.2673	18.3216
Median	0.0474	4.8165	16.2913	18.3332
Maximum	0.3540	5.0606	17.2747	18.6294
Minimum	-0.4961	4.4704	15.7900	18.0171
Std Dev.	0.2609	0.1861	0.3819	0.1680
Skewness	-0.2800	-0.0336	0.8171	-0.0893
Kurtosis	1.7401	1.6188	3.1648	1.9433
Jarque-Bera	2.2177	2.2307	3.1475	1.3399
Probability	0.3299	0.3277	0.2072	0.5117
LTB	1.0000			
LREER	-0.7869	1.0000		
LRM	0.7777	-0.7654	1.0000	
LRGDP	0.8849	-0.7341	0.8739	1.0000

Mostly in case country, panel and cross-sectional studies, trade balance has been measured by taking the difference from value of total exports to value of total imports. This study has used a better measure for trade balance, measuring it as the ratio of real exports (X) to real imports (M). The ratio of X/M or the inverse has been employed extensively in other studies to examine the relationship between currency depreciation and trade balance (for instance, Shahbaz et al. 2010; Dusasa, 2007; Onafowora, 2003; and Bahmani-Oskooee, 1992). This ratio (X/M) is preferred because there is no sensitivity problem of unit measurement and it can be predicted as real trade balance (Bahmani-Oskooee, 1992; Dusasa, 2007; and Shahbaz et al. 2010). Data of real effective exchange rate has been obtained from International Financial Statistics (IFS, 2009). World Development Indicators (WDI, 2009) has been combed for exports, imports, consumer price index and money supply. The time period of study starts from 1980 up to 2008.

Methodological framework

Ng–Perron Test

The recently developed Ng–Perron (Ng & Perron, 2001) unit root test has been utilized to investigate the order of integration for running actors in the model (theoretical formation of Ng–Perron is based on Joseph & Sinha, 2007). The Ng–Perron test has good size and explaining power for small sample data and is particularly suitable for small samples. The Ng–Perron unit root test consists of the following four unit root tests based on modifications: Phillips–Perron, Z_a *and* Z_t Bhargava (1986) R_1 and ERS optimal point tests. The tests are based on GLS de-trend data, Δy_t. First, let us define .

$$k = \sum_{t-2}^{T} (y_{t-1}^{d})^2 / T^2$$

The four statistics are listed below.

$$MZ_{\alpha}^{d} = (T^{1} y_{T}^{d})^{2} - f_{0})/2k$$

$$MZ_{t}^{d} = MZ_{\alpha} \times MSB$$

$$MSB^{d} = (k/ f_{0})^{1/2}$$

$$MP_{T}^{d} = (\bar{c}^{2} k - \bar{c} T^{1})(y^{d} T)^{2} / f_{0} \text{ if } x_{t} = \{1\}$$

and $$MP_{T}^{d} = (\bar{c}^{2} k + (1 - \bar{c}) T^{1})(y^{d} T)^{2} / f_{0} \text{ if } x_{t} = \{1,t\}$$

where $\bar{c} = -7$ if $x_{t} = \{1\}$ and $\bar{c} = -13.5$ if $x_{t} = \{1,t\}$

Johansen maximum likelihood test for cointegration

The innermost idea for a co-integration test is relevant to the functional forms of a model. This includes the long run relationship of one variable with other variables. In simple words, it is documented that cointegration describes the existence of a long-running stable relationship between the two variables. If the time series variables are non-stationary at I(0) then they can be integrated at I(1) order of integration, when their first differences are stationary. These variables can be cointegrated when they have one or more linear combinations among themselves that are stationary. Furthermore, when variables are being cointegrated then there exists a constant long-run linear relationship among these variables.

The cointegration approach was first commenced by Engle and Granger (1987). Later on, it was further developed and changed by Stock and Watson (1988), Johansen (1991, 1992) and Johansen and Juselius (1990). The test is very easy and useful in examining the long run equilibrium relationships between the variables. In this study, Johansen's maximum likelihood (ML) approach is applied to examine the cointegration among variables. The main reason is that Johansen cointegration is the most consistent one. It is better for small sample properties such as in this study. Another major advantage of this approach is that one can estimate several cointegration relationships among the variables simultaneously. Two statistics now being used for cointegration are the trace (Tr) test and the maximum Eigen value (λmax) test. The estimation procedures of these statistics have been explained as given below.

Let us suppose Xt be an (n X_{1}) vector of variables with a sample of t. It is assumed that Xt seems to follow the I(1) process that identifies the number of cointegrating vectors. This procedure involves estimation of the vector error correction representation as follows:

$$\Delta X_{t} = A_{0} + \Pi X_{t-p} + \sum_{i=1}^{p-1} A_{i} \Delta X_{t-1} + \varepsilon_{t} \qquad (2).$$

In equation (2), the vector ΔXt and ΔXt-1 are variables integrated at I(1) order of integration. As a result, the long-run stable relationship among Xt is determined by the rank of Π, says r, is zero. In such circumstances, equation (2) cuts to a VAR model of pth order. This tends to conclude that variables in level are not having any cointegrating relationship. Instead, if $0 < r < n$ then there are n X r matrices of α and β such that $\Pi = \alpha\beta'$ where, α, β are mostly used to measure the strength of the cointegration relationship $\beta' X_{t}$ and is I (0), although Xt are I (I). In such an environment, (A0, A1, . . Ap-1, $\prod$) is estimated through maximum likelihood methods, such that 'Π' can be written as in equation (2). A two-step approach is employed for estimation of all these parameters. Initially, we have to regress ΔXt on ΔXt-1, ΔXt-2, …., ΔXt-p+1 and acquire the residuals $\hat{\mu}_{t}$. In the second step,

Xt-1 on ΔXt-1, ΔXt-2 . . . ΔXt-p+1 is regressed to obtain the residuals $\hat{e}_t$. After finding residuals such as '$\hat{\mu}_t$' and '$\hat{e}_t$', variance-covariance matrices are estimated.

$$\hat{\sum}_{uu} = \left[\frac{1}{T}\right]\sum_{t=1}^{T}\hat{u}_t\hat{u}_t'$$

$$\hat{\sum}_{ee} = \left[\frac{1}{T}\right]\sum_{t=1}^{T}\hat{e}_t\hat{e}_t'$$

$$\hat{\sum}_{ue} = \left[\frac{1}{T}\right]\sum_{t=1}^{T}\hat{u}_t\hat{e}_t'$$

The maximum likelihood estimator of 'β' can be measured by solving:

$$\left|\lambda\hat{\sum}_{ee} - \hat{\sum}_{eu}\ INV(\hat{\sum}_{uu})\hat{\sum}_{ue}\right| = 0$$

With the Eigen-values $\hat{\lambda}_1 > \hat{\lambda}_2 > \hat{\lambda}_3 > \ldots\ldots\ldots > \hat{\lambda}_n$. The normalized cointegrating vectors are, $\hat{\beta} = (\hat{\beta}_1, \hat{\beta}_2, \ldots\ldots\hat{\beta}_n)$ such that $\beta' \hat{\sum}_{ee} \beta = I$. Moreover, one can estimate the null hypothesis that r = h, 0 ≤ h < n against the alternative one of r = n by obtaining the following statistics as given below:

λtrac = LA – L0

Where, $L_0 = -\left(\frac{Tn}{2}\right)\log(2\Pi) - \left|\frac{Tn}{2}\right| - \left(\frac{T}{2}\right)\log\left|\hat{\sum}_{uu}\right| - \left(\frac{T}{2}\right)\sum_{i=1}^{h}\log(1-\hat{\lambda}_i)$

and $L_A = -\left(\frac{Tn}{2}\right)\log(2\Pi) - \left|\frac{Tn}{2}\right| - \left(\frac{T}{2}\right)\log\left|\hat{\sum}_{uu}\right| - \left(\frac{T}{2}\right)\sum_{i=1}^{n}\log(1-\hat{\lambda}_i)$

Hence $L_A - L_0 = -\left(\frac{T}{2}\right)\sum_{i=1+h}^{h}\log(1-\hat{\lambda}_i)$

$$2(L_A - L_0) = -T\sum_{i=r+1}^{h}\log(1-\hat{\lambda}_i)$$

Where $\hat{\lambda}_{r+1}, \ldots\ldots\hat{\lambda}_p$ are the calculated p-r smallest Eigen-values. The null hypothesis can be examined. The null hypothesis is that there are at most r cointegrating vectors among variables. Simply, it is said that it is the number of vectors that is less than or equal to r, where r is 0, 1, or 2,…., and onward. Like the Upper Case, the null hypothesis will be examined against the general alternative one. The λmax statistic is given below:

$$\lambda_{\max} = -T\log(1-\hat{\lambda}_{r+1})$$

The hypothesis of r cointegrating vectors is being examined against the alternative hypothesis of r +1 cointegrating vectors. Consequently, the hypothesis of r = 0 is tested against the alternative hypothesis of r = 1, r =1 against the alternative r = 2, and so on. It is well known that the cointegration tests require lag length. The Akaike Information Criterion (AIC) and Schwarz Bayesian Criterion (SBC) have been used to select the number of lags on the basis of minimum values of both criterions.

Results and discussion

Primarily the Ng–Perron unit root test is used to find out the stationarity level of the macroeconomic variables. The results of the Ng–Perron test reported in Table 4 indicate that trade balance (TB), currency depreciation (REER), real GDP per capita (RGDP) real GDP and real money supply (RM) have unit root problem at level. Stationarity is found at 1st difference and similarity in integrating order tends to support for the approach of Johansen and Juselius (1990) to cointegration for long-run relationship between the variables.

Table-4 Unit root estimation

	Ng–Perron at Level			
Variables	**MZa**	**MZt**	**MSB**	**MPT**
LTB	-8.445	-2.044	0.242	10.821
LREER	-8.033	-1.698	0.211	12.092
LRGDP	-5.665	-1.639	0.289	15.978
LRM	-12.58	-2.229	0.177	8.655
	Ng–Perron at First Difference			
LTB	-16.446***	-2.858	0.173	5.596
LREER	-34.634*	-4.075	0.117	3.094
LRGDP	-16.548***	-2.869	0.173	5.548
LRM	-26.685**	-3.636	0.136	3.507

Note: *, ** and *** show significance level at 1%, 5% and 10%.

Table 5 Lag Length and Cointegration Estimation

Lag- order	Akaike Information Criteria	Schwarz Criteria	Log Likelihood
1	-7.8247	-6.8648	125.6343
2	-8.1827	-6.4408	142.3762

Short run Diagnostic Tests

Serial Correlation LM Test = 1.2538(0.3119)

ARCH Test = 0.1927(0.6647)

Hetroscedisticity Test = 0.5405(0.8612)

Jarque-Bera Test = 1.1239 (0.5900)

Ramsey Test = 1.0516 (0.3723)

Table 6 Maximum Likelihood Test for Cointegration

Hypotheses	Trace-Test	0.05 critical value	Inst.value	Hypotheses	Maximum Eigen value	0.05 critical value	Inst.value
R = 0	58.7764	47.8561	0.0034	R = 0	31.2361	27.5843	0.0162
R ≤ 1	27.5402	29.7970	0.0891	R = 1	20.8278	21.1316	0.0551
R ≤ 2	6.71233	15.4947	0.6113	R = 2	6.71034	14.2646	0.5239
R ≤ 3	0.0019	3.84146	0.9609	R = 3	0.0019	3.84146	0.9609

The results from the Johansen Cointegration analysis are pasted in Table-6. Both maximum Eigen value and trace-test value have examined the hypothesis of no cointegration against the alternative of cointegration. Starting with the null hypothesis of no cointegration ($R = 0$) among the variables, the trace-test statistics is 58.77, which is above the 5% critical value, i.e. 47.85. Hence it rejects the null hypothesis $R \leq 0$ in favour of the general alternative $R = 1$. It may be concluded that there is one cointegrating vector among the variables. This indicates that there exists a long-run equilibrium relationship between trade balance, currency depreciation including real income and real money supply. Turning to the maximum Eigen value test, the null hypothesis of no cointegration ($R = 0$) is rejected at the 5% level of significance in favour of the alternative, that is one cointegrating vector, $R = 1$. Overall, it is confirmed that there is one cointegrating relationship among the four I(1) variables. Therefore, analysis of annual data over the period of 1980–2008 appears to support the proposition that there exists a stable long-run relationship between the variables in the case of Papua New Guinea.

Table 7 Long-run relation

Dependent Variable = LTB				
Variable	**Coefficient**	**Std Error**	**T-Statistic**	**Prob-Value**
Constant	-13.6997	5.9495	-2.3026	0.0311
LTBt-1	0.3222	0.0842	3.8249	0.0009
LREER	-0.3523	0.1693	-2.0804	0.0493
LRM	-0.1382	0.0747	-1.8484	0.0780
LRGDP	0.9626	0.3394	2.8362	0.0096

R-squared = 0.8541
Adjusted R-squared = 0.8276
Akaike info criterion = -1.4300
Schwarz criterion = -1.1900
F-statistic = 32.204
Prob(F-statistic) = 0.000
Durbin-Watson stat = 1.824

Empirical results show that trade balance is improved through its lagged value. Depreciation of the kina is worsening the trade balance situation in Papua New Guinea. It may be documented that a 20 per cent depreciation in the kina will increase the deficit in trade by 7.046 per cent. For 2000 as a whole, the kina weakened by 8 per cent against the US dollar, following a substantial depreciation of 19 per cent in 1999. The weakness in 1999 reflected problems in securing finance for a growing budget deficit and the impact of political instability on confidence. The slower depreciation in 2000 reflected the impact of a higher trade surplus, international financial assistance and improved sentiment in the foreign exchange markets. However, the exchange rate varied considerably over the year: in the first half, the kina appreciated strongly against most major currencies, but in the second half it weakened from around $0.40 at the end of July to $0.34 at the end of October. A further negative factor may have been the expectation among importers of an even weaker kina. Papua New Guinea does not operate a normal forward currency market and, therefore, when importers seek to obtain forward cover, the effect is felt on the foreign exchange market straightaway as banks purchase the required foreign currency immediately and place it on deposit (ADB, 2001).

Inflation has been high and rising in recent years, largely reflecting the impact of a general weakening of the kina during 1998–2000 and drought-induced local price increases. For 2000, year-on-year inflation was 17.9 per cent. The major factors were the medium-term weakening of the kina, the introduction of value-added tax and increases in other excise taxes, and the flow-on impact of rises in civil servants' wages in 1999 (ADB, 2001). The country's major export commodities were reduced mainly because of the reduction in the government revenue, foreign exchange inflows, potential depreciation of the kina and the high inflation rate. Also, very importantly, the kina appreciated against the US and Australian dollars and the prices of fuel and food declined in the second half of 2008. These would have some positive flow-on effects to domestic prices, but we have not seen business houses pass on the benefits of reduced import costs to consumers (Loi, 2009). According to the Bank of Papua New Guinea, there is still a lag effect of the appreciation, that is, goods bought under the appreciated rates will be sold at lower prices. Firms must be fair and pass on the benefits to consumers. However, the latest (2009) depreciation of the kina against the key currencies—US and Australian dollars—may give them an excuse not to reduce prices of goods and services or delay further any downward adjustment to domestic prices (Loi,2009).

Increase in the real money supply also deteriorates balance of trade at 10 per cent. It is documented on the basis of results that an increase in domestic money supply not only depreciates the exchange rate but also tends to increase demand for imported goods (Woglom , 2003). This affects the trade balance inversely. The negative rapport of money supply with the trade balance is consistent with the argument that an increase in domestic money supply would lead to an increase in the level of real money balances. Now, if individuals distinguish the rise in the level of real money balances as a rise in their wealth, this will cause the level of consumption (and import) expenditure (Smal & de Jager, 2001) to increase relative to income, resulting in the trade balance deterioration (Johnson, 1972). A fall in money supply improves the trade balance since the foreigners send their money domestically to purchase more goods and services, and so on. The association between real income and trade balance is positive and highly significant. It may be documented that a 10 per cent increase in real income will improve trade balance by almost 9.6 per cent. This empirical finding supports the absorption approach in Papua New Guinea. Absorption theory states that an increase in domestic income raises the demand for money, which would subsequently increase exports and hence in turn improve trade balance.

Table 8 Short-run relation

Dependent Variable = ΔTB				
Variable	**Coefficient**	**Std Error**	**T-Statistic**	**Prob-Value**
Constant	0.0101	0.0222	0.4538	0.6553
ΔLTBt-1	0.6672	0.2054	3.2474	0.0045
ΔLREER	0.1558	0.4255	0.3662	0.7185
ΔLRGDP	0.8520	0.2186	3.8962	0.0011
ΔLRGDPt-1	0.3918	0.4604	0.8508	0.4060
ΔLRM	-0.1972	0.1154	-1.7080	0.1048
ΔLRMt-1	-0.1486	0.2543	-0.5845	0.5661
ECM t-1	-0.1194	0.2567	-4.6485	0.0002

R-squared = 0.541720
Adjusted R-squared = 0.363500
Akaike info criterion = -1.527462
Schwarz criterion = -1.140355
F-statistic = 3.039610
Durbin-Watson stat = 2.123714
Prob(F-statistic) = 0.027026

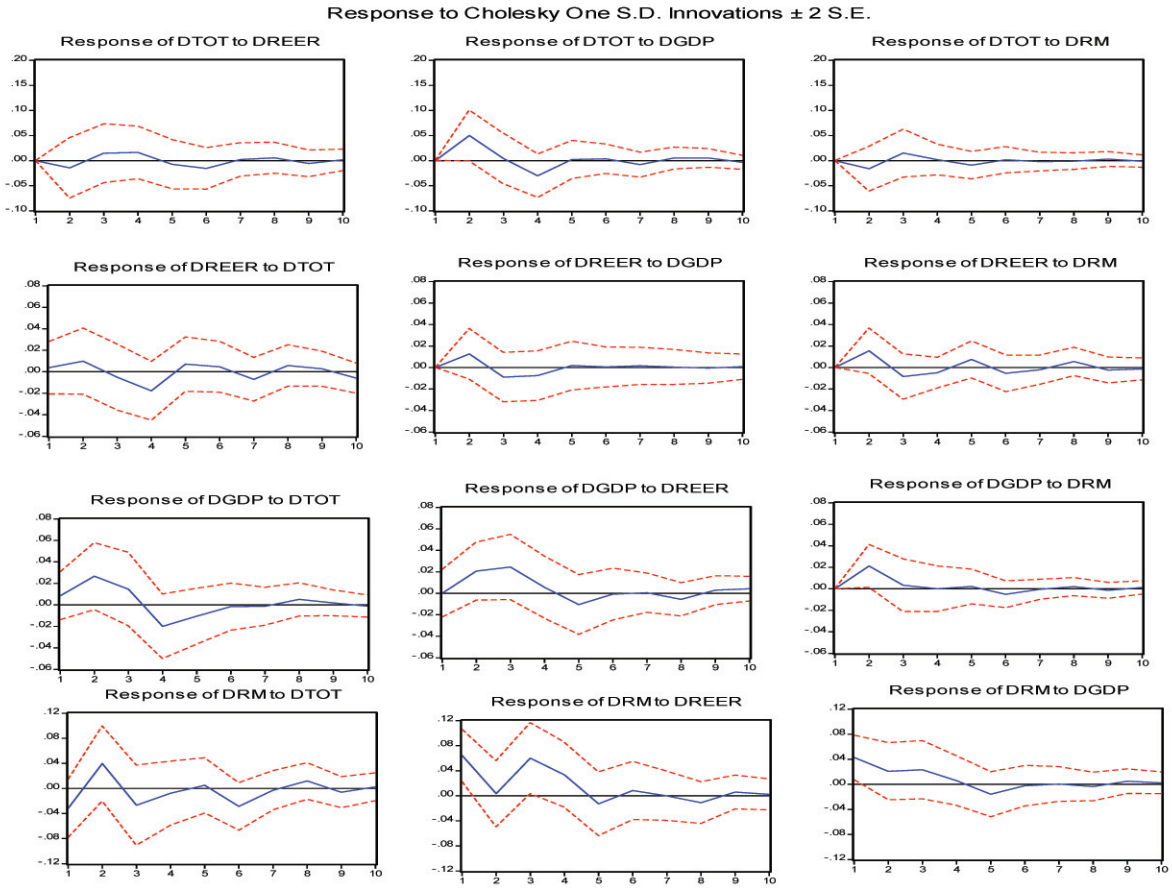
The empirical results in Table 8 discuss short=run behaviour of currency depreciation on trade balance, including real income and real money supply. The results show that depreciation in local currency is positively correlated with trade balance but insignificant. This shows that no more devaluation is beneficial for Papua New Guinea in the short term. The impact of a differenced term of real income on trade balance is positive with high significance. The correlation is also positive for trade balance and lag of differenced term for real income. The result does not support the validity of the Keynesian view that income increases will encourage the general public to purchase more imported goods, resulting in deterioration in the trade balance. The impact of real money supply on trade balance is negative and significant. This shows that a fall in money supply improves the trade balance since the foreigners send their money domestically to purchase more goods and services.

The error correction term ECM_{t-1} measures the speed of adjustment to restore equilibrium in the long run. The significance of the error correction term, i.e. ECM_{t-1} in the negative, is further proof of an established long-run relationship. The coefficient of ECM_{t-1} is equivalent to –0.1194 and it is significant at the 1 per cent significance level. This implies that deviation from the long-run trade balance is corrected by 11.94 per cent per year.

We have also computed variance decompositions and impulse response functions through the VAR system. This is a better tool for the evaluation of dynamic relationship and strength of causal relations among the variables in the system. Therefore, we have used Cholesky factorization that orthogonalizes the innovations. Figure-1 indicates the direction for response to innovation of variables in the system. The trade balance reacts insignificantly like the J-curve phenomenon. Depreciation in local currency worsens the trade balance till the second time horizon, when trade balance is improved. Response of the trade balance to real income indicates that trade balance responds positively till the second time horizon. After the second year it becomes negative and then dies out. The response of trade balance to money supply innovative shocks is negative till two-and-a

half years and subsidizes to zero before the sixth year. It is proved in the long and short run that increased money supply worsens trade balance. This confirms the monetary view that trade balance will be improved through the fall in money supply.

Figure 1 Impulse Response Function



The variance decomposition is another approach for observing the effects of shocks on dependent variables. The variance decomposition method examines the extent to which innovations to each variable are explained by the forecast error variance for any variable in the system. Not only its own series is influenced but other variables are also affected by the innovative shocks in one variable. Table 7 explains the important role played by currency depreciation, real income and real money supply to account for the fluctuations in Papua New Guinea's trade balance. In the case of Papua New Guinea, forecast error variance in trade balance is ascribed to depreciation in kina, real income and real money supply at the 1-year horizon. These variations are 0.00%, 0.00% and 0.00% respectively for REER, RGDP and RM for Papua New Guinea.

Table-8 Variance decomposition

Variance Decomposition of DLTB					
Horizons	**S.E.**	**DLTB**	**DLREER**	**DLRGDP**	**DLRM**
1	0.1310	100.0000	0.0000	0.0000	0.0000
2	0.1425	85.3751	1.0328	12.3022	1.2897
3	0.1448	83.6555	2.0250	12.0023	2.3171
4	0.1494	79.3257	3.0947	15.3855	2.1939
5	0.1508	79.0753	3.2745	15.1204	2.5296
6	0.1520	78.2916	4.2789	14.9294	2.4998
7	0.1525	78.1094	4.2729	15.1157	2.5019
8	0.1527	77.9180	4.3949	15.1859	2.5010
9	0.1529	77.6906	4.5188	15.2560	2.5344
10	0.1530	77.6373	4.5242	15.2997	2.5386
Variance Decomposition of DLREER					
Horizons	**S.E.**	**DLTB**	**DLREER**	**DLRGDP**	**DLRM**
1	0.0609	0.3888	99.6111	0.0000	0.0000
2	0.0654	2.6130	88.0400	3.7434	5.6035
3	0.0702	2.7935	86.0019	4.8823	6.3220
4	0.0760	7.8468	81.2346	5.1314	5.7870
5	0.0769	8.5124	79.8213	5.0694	6.5967
6	0.0787	8.4655	79.9229	4.8425	6.7689
7	0.0798	9.0217	79.5648	4.7542	6.6591
8	0.0802	9.4503	78.7754	4.7058	7.0683
9	0.0805	9.4942	78.7330	4.6748	7.0977
10	0.0808	9.9628	78.3215	4.6458	7.0697

The percentage of trade balance forecast variance explained by innovative shocks in real money supply (RM) is smaller than depreciation in the kina (REER) and real income (RGDP). It is documented that the segment of trade balance variance explained by other independent variables consistently increases in the long run in the Papua New Guinea case. In the long-term time horizon, a large portion of the percentage of forecast variance in the balance of trade is explained by innovative shocks in real income (RGDP) among the other variables. The percentage of forecast variance in trade balance explained by REER, RGDP and RM is 4.52%, 15.25% and 2.54% respectively.

Table 9 Variance decomposition

Variance Decomposition of DLRGDP					
Horizons	**S.E.**	**DLTB**	**DLREER**	**DLRGDP**	**DLRM**
1	0.0560	2.2800	0.0001	97.7198	0.0000
2	0.0707	15.6406	8.5253	66.8295	9.0044
3	0.0769	16.8506	17.3453	57.9995	7.8044
4	0.0796	21.9688	16.6426	54.1130	7.2755
5	0.0813	22.7296	17.6024	52.6276	7.0402
6	0.0819	22.4234	17.3442	52.8996	7.3326
7	0.0821	22.3696	17.2879	53.0307	7.3116
8	0.0825	22.5174	17.5746	52.6179	7.2899
9	0.0826	22.5225	17.6566	52.5154	7.3054
10	0.0827	22.4675	17.8656	52.3639	7.3029
Variance Decomposition of DLRM					
Horizons	**S.E.**	**DLTB**	**DLREER**	**DLRGDP**	**DLRM**
1	0.1182	7.2536	29.7252	13.0962	49.9248
2	0.1301	15.3019	24.6191	13.3688	46.7101
3	0.1476	15.1612	35.6052	12.8572	36.3762
4	0.1548	14.0286	37.0143	11.8400	37.1169
5	0.1562	13.8740	37.0235	12.6519	36.4504
6	0.1593	16.5733	35.8442	12.1729	35.4094
7	0.1596	16.5531	35.7284	12.1341	35.5842
8	0.1605	16.9175	35.8033	12.0516	35.2274
9	0.1608	16.9864	35.7834	12.0957	35.1344
10	0.1610	16.9778	35.7316	12.0922	35.1983

The whole picture of the main diagonal (see Table 9) reveals that shocks are relatively greater of TB and REER, i.e. 77.64% and 78.32% as compared to RGDP and RM, i.e. 52.36% and 35.19% respectively. This seems to imply the exogeneity between TB and REER in variance decomposition. However, empirical findings show that the percentage of variance explained by own shock for RGDP and RM are 52.36% and 35.19% respectively. It is also documented that money supply is more explained by innovative shocks in REER as compared to its own innovative shocks. This shows that no sole variable relative to other variables is highly exogenous / highly endogenous, at least after a 10-year post-shock horizon.

Sensitivity analysis

Diagnostic tests have also been conducted to check serial correlation, normality, autoregressive conditional Hetroscedisticity, hetroscedisticity and functional form of the model and results are shown in Table 3 . The empirical findings indicate that the short-run model passes through the sensitivity analysis. The tests suggest that there is no evidence of autocorrelation and the error term is normally distributed. The functional form of the model is well specified and there is no

existence of white hetroscedisticity in model and the same holds for autoregressive conditional hetroscedisticity. Finally, when analysing the stability of the long-run coefficients together with the short-run dynamics, the cumulative sum (CUSUM) and the cumulative sum of squares (CUSUMsq) with recursive residual tests are applied.

A graphical representation of both CUSUM and CUSUMsq are shown in Figures-2 and 3 (appendixes A and B). It is documented by Bahmani-Oskooee and Nasir (2004) that the null hypothesis (i.e. that the regression equation is correctly specified) cannot be rejected if the plot of these statistics remains within the critical bounds of the 5% significance level. It can be seen from Figures 2 and 3 that the plots of both the CUSUM and the CUSUMsq are within the boundaries at the 5 per cent level of significance. These statistics confirm the stability of the long-run coefficients of regressors that affect the trade balance of Papua New Guinea. Furthermore, the recursive residuals' diagrams also supports the stability of the selected ARDL model specification.

Conclusion

The empirical evidence of previous studies on the understanding between the relationship of currency depreciation and trade balance is unimpressive. This article presents a comprehensive understanding between trade balance and depreciation in currency by incorporating the absorption and monetary approaches, including the Marshal Lerner condition, into the discussion. In so doing, the Ng–Perron test is used to find out the order of integration, as well as the cointegration technique developed by Johansen and Juselius (1990) to examine long-run relationship between currency depreciation and trade balance including real income and real money supply.

Our results reveal that there is a long-run relationship among trade balance, depreciation in the kina, real income and real money supply. Indeed, the depreciation in the kina worsens the trade balance. The improvements in trade policies improve the trade balance in future but deterioration of the trade balance seems to reverse this impact due to depreciation in the kina. A fall in money supply plays a vital role to improve the trade balance in Papua New Guinea. The rise in domestic price seems to recover the trade deficit and does not support the Keynesian view that 'income increases will encourage general public to purchase more imported goods and thus deteriorate the trade balance' in the case of Papua New Guinea. Besides, Papua New Guinea does not operate a normal forward currency market and, therefore, when importers seek to obtain forward cover, the effect is felt on the foreign exchange market straightaway as banks purchase the required foreign currency immediately and place it on deposit. According to the Bank of Papua New Guinea, there is still a lag effect of the appreciation, that is, goods bought under the appreciated rates will be sold at lower prices. Firms must be fair and pass on the benefits to consumers. However, the latest (2009) depreciation of the kina against the key currencies—US and Australian dollars—may give them an excuse not to reduce prices of goods and services or delay further any downward adjustment to domestic prices (Loi, 2009).

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Notes

[1] Nominal devaluation improves the balance of payments, according to traditional theory of international trade.

[2] According to the Marshal Lerner Condition, when the exchange rate is above the equilibrium, there is excess supply for foreign exchange and when the exchange rate is below the equilibrium, there is excess demand for foreign exchange.

[3] Kenen (1985, Ch. 3) presents a static model, which puts together the elasticity and absorption approaches. Where there is income and substitution effects monetary (i.e. the effects of a devaluation) and fiscal policies.

[4] As for the trade balance, it is necessary to clarify some points. The absorption approach takes implicitly the Keynesian income–expenditure assumption that export volumes are independent (*autonomous*) of national income, and that imports depend directly and positively on national income. This positive dependence is said to happen in two ways. One is that often a country's production needs imported inputs; the other is that imports respond to the total absorption (Alexander, 1952). The more a country spends on goods and services, the more it will be inclined to spend on that portion that is bought from abroad. This behaviour is summarized by the well-known Keynesian *foreign trade multiplier*.

[5] The literature discusses the two approaches relating to balance of payments, i.e. the monetary view and the Keynesian monetary approach. Some of the basic assumptions underlying each of these perspectives are the following. With respect to the former: (a) there prevails full employment in the economy; (b) there is perfect arbitrage in the world market, that is PPP holds; (c) money and other assets may exist that are considered close substitutes for domestic and foreign goods along with assets. This approach is also known as the 'global monetarist' approach (Whitman, 1975). With regard to the Keynesian view, (1) there is unemployment, (2) price sluggishness occurs, so that PPP may not hold and (3) money is a close substitute for other assets. For more details on the monetary view, see Whitman (1975) and Frenkel and Johnson (1977**)**.

[6] The term 'balance of payments' is related to all those items that are below the line. Those items constitute what is called the money account. Corden (1994) argues that the monetary approach is useful 'as a supplement to approaches that focus on the real economy: on absorption, savings, investment, and real exchange rate.

[7] MA assumes that a change in exchange rate will not systematically alter relative prices of domestic and foreign goods and it will have only transitory influence on balance of payments (Whitman, 1975).

[8] Money increases may raise real incomes and stimulate import demand, and as a result, degenerate the trade balance – *income absorption effect*.

[9] If the domestic credit increases after a devaluation to satisfy the new demand for money, the effect of the devaluation on the trade balance will be undetermined.

Footnotes:

[1] Corresponding author, Harold Pupkewitz Graduate School of Business, Polytechnic of Namibia, Beethoven/Wagner Streets, Private Bag 13388; Windhoek, Namibia. Editor-in-Chief, International Journal of Education Economics and Development (IJEED). Formerly Head of Economics, Department of Business Studies, The Papua New Guinea University of Technology, Province, Papua New Guinea. He earned his PhD from the Department of Economics, Osmania University, Hyderabad, India, with an achievement of the University best PhD Gold Medal. He has published widely on the Asia–Pacific and African economies. Email: drravinderrena@gmail.com, rravinder@polytechnic.edu.na

[2] Research Fellow, Management Sciences, COMSATS Institute of Information Technology, Lahore Campus, Pakistan. He obtained his Masters in Applied Sciences, specialising in Economics from Karachi University. He has many publications in various national and international refereed journals.

[3] Department of Economics, National College of Business Administration & Economics, Lahore, Pakistan

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References

ADB (Asian Development Bank), (2001) Asian Development Outlook 2001 : II. Economic Trends and Prospects in Developing Asia , available at http://www.adb.org/documents/books/ado/2001/png.asp retrieved on 26 November 2008.

Aftab, Z & Aurangzeb (2002) The Long Run and Short Run Impact of Exchange Rate Devaluation on Pakistan's Trade Performance, The Pakistan Development Review, 41, 277–286.

Aftab, Z & Khan, S (2008) Bilateral J-Curves between her Trading Partners. PIDE Working Paper, WP-45, Islamabad, Pakistan.

Agbola, F W, (2004) Does Devaluation Improve Trade Balance of Ghana?, Paper to be presented at the International Conference on Ghana's Economy at the Half Century, M-Plaza Hotel, Accra, Ghana, 18–20 July 2004.

Akbostanci, E, (2002) Dynamics of the Trade Balance: The Turkish J-curve, *ERC Working Papers*, 02/05.

Alexander, SS (1952) Effects of a Devaluation on a Trade Balance, *International Monetary Fund Staff Papers*, 2, 263-278.

Alexander, SS (1959) Effects of Devaluation: A Simplified Synthesis of Elasticities and Absorption Approaches, *American Economic Review*, 49, 21–42.

Asafu-Adjaye, J, (1998) The Relationship between Exchange Rates and Inflation in a Small, Open Economy: The Case of Papua New Guinea, *Singapore Economic Review*, 43(2), 60–74.

Backus, DK, Kehoe, PJ & Kydland, FE (1994) Dynamics of the trade balance and the terms of trade: The j-curve? *The American Economic Review* 84, 84-103.

Baharumshah, A, (2001) The Effect of Exchange Rate on Bilateral Trade Balance: New Evidence from Malaysia and Thailand, *Asian Economic Journal*, 15, 3, 291– 312.

Bahmani-Oskooee, M, (1985) Devaluation and the J Curve: Some Evidence from LDCs, *The Review of Economics and Statistics*, 67, 500–504.

Bahmani-Oskooee, M, (1992) More Evidence on the J-Curve from LDCs, *Journal of Policy Modeling*, 14, 641–653.

Bahmani-Oskooee, M, (2001) Nominal and Real Effective Exchange Rates in Middle Eastern Countries and Their Trade Balance, *Applied Economics*, 1, 103–11.

Bahmani-Oskooee, M & Kandil, M (2007) Real and Nominal Effective Exchange Rates in MENA countries: 1970–2004, *Applied Economics*, 19, 2489–2501.

Bahmani-Oskooee, M & Nasir, A (2004) ARDL Approach to Test the Productivity Bias Hypothesis, *Review of Development Economics*, 8, 483–488.

Bahmani-Oskooee, M & Ratha, A (2004) The J Curve: A Literature Review, *Applied Economics*, 36, 1377–1398.

Bank of PNG, (2008) *Quarterly Economic Bulletin* March 2008, Port Moresby: Bank of Papua New Guinea, 16–17.

Bhargava, A (1986) On the Theory of Testing for Unit Roots in Observed Time Series, *The Review of Economic Studies*, 53, 3, 369–384.

Bhattarai, DK & Armah, MK (2005) The Effects of Exchange Rate on the Trade Balance in Ghana: Evidence from Cointegration Analysis. Cottingham United Kingdom: Centre for Economic Policy, Business School, University of Hull, Cottingham.

Bickerdike, C F, (1920) The Instability of Foreign Exchanges, *Economic Journal*, 30, 118–122.

Brahmasrene, T, (2002) Exploring Real Exchange Rate Effects on Trade Balances in Thailand, *Managerial Finance*, 28, 11, 16–27.

Buluswar, M et al. (1996) Devaluation and the Trade Balance in India: Stationarity and Cointegration, *Applied Economics*, 28, 429–32.

Choudhri, EU & Hakura, DS (2001) Exchange Rate Pass-Through to Domestic Prices: Does the Inflationary Environment Matter?, *IMF Working Paper 01/194*, International Monetary Fund, Washington, DC.

Cooper, RN (1971) Currency Devaluation in Developing Countries, *Essays in International Finance*, WP No. 86, Princeton University.

Corden, WM (1994) *Economic Policy, Exchange Rates and the International System*, The University of Chicago Press.

Damoense & Agbola, (2004) Estimating the Long Run Effects of Exchange Rate Devaluation on the Trade Balance of South Africa. University of Newcastle, Callaghan, NSW 2308, Australia.

Dornbusch, R (1973) Devaluation, Money and Non-traded Goods, *American Economic Review*, 63, 871–780.

Dusasa, J, (2007) Determinants of Malaysian Trade Balance: An ARDL Bound Testing Approach, *Journal of Economic Cooperation*, 28, 3, 21–40.

Engle, RF & Granger, CWJ (1987) Cointegration and Error Correction Representation: Estimation and Testing, *Econometrica*, 55, 251–276.

Felmingham, B. (1988) Where is the Australian J-Curve? *Bulletin of Economic Research*, 40, 43–56.

Frenkel, JA ^& Johnson, HG (1977) The Monetary Approach to the Balance of Payments, in J A Frenkel and H G Johnson (eds), *The Monetary Approach to the Balance of Payments*. University of Toronto Press, Toronto, 147-167

Garnaut, R & Baxter, P (1983) *Exchange Rate and Macroeconomic Policy in Independent Papua New Guinea*, Pacific Research Monograph, Australian National University, Canberra.

Greenwood, J, (1984) Non-traded Goods, the Trade Balance and the Balance of Payments, *Canadian Journal of Economics*, 17, 806–823.

Hahn, FH (1959) The Balance of Payments in a Monetary Economy, *Review of Economic Studies*, 26, 110–25.

Halicioglu, F, 2008. The Bilateral J-curve: Turkey versus her 13 Trading Partners, *Journal of Asian Economics*, 19, 236–243.

Harberger, AC, (1950) Currency Depreciation, Income, and the Balance of Trade, *Journal of Political Economy*, 58, 47–60.

Himarios, (1989) Devaluation Improve the Trade Balance and the Balance of Payments, *Canadian Journal of economics,* 17, 806–823.

International Monetary Fund (2009) International Financial Statistics (IFS, 2009) Washington, DC: World Bank available at at www.imfstatistics.org/imf/IFSCodes.htm

Johansen, S (1991) Estimation and Hypothesis Testing of Cointegrating Vectors in Gaussian Vector Autoregressive Models, *Econometrica,* 59, 1551–1580.

Johansen, S (1992) Cointegration in Partial Systems and the Efficiency of Single-equation Analysis, *Journal of Econometrics*, 52, 389–402.

Johansen, S & Juselius, K (1990) Maximum Likelihood Estimation and Inference on Cointegration with Applications to the Demand for Money, Oxford Bulletin of Economics and Statistics, 52(2), 169–210.

Johnson, HG (1972) The Monetary Approach to Balance of Payments Theory, *Journal of Financial and Quantitative Analysis*, 7, 1555–1571.

Joseph, M & Sinha, D (2007) Does Black's Hypothesis for Output Variability Hold for Mexico? mpra.ub.uni-muenchen.de/4021.

Jung, C & Doroodian, K (1998) The Persistence of Japan's Trade Surplus, *International Economic Journal*, 12, 1, 25–38.

Kale, P, (2001) Turkey's Trade Balance in the Short and the Long Run: Error Correction Modeling and Cointegration, *The International Trade Journal*, 55, 33–56.

Kenen, PB (1985) Macroeconomic Theory and Policy: How the Closed Economy Model was Opened, in R Jones and P Kenen (eds), *Handbook of International Economics*, 2, Amsterdam, North-Holland, 625–677.

Krueger, AO (1983) *Exchange-Rate Determination*, Cambridge University Press, Cambridge.

Lal, A & Lowinger, T (2002) The J-curve: Evidence from East Asia, *Journal of Economic Integration*, 17, 397–415.

Lindert, PH & Kindleberger, CP(1982) *International Economics,* Irwin Series in Economics, Homewood, IL.

Loi, MB (2009) A Commentary by Deputy Governor of the Bank of Papua New Guinea, on the Papua New Guinea. Economic Survey: 'From Boom to Gloom', at the 2009 Papua New Guinea Update, Port Moresby, 16 April 2009.

Mahdavi, S & Sobrabian, A (1993) The Exchange value of the Dollar and US Trade Balance: An Empirical Investigation Based on Co-integration and Granger Causality, *Quarterly Review of Economics and Finance*, 33, 343–358.

Marwah, K & Klein, LR (1996) Estimation of J-curves: United States and Canada, *Canadian Journal of Economics*, 29, 3, 523–539.

Meade, JE (1951) *The Balance of Payments*, Oxford University Press, Oxford.

Metzler, L, (1948) *A Survey of Contemporary Economics*, Vol. I, Richard D Irwin, Inc, Homewood, IL.

Mundell, RA (1968) *International Economics*, Macmillan, New York, NY.

Mundell, RA (1971) *Monetary Theory*, Pacific Palisades CA.

Musila, JW & Newark, J (2003) Does Currency Devaluation Improve the Trade Balance in the Longrun? Evidence from Malawi, *African Development Review*, 15, 339–352.

Narayan, P K & Narayan, S (2004) The J-Curve: Evidence from Fiji, *International Review of Applied Economics,* 18, 369–380.

Ng, S & Perron, P (2001). Lag Length Selection and the Construction of Unit Root Test with Good Size and Power*, Econometrica,* 69, 1519–1554.

Onafowora, O, (2003) Exchange Rate and Trade Balance in East Asia: Is there a J-Curve? *Economics Bulletin*, 5, 1–13.

Pearce, IF (1961) The Problem of the Balance of Payments, *International Economic Review*, 2, 1–28.

Polak, JJ (1957) Monetary Analysis on Income Formation and Payments Problems, *IMF Staff Papers*, 6, 1–50.

Prais, SJ (1961) Some Mathematical Notes on the Quantity Theory of Money in a Small Open Economy, *IMF Staff Papers*, 2, 212–26.

Rawlins, G & Praveen, J (2000) Devaluation and the Trade Balance: The Recent Experiences of Selected African Countries Centre for Economic Research on Africa, School of Business, Montclair State University, New Jersey, USA.

Rena, R (2008) *International Trade and Finance*, The Papua New Guinea University of Technology, Lae, Papua New Guinea.

Rincon, H, (2000) Testing the Short Run and Long run Exchange Rate Effects on Trade Balance: The Case of Colombia, *Borradores de Economia WP/No. 120.*

Robinson, J, (1947) Essays in the Theory of Employment, Basil Blackwell, Oxford.

Rose, A, (1991) The Role of Exchange Rates in a Popular Model of International Trade: Does the 'Marshall-Lerner' Condition Hold?, *Journal of International Economics*, 30, 301–316.

Rose, A & Yellen, J (1989) Is There a J-Curve? *Journal of Monetary Economics*, 24, 53–68.

Sali, D & Nants, A (2006) Monetary Policy Transition Mechanisms in Papua New Guinea, *Working Paper BPNGWP 2006/01,* Bank of PNG, 6–7.

Sampson, T, Yabom; J Nindim, W & Marambini, J (2006) Exchange Rate Pass-through in Papua New Guinea, *Working Paper BPNGWP 2006/02*, Bank of PNG.

Shahbaz, M, (2010) Income Inequality-Economic growth and Non-Linearity: A Case of Pakistan, *International Journal of Social Economics*, 37 (9), 613–636.

Shahbaz, M, Awan, R & Ahmad, K (2010) The Exchange Value of the Pak-Rupee & Pak-Trade Balance: An ARDL Bounds Testing Approach, *Journal of Developing Areas* (forthcoming).

Smal, MM & de Jager, S (2001) The Monetary Transmission Mechanism, *South African Reserve Bank*, Occasional Paper, No. 16, September, Pretoria.

Stock, JH & Watson, M (1993) A Simple Estimator of Cointegrating Vectors in Higher Order Integrated System, *Econometrica*, 61, 783–820.

Stucka, T, (2003) The Impact of Exchange Rate Changes on the Trade Balance in Croatia, Croatian National Bank, *Working Papers, 11.*

Stucka, T, (2004) The Effects of Exchange Rate Change on the Trade Balance in Croatia, IMF Working Paper, WP/04/65.

Tochistskaya, I, (2005) The Effects of Exchange rate Changes on Belarus' *Trade Balance, Problems of Economic Transition*, 50, 46–65.

Upadhyaya, K P and D Dhakal, (1997) Devaluation and the Trade Balance: Estimating the Long Run Effect, *Applied Economic Letters,* 4, 343–345.

Whitman, MV (1975) Global Monetarism and the Monetary Approach to the Balance of Payments, *Brookings Papers on Economic Activity,* 3, 491–536.

Wilson, P, (2001) Exchange Rates and the Trade Balance for Dynamic Asian Economies: Does the J-Curve Exist for Singapore, Malaysia and Korea, *Open Economies Review*, 12, 389–413.

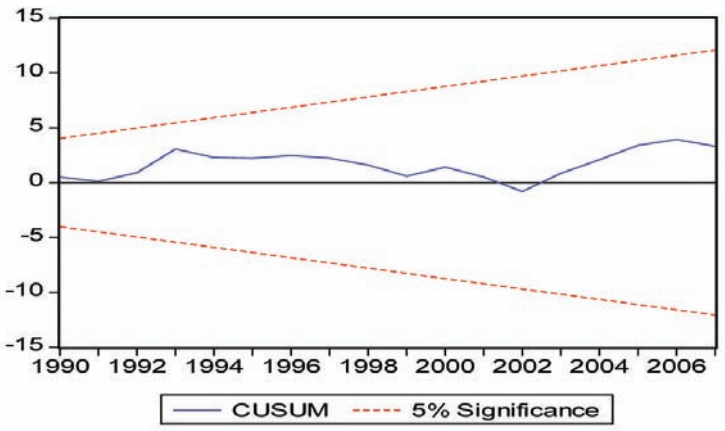
Wilson, P & Tat, K (2001) Exchange Rates and the Trade Balance: the Case of Singapore 1970 to 1961, *Journal of Asian Economics,* 12, 47–63.

Woglom, G (2003) How has Inflation Targeting Affected Monetary Policy in South Africa?, *The South African Journal of Economics*, 71(2), 198–210.

World Bank (2009) World Development Indicators (WDI, 2009) Washington, DC: World Bank available at http://www.workinfo.com/Workforce/20997_devindicators.pdf accessed on 18 September 2010.

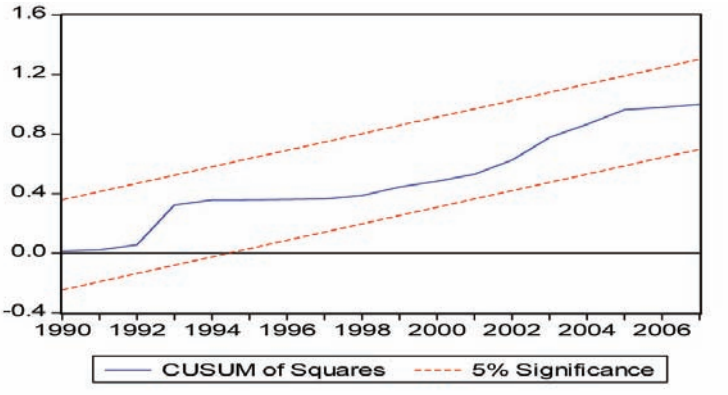
Appendix A

Figure 2 Plot of Cumulative Sum of Recursive Residuals



The straight lines represent critical bounds at the 5% significance level.

Figure 3 Plot of Cumulative Sum of Squares of Recursive Residuals



The straight lines represent critical bounds at the 5% significance level.